



**PHILADELPHIA WATER DEPARTMENT – BELMONT & QUEEN LANE
TREATMENT PLANTS (PWSID #1510001)
SECTION 3: QUEEN LANE INTAKE
SOURCE WATER ASSESSMENT REPORT**



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Executive Summary – Queen Lane WTP Source Water Assessment

The 1996 Safe Drinking Water Act Amendments required the assessment of all source water supplies across the country to identify potential sources of contamination, the vulnerability and susceptibility of water supplies to that contamination, and public availability of the information. In response to this charge, the Schuylkill River Source Water Assessment Partnership, comprised of the Pennsylvania Department of Environmental Protection, the Philadelphia Water Department, the Philadelphia Suburban Water Company, and the Pennsylvania American Water Company, conducted the assessment with stakeholders to identify water supply protection priorities in the Schuylkill River watershed. The following summary includes two main sections. One section discusses the various characteristics and observations made through collection of watershed wide information. The remaining section provides a brief listing of the main recommendations based on the results of the analysis.

High Protection Priority Issues and Activities

Overall, the following activities were identified as having high priority for protection efforts to address:

- Sanitary Sewer Overflows of raw sewage from sewer collection systems, sewage lift stations, and manholes from upstream communities
- Combined Sewer Overflows from upstream communities such as Bridgeport and Norristown
- Urban, residential, and agricultural runoff from various areas of the watershed, mostly located along the mainstem of the Schuylkill River from Reading to Philadelphia
- Discharges from municipal and industrial sources such as sewage treatment plants and chemical manufacturing facilities
- Acid Mine Drainage from Schuylkill County
- Spill and accidents from cars, tanker trucks, railroad cars, pipelines, tire piles, and fires at industrial facilities near the river and its tributaries

Observations & Characterization

- The source of water for the Philadelphia Water Department – Queen Lane Water Treatment Plant is surface water from the Schuylkill River. An average of 80 million gallons is withdrawn from the river per day.
- The Queen Lane Water Treatment Plant serves approximately 350,000 customers in Philadelphia covering the area between the Schuylkill River and Broad Street (Route 611)
- The water supply intake is located in Fairmount Park section of Philadelphia near the intersection of Kelly Drive and City Line Avenue along the Schuylkill River.

- Depending upon flow conditions, between 11 to 28 percent of the water withdrawn by the Queen Lane WTP can originate from the Wissahickon Creek. Water quality data shows that the Wissahickon Creek regularly influences water quality at the Queen Lane intake.
- Approximately 1,900 square miles of land covering portions of 11 counties including large sections of Berks, Schuylkill, Montgomery, and Chester Counties drain into the river upstream from the intake. The land upstream of the intake is 46 % forested/greenspace, 35 % agricultural, and 18 % developed. Approximately 3 million people live in the Schuylkill River Watershed.
- Water withdrawn from the Schuylkill River is coagulated, settled, filtered, and disinfected with chlorine to make it safe prior to distribution to customers. Drinking water quality meets or exceeds all state or federal requirements.
- Schuylkill River and Wissahickon Creek water quality has significantly improved over the past twenty years. As the impacts of point sources have been reduced over the years, the importance of non-point sources such as stormwater runoff from developed areas within the watershed has become evident.
- While dissolved solute and metal levels have increased over the past few decades, dissolved oxygen and nutrients have significantly improved, due to reductions in agricultural runoff and improved wastewater treatment.
- Over the past decade, levels of alkalinity, conductivity, sodium, chloride, bromide, iron, manganese, total organic carbon, and turbidity have increased in the mainstem river and throughout portions of the watershed.
- Increases in levels of solids, salts, and metals are believed to result from contaminated runoff resulting from increased development, increased use of deicing chemicals, and from acid mine drainage. If current trends continue, there will be impacts on drinking water supplies that require additional treatment and costs to make the water potable for drinking.
- Just under 3,000 potential point sources were identified upstream of the Queen Lane WTP intake. Most of these potential sources do not and will never discharge into the Schuylkill River, but may store, generate, or transport hazardous chemicals. Only 14% of these sources discharge into the river or local streams. Wastewater dischargers were the most prevalent discharging source.
- The most prevalent industries upstream were sewerage systems, dry cleaning plants, and commercial printing facilities.
- Volatile organic chemicals (solvents, degreasers, paints, etc) and metals were the most prevalent contaminant types related to upstream sources.
- A total of 36.5 million gallons of petroleum, gasoline, and crude oil are stored in above ground storage tanks upstream of the Queen Lane WTP intake. The tanks range in size from 250 gallons to 4 million gallons and range in age from 1 to 98 years old. The storage tanks were determined to hold 123 different substances or chemicals.

- The Schuylkill River Runoff Loading Model was developed to estimate contaminant loadings to the River from storm runoff.
- The model used the physical characteristics of the sub-watersheds, meteorological data, updated land use information, and event mean concentrations for the nine parameters of interest to estimate average daily contaminant loadings within each of the Queen Lane intake's zones of contribution.
- The developed areas associated with industrial/commercial land use and residential uses were estimated to contribute the highest per acre loadings of most of the contaminants evaluated, including disinfection by-products, metals, nutrients, petroleum hydrocarbons, salts, and coliforms.
- Unit *cryptosporidium* and turbidity loadings were higher from agricultural areas.
- A series of successive screenings was used to identify those sources that have the greatest potential to affect water quality at the Queen Lane intake.
- Five non-conservative contaminant categories and five conservative contaminant categories were selected to represent all potential contaminants.
- For each category, a threshold value indicative of the significance of the concentrations of contaminants that could result from a potential spill or discharge was defined.
- EVAMIX, a multi-criteria software package was used to prioritize the potential significance of each of the potential point sources within Queen Lane's Zone A and Zone B, and to evaluate the potential significance of non-point sources estimated by the Schuylkill River Runoff Loading Model.
- Criteria that were given various weighting by the Technical Advisory Group were the main components used in the EVAMIX evaluation. These criteria included potential impact, time of travel, location, public health implications, discharge frequency and controls, violations, removal capacity, and treatment impacts.
- NPDES and nonpoint source discharges within the Queen Lane intake's Zone A and Zone B were determined to have the highest protection priorities in the watershed.
- The potential significance of each source of contamination was designated A (potentially significant source of highest protection priority) through F (Potential source of lowest protection priority). Those sources ranked A through C are potentially significant sources of contamination to the Queen Lane intake.
- All of the highest ranked sources are either NPDES sites (dischargers) or storm water loadings from specific sub-watersheds.
- Contaminant sources actually discharging to the River (e.g., NPDES permitted point sources, or stormwater runoff) are estimated to have greater potential significance than those with only the potential to release contaminants to the River (e.g, a spill or leak).
- EVAMIX was also used to rank potential sources for each contaminant category. Table I provides a summary of the sources and contaminants of significance.

Protection Recommendations

- Overall, the primary protection areas to focus PWD's protection efforts include the mainstem areas of the Schuylkill River between Reading and Philadelphia, and the Wissahickon Creek to protect and improve PWD's water supply.
- The Perkiomen Creek, Valley Creek, Manatawny Creek and Tulpehocken Creeks appear to have secondary protection priority. However other parts of the watershed may need limited attention for contaminant specific issues (i.e. metals and acid mine drainage).

Based on the results of the susceptibility analysis, water quality data, and stream impairments, it is clear that the impacts from stormwater runoff need to be addressed from the communities along the mainstem of the Schuylkill River from Reading to Philadelphia. Efforts to reduce these impacts would require the following components:

- Development of a regional watershed coalition or council for improved coordination of watershed activities and grant funding between watershed organizations, public agencies, municipalities, and planning commissions for water supply protection. This would include a special matching source water protection grant fund for the Schuylkill River Watershed that members would contribute to the state for matching. The watershed council including representatives from PADEP, water suppliers, counties, Schuylkill Riverkeeper, and other organizations would then review the grant applications and fund projects with the most value to water supply protection.
- Development of a coordinated regional protection plan that will be adopted by water suppliers, planning commissions, and municipalities for establishment and protection of sensitive and high priority protection areas to the multiple and overlapping water supply areas between Reading and Philadelphia.
- Enforcement of rigorous and regular revision and implementation of ACT 537 Sewage Facilities Management Plans in Montgomery, Chester, Berks, and Schuylkill Counties. In addition, the sewage facility related issues from the SWAs should be incorporated into the ACT 537 plan with emphasis on monitoring and measuring progress towards addressing identified problems.
- Development of incentives for upstream communities to mitigate stormwater runoff
- Education of township officials along the protection priority corridor about stormwater impacts
- Preservation of existing greenspace along the Schuylkill River in the protection area
- Acquisition of conservation easements or adjustment of zoning areas or local ordinances to reduce stormwater impacts due to future development in the protection priority corridor between Philadelphia and Reading

- The Phase II stormwater regulations should be fully implemented and enforced, with first priority for compliance monitoring and inspections recommended for communities discharging into protection priority areas for drinking water supplies.
- Enforcement of compliance requirements for industries and municipalities discharging wastewater into the protection priority corridor between Philadelphia and Reading
- Development and support of watershed or local community/environmental organizations to restore and protect various segments of the protection priority corridor between Philadelphia and Reading
- Ensure that TMDL process and requirements along the Schuylkill River include components to address drinking water impacts
- Development of special state or federal legislation that provides funding and authority for water supply protection efforts in the protection priority corridor between Philadelphia and Reading
- A corporate environmental stewardship program should be developed to educate, provide incentives, and engage businesses in water supply protection and stormwater mitigation.
- A workshop should be sponsored by PADEP to educate golf courses about the benefits of joining the environmental certification program by the Audobon Society.
- Efforts should be made to encourage PADEP and DRBC to address and prioritize the impacts of CSOs and untreated discharges of raw sewage upstream of drinking water intakes. Similar efforts should also be allocated for mitigation of acid mine drainage impacts.

In addition to those efforts mentioned above, the following specific actions are recommended for protection efforts in the Wissahickon Creek Watershed:

- Development of regulatory and financial incentives for enhanced wastewater discharge for pathogen removal and inactivation to address *Cryptosporidium* impacts
- Development of incentives and controls for mitigation of stormwater runoff impacts. This includes requiring that current TMDL efforts in the watershed include specific components to address drinking water issues and concerns. This will provide an example of how the Safe Drinking Water Act and Clean Water Act should be integrated.
- Conduct and examination of current zonings and ordinances with the Montgomery County Planning Commission, Montgomery County Conservation District, and local townships to determine ways they can be enhanced to address current and future stormwater impacts. Identify areas where innovative techniques and incentives can be used to mitigate stormwater impacts and assist in the development and implementation of these efforts.

- Support of existing greenways, riparian corridor areas, and future riparian corridor easement and acquisition being conducted by the Wissahickon Valley Watershed Association and Montgomery County
- Encourage and support the development of an Act 537 Stormwater Management Plan for the Wissahickon Creek.

The Philadelphia Suburban Water Company already works with numerous stakeholders to protect its water supply in the Perkiomen Creek. Therefore, it is recommended that any protection efforts be coordinated with the Philadelphia Suburban Water Company environmental initiatives and programs in the Perkiomen Creek Watershed.

In addition to the previous specific geographic recommendations, the following general efforts are recommended:

- Emergency Response Planning activities should be focused on priority AST, TRI, and RECRA facilities since they have been shown to have the greatest relative impact on water quality. Efforts should also be initiated to collect more detailed data on these sites for reprioritization.
- Given the catastrophic impacts from spills and accidents, an early warning system similar to that on the Ohio River should be installed along the mainstem Schuylkill River to provide water suppliers warning and accurate real time data when spills and accidents occur. It is recommended that USGS should be involved in the implementation of the early warning system.
- Long-term protection efforts should be focused on enhancing wastewater discharges and mitigating stormwater runoff. These will have the greatest overall impacts on improving source water quality.
- Sources of pathogens appear to be the sources of greatest priority to PWD when examined in the overall rankings. Therefore, these sources should be addressed accordingly.
- Given the significant amount of activity in the watershed by various organizations, protection efforts should be coordinated in such a way as to support and enhance existing efforts in the watershed.
- A corporate environmental stewardship program should be developed to educate, provide incentives, and engage businesses in water supply protection and stormwater mitigation.
- Special mechanisms and funding should be developed to allow the distribution of monies to support or initiate specific initiatives outside the City of Philadelphia that will protect or restore the water supply. This may involve development of a quasi-governmental or non-profit organization that can raise funds and distribute them to various organizations conducting protection activities beneficial to PWD. This organization may also need the ability acquire conservation easements or land in sensitive areas to maintain protected areas.

- Efforts should be made to encourage PADEP and DRBC to address and prioritize the impacts of CSOs and untreated discharges of raw sewage upstream of drinking water intakes. Similar efforts should also be allocated for mitigation of acid mine drainage impacts.

Public Meetings and Participation

- Public Kick-off meetings, Technical Advisory Group meetings, media articles and a website were some of the methods used to involve the public in the Source Water Assessment Program (SWAP)
- A Technical Advisory Group (TAG) was established to facilitate communication among stakeholders, and to gather information about the watershed. The TAG met quarterly to assist the SWAP process.
- Two public kick-off meetings were held in the Philadelphia area. Meetings were advertised in many local newspapers.
- Project information was available to the public and stakeholders through the project website at www.schuylkillswa.org.

Table I – Summary of Protection Priorities From Various Upstream Sources

Source	Protection Priority	Description	Priority Area(s)	Contaminants
Treated Sewage	A	Wastewater discharges from wastewater treatment plants	Reading to Philadelphia	Pathogens, bacteria, viruses, <i>Cryptosporidium</i> , nutrients, sediment, organic chemicals
Untreated Sewage	A	Combined sewer overflows	Bridgeport, Norristown, & Schuylkill County	Pathogens, bacteria, viruses, <i>Cryptosporidium</i> , nutrients
Urban/Residential Runoff	A - C	Stormwater runoff from roads, parking lots, roofs	Reading to Philadelphia	Pathogens, bacteria, viruses, <i>Cryptosporidium</i> , nutrients, metals, sediment
Agricultural Runoff	A-C	Stormwater runoff from croplands, pastures, livestock	Perkiomen Creek & Tulpehocken Creek	Pathogens, bacteria, viruses, <i>Cryptosporidium</i> , nutrients, sediment
Acid Mine Drainage	A	Discharge from abandoned coal mining areas	Schuylkill County	Metals
Industrial Facilities	A-C	Facilities that store or use hazardous chemicals	Reading to Philadelphia	Metals, nutrients, organic chemicals
Above Ground Storage Tanks	A-C	If storage tank spilled into river	Reading to Philadelphia	Petroleum hydrocarbons, metals, phosphorus
Landfills	C	Leaching of contaminants into streams	Reading to Philadelphia	Petroleum hydrocarbons, metals
Spills and Accidents	A-C	Car, truck, train, or pipeline accident spilling benzene	Watershed wide	Petroleum hydrocarbons, organic chemicals

Note: Petroleum hydrocarbons include chemicals found in oils and greases. Organic chemicals include chemicals found in solvents, degreasers, varnishes, paints, gasoline, plastics, insect and weed killers.

Rankings: A – highest protection priority, B- moderately high protection priority, C-moderate protection priority, D through F low protection priorities.

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Section 3

PWD – Queen Lane Water Treatment Plant

3.1 Watershed and Drinking Water System

3.1.1 Watershed

Key Points

- The Philadelphia Water Department’s Queen Lane Intake is the second public water supply intake on the Schuylkill River above the confluence with the Delaware Estuary.
- Under certain flow conditions, water quality at the Queen Lane Intake is influenced by the Wissahickon Creek, which discharges to the Schuylkill River directly upstream of the intake.

The Philadelphia Water Department’s Queen Lane Intake is located 12 miles from the mouth of the Schuylkill River and directly downstream of the confluence of the Wissahickon Creek and the Schuylkill River. It is located approximately four miles above the Fairmount Dam, which is the uppermost tidal limit on the Schuylkill River.

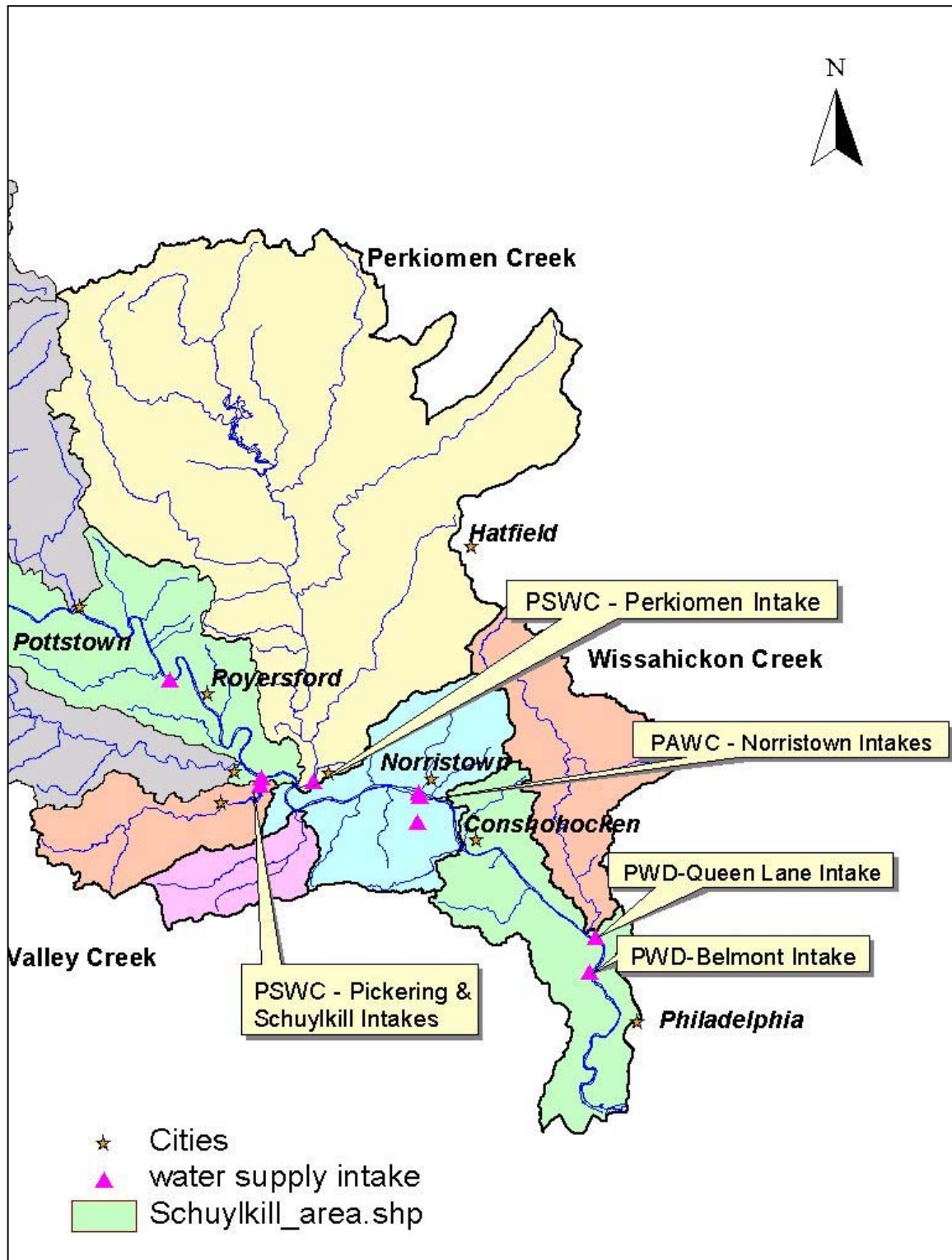
The drainage area of the basin above the Queen Lane Intake is approximately 1,888 square miles. Land use in the area upstream of the intake is primarily commercial/industrial, located in Manayunk and on the Montgomery County side of the river. Interstate 76 travels directly along the western side of the river all the way to Conshohocken. Water quality at the Queen Lane Intake is also heavily influenced by the Wissahickon Creek. Due to channel hydrology and intake location, approximately 11 to 28% of the water supply entering the Queen Lane Intake originates from Wissahickon Creek.

There are two active USGS gauge stations located near the intake. One is a gauge located at the mouth of the Wissahickon Creek directly before the confluence with the Schuylkill River. The other gauge is located at Fairmount Dam. Moving upstream from the mouth of the Schuylkill River, the Queen Lane Intake is the second public water supply intake (see Figure 3.1.1-2).

Figure 3.1.1-1 Aerial Photograph of Queen Lane Intake



Figure 3.1.1-2 Location of Water Supply Intakes in the Lower Schuylkill River Watershed



3.1.2 Geology, Soils, Hydrology, Physiography, and Topography

Key Points

- Topography and types of soils in the watershed affect the amount and quality of runoff produced during precipitation events.
- Soils in the Lower Schuylkill River Watershed are generally well drained and generate moderate amounts of runoff.
- Approximately 11 to 28% of the flow entering the Queen Lane Intake originates from the Wissahickon Creek.
- The Queen Lane Intake is located in the Atlantic Coastal Plain physiographic province.

3.1.2.1 Geology and Soils

The physical properties of the soils are the determining factors in the sediment-transport characteristics of the Schuylkill River and its tributaries. The soils, in turn, are determined by the geology and weathering processes of the rock material. The area north and east of the river, which includes the area drained by the Perkiomen and Skippack Creeks and by part of the Manatawny Creek, is underlain by mudstones, reddish-brown shales, and siltstones. The shaly silt loams that form above the shales are shallow and subject to erosion.

Silty loams are the dominant soils in the basin downstream from the Perkiomen Creek. The soils in the areas drained by Valley and Plymouth creeks, and partially by Wissahickon Creek are underlain by a narrow band of limestone. The other tributaries in the lower basin are underlain by channery, silty loam soils formed in the residuum of mica schist and gneiss. Many of the soils in the lower basin are classified as urban land because the soil profile has been reworked during the cut-and-fill operations of construction projects. They generally have the same soil particle size distribution as the original silty loams.

New urban land or urban construction sites on Piedmont soils may contribute as much as 100 tons of sediment per acre each year (Yorke and Herb, 1978). Runoff from lawns, parking lots, and streets may contribute much of the trace metals and organic substances that enter the lower part of the Schuylkill River.

There are 16 specific soil subtypes in the Schuylkill River Watershed. Table 3.1.2-1 summarizes the characteristics of the soil types found in the Schuylkill River Watershed, and Figure 3.1.2-1 illustrates their distribution throughout the Lower Schuylkill River Basin. Typically, two or three types dominate within a given subwatershed. The Abbottstown, Chester, Neshaminy, and Ungers soil classifications define approximately 74% of the watershed soils. Table 3.1.2-1 indicates that these soils are generally well drained, generate moderate runoff, and are located on significant slopes. The only poorly-drained soil, the Abbottstown soil, is located in the headwater areas of the Wissahickon and Perkiomen Creek Watersheds.

Figure 3.1.2-1 Soil Types in the Lower Schuylkill River Basin

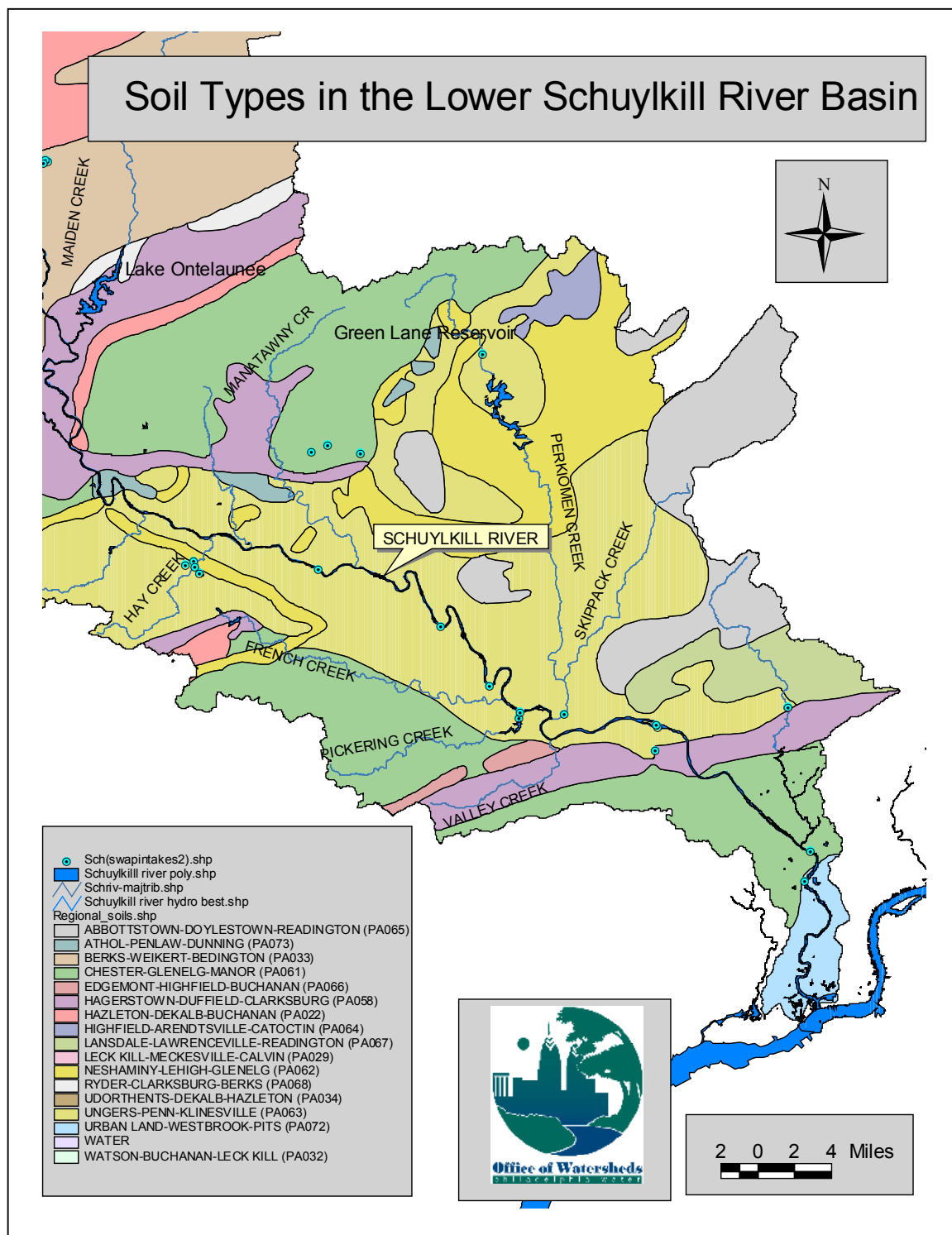


Table 3.1.2-1 Prevalence of Various Soil Types in the Lower Schuylkill River Watershed (Pottstown to Philadelphia)

Soil Type	Percent of watershed	Slopes (%)	Permeability	Runoff	Drainage	Found on
Abbottstown-Doylestown-Readington (PA065)	13	0-15	Slow to moderate	Slow to medium	Poorly drained	Level to sloping concave upland flats, depressions and drainageways
Athol-Penlaw-Dunning (PA073)	0	0-35	Moderate	Slow to rapid	Well drained	Level to moderately steep convex and dissected upland ridge tops and side slopes
Chester-Glenelg-Manor (PA061)	19	0-65 (mostly 3-10)	Moderate	Medium	Well drained	Upland divides and slopes
Edgemont-Highfield-Buchanan (PA066)	1	0-70	Moderate to moderately rapid	Rapid	Well drained	Sloping hills and ridges
Hagerstown-Duffield-Clarksburg (PA058)	6	0-45 (mostly 15)	Moderate	Moderate to rapid	Well drained	Valley floors and adjacent hills
Lansdale-Lawrenceville-Readington (PA067)	5	0-25	Moderate to moderately rapid	Moderate	Well drained	Rolling uplands
Neshaminy-Lehigh-Glenelg (PA062)	15	1 to 45	Moderately slow	Slow to very rapid	Well drained	Level to steep uplands
Ungers-Penn-Klinesville (PA063)	36	0-50	Moderate or moderately rapid	Medium to rapid	Well drained	Gently sloping to steep slopes

Note : Data from NRCS Official Soil Classifications and PASDA soil coverage

The lower watershed is comprised of both group B and C soils. Group B soils are mainly moderately well to well-drained soils with moderately-fine to moderately-coarse textures with transmission rates between 0.38 and 0.76 centimeters per hour (cm/hour). Group C soils are of a moderately-fine to fine texture and have low infiltration rates. These soils have transmission rates between 0.13 and 0.38 cm/hr.

Typical rainstorms that are less than 0.5 inches (1.27 cm) can infiltrate a well-drained Group B soil in less than two hours, whereas it will take the group C soils almost 4 hours to allow the same amount of infiltration. The lower infiltration rates increase the potential amount of runoff and pollutant transport from the land. In addition, the topography or slope steepness in these areas will also have significant impacts on pollutant transport.

3.1.2.2 Hydrology

The Lower Schuylkill River Watershed consists of the land areas draining directly to the Schuylkill River and four major tributaries, as shown on Figure 3.1.2-2. Table 3.1.2-2 indicates that the Perkiomen Creek is the largest tributary in this area. The Wissahickon Creek is the closest tributary discharging into the Schuylkill River above the Belmont and Queen Lane WTP Intakes for the City of Philadelphia. However, because the Wissahickon Creek discharges into the Schuylkill River on the same (east) riverside as the Queen Lane Intake, it has significant influence on the water quality at Queen Lane.

Table 3.1.2-2 Characteristics of Tributaries in the Lower Schuylkill River Watershed (From Bottom of Watershed to Top of Watershed by River Mile Location)

Major Subwatershed	Drainage Area (mi ²)	River Mile Location	Length (mi)
Lower Schuylkill (Philadelphia-Conshocken)*	69.6	<20.5	20.5
Wissahickon Creek	63.6	12.8	24.2
Middle Schuylkill 1 (Norristown - Valley Forge)*	64.8	20.5-32	11.5
Valley Creek	23.3	30.6	10.4
Middle Schuylkill 2 (Phoenixville-Pottstown)*	103.0	32-63	31
Perkiomen Creek	366.3	32.3	37.8
Pickering Creek	38.8	34	14.8

**These watershed boundaries were selected for purpose of the study*

In the lower half of the Schuylkill River Watershed, there are two major reservoirs. As shown in Table 3.1.2-3, Green Lane Reservoir is the largest and stores over 4.4 billion gallons of water. Contaminants may settle out in the reservoirs, and accumulate in the sediments for future release. There are seven dams across the river in the lower half of the watershed that were designed to trap sediment and coal culm. These dams are beginning to exceed their service life, and in some cases, have failed. Similar, but smaller dams on the tributaries are also being removed to improve aquatic life. Because these dams trap significant amounts of contaminated sediment behind them, their removal should be handled carefully.

Table 3.1.2-3 Reservoir Characteristics for the Lower Schuylkill River Watershed

Water Body	Average Width	Average Depth	Surface Area	Length	Volume (billions of gallons)	Detention Time
Pickering Creek	460 ft	11 ft *	4,804,020 sq ft 0.1723 sq miles	9,395 ft 1.78 miles	0.4	34 days
Green Lane Reservoir	888 ft	16.4 ft *	43,302,856 sq ft 1.5533 sq miles	74,648 ft 14.14 miles	4.4 *	62 days

** Data from Philadelphia Suburban Water Company*

As indicated in Figure 3.1.2-2, there are a number of flow-monitoring gauging stations in the Lower Schuylkill River Basin. However, only a few have continuous data that is suitable for long term characterization. Table 3.1.2-4 lists four active gauging stations that are located within the Lower Schuylkill Subwatershed. They are: Perkiomen Creek at Graterford, Valley Creek near Valley Forge, Wissahickon Creek at the mouth of Philadelphia, and Schuylkill River at Philadelphia. Table 3.1.2-4 summarizes the drainage area in square miles, annual mean flow, annual runoff, and the 10, 50, and 90% exceedance limits.

Table 3.1.2-4 Active Gauging Stations within the Lower Schuylkill Subwatershed

Station ID	Location	Drainage Area (mi ²)	Period of Record	Annual Mean Flow (cfs)	Annual Runoff (Inches)	10% Exceeds (cfs)	50% Exceeds (cfs)	90% Exceeds (cfs)
01473000	Perkiomen Creek at Graterford	279	1957-1999	411	N/A	831	180	60
01473169	Valley Creek Near Valley Forge	21	1983-1999	32.3	21.09	52	23	15
01474000	Wissahickon Creek Mouth at Philadelphia	64	1966-1999	104	22.02	177	60	28
01474500	Schuylkill River at Philadelphia	1893	1932-1999	2721	N/A	5850	1670	430

cfs – cubic feet per second

Recent decade scale patterns in climate and river flow for the region were also assessed to ascertain direct connections between these parameters and PWD Intake water quality data. Daily averaged data for the Schuylkill River flow at the Fairmount Dam through the 1990s, as seen in Figure 3.1.2-3, indicates extremely low flow conditions in summer 1999, with less pronounced low flow occurring in 1991 and 1993. The lowest flows through the decade were not always associated with extended low levels of summer precipitation, suggesting that evaporation, groundwater storage and surface water removal are important components in the water budget of the region.

Figure 3.1.2-2 Hydrologic Features of the Lower Schuylkill River Area

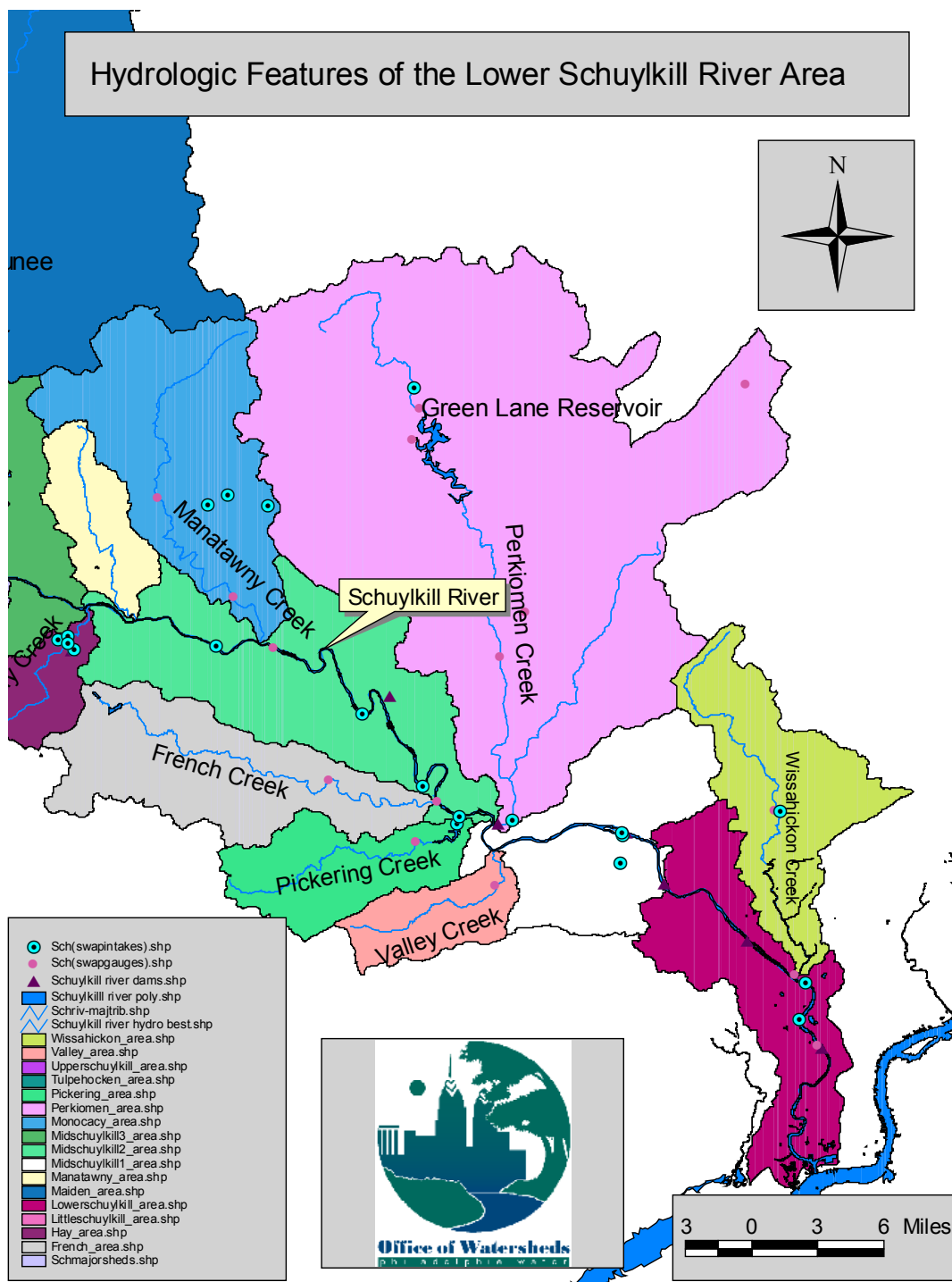
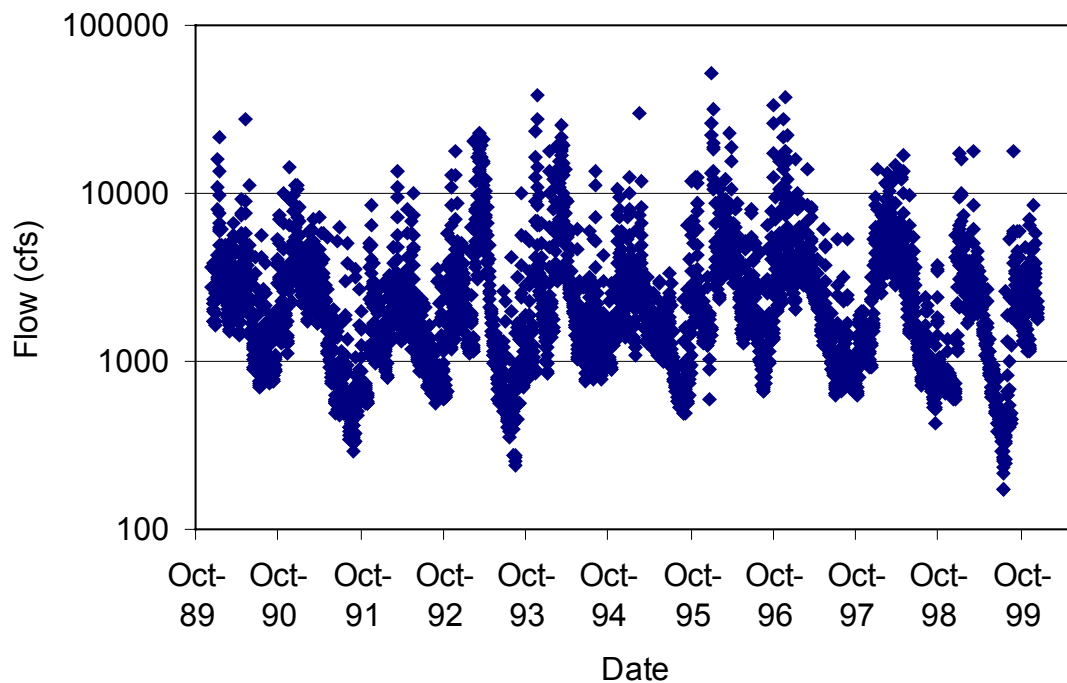


Figure 3.1.2-3 Schuylkill River Flow at Fairmont Dam



Based on the trends of precipitation in the area, during the spring and winter seasons, runoff plays a significant role in pollution. During the drier seasons, pollution is caused by point sources rather than non-point sources.

3.1.2.3 Physiography

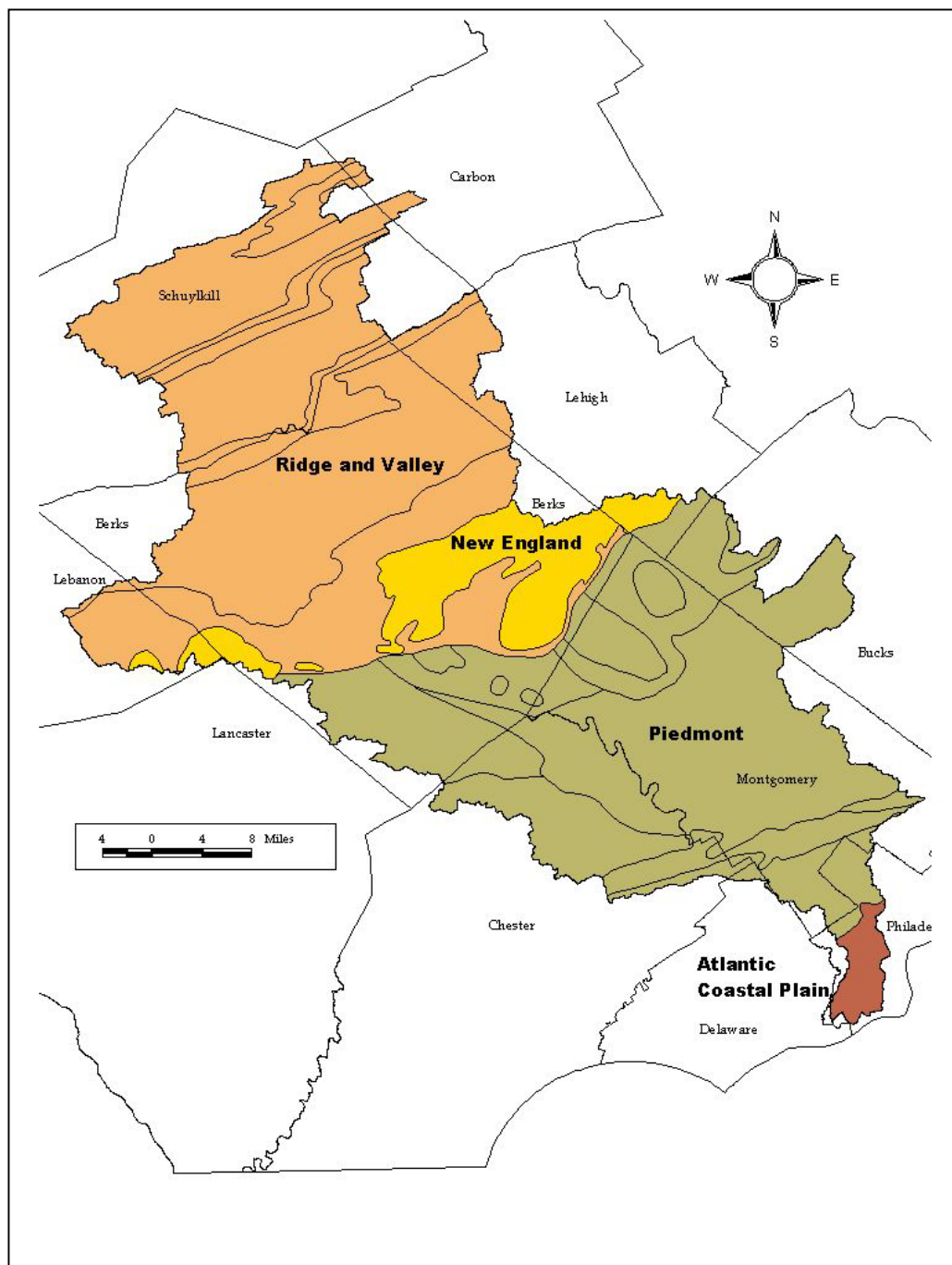
The Schuylkill River flows through four physiographic provinces: the Valley and Ridge, New England, Piedmont and Atlantic Coastal Plain. PWD's Queen Lane WTP is located in the Atlantic Coastal Plain Province. The last physiographic province represented in the Schuylkill River Basin is the Atlantic Coastal Plain, as shown in Figure 3.1.2-4.

About 20 square miles of the basin is in this province, and most of it is located downstream of the Fairmount Dam to the Delaware River. The Atlantic Coastal Plain is mainly lowlands with numerous streams and marshlands. This particular section of the Schuylkill is an estuary, which experiences a range of tidal fluctuations of about 5.5 ft.

The Queen Lane WTP is located in Philadelphia County, where the Wissahickon Creek Subbasin drains into the Schuylkill River south of Manayunk. The Wissahickon Creek includes a drainage area of 63.8 square miles. Its headwaters are in Montgomery County and in the Triassic Lowland and it flows through the Piedmont Uplands. South of the Wissahickon confluence, the river crosses the fall line and flows into the Atlantic Coastal Plain province.

Further upstream from Philadelphia, the Schuylkill River delineates the borders of Chester and Montgomery counties. Here, as the river flows through Norristown, it passes into the Piedmont Uplands. In the Piedmont Uplands, a region of broad, rolling hills and valleys, the river crosses the Chester Valley, a narrow valley of low relief. Valley Creek, a small tributary to the Schuylkill in Chester County, lies in the Piedmont Uplands. The confluence of Valley Creek with the Schuylkill River is just south of Perkiomen Creek's confluence with the Schuylkill River.

Figure 3.1.2-4 Physiographic Areas of the Lower Schuylkill Watershed

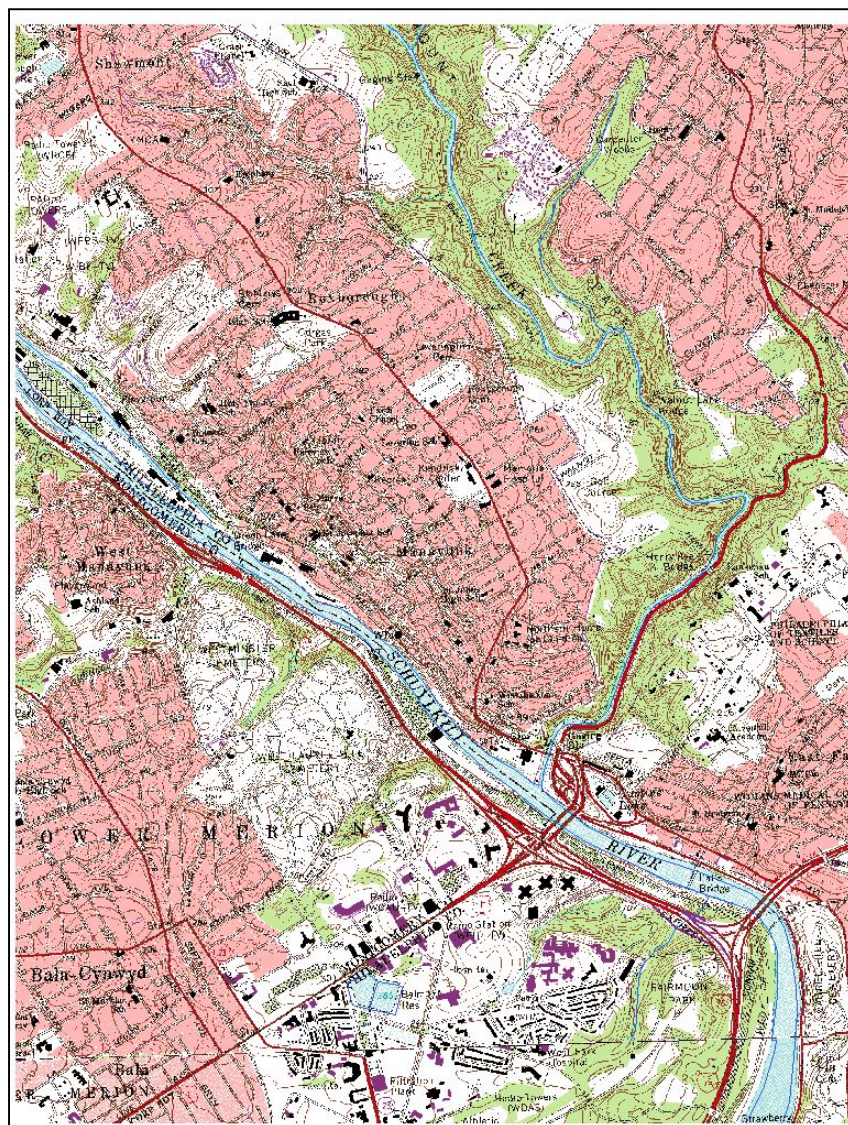


3.1.2.4 Topography

The combination of geologic, soil, and hydrologic characteristics found in the watershed make runoff of conservative contaminants from land activities into the adjacent surface waters very possible if no mitigation strategies are implemented. These characteristics also affect the quantity of the flow that can create erosion of streambanks and deposit sediment in reservoirs.

The topography of the watershed indicates where significant runoff may be generated. Land-based activities on steeply sloping areas may generate more runoff and associated contaminants than those located on gentler slopes due to the potential to transport contaminated runoff farther and faster. The steeply sloping areas shown on Figure 3.1.2-5 are considered to be sensitive areas where runoff from various activities could have a potentially significant impact on river water quality. These areas are ideal for preservation and protection from development to prevent increased runoff and contamination in the future.

Figure 3.1.2-5 Topographic Map of Queen Lane WTP Intake Area



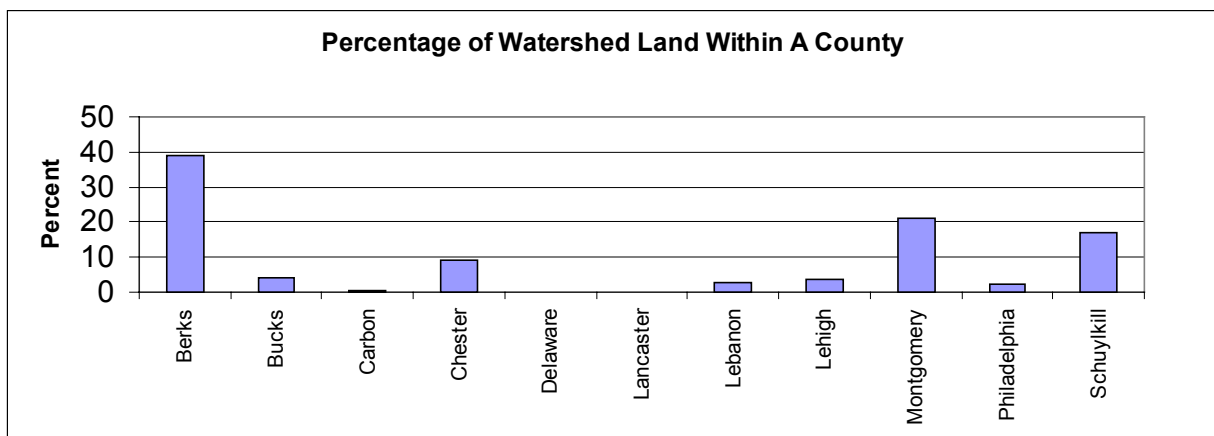
3.1.3 Land Use

Key Points

- Recent land use studies conclude that the amount of developed land within the Schuylkill River Watershed ranges between 14 and 30%.
- Studies of changing land use patterns in the watershed conclude that the amount of developed land is increasing, as agricultural and forested lands decrease.
- Developed land areas are found mainly in the Lower Schuylkill River Watershed, near major cities and transportation corridors.
- The area surrounding the Queen Lane Intake is primarily forested, with some residential and commercial areas.

Parts of 11 counties are located within the Schuylkill River Watershed. Of these 11 counties, only 4 (Berks, Chester, Montgomery, and Schuylkill counties) have nearly ten percent or more of the watershed within their boundaries (Figure 3.1.3-1).

Figure 3.1.3-1 Percentage of Land Area in the Schuylkill River Watershed within Each County



The Queen Lane WTP is at the downstream end of the watershed, where Philadelphia accounts for only two percent of the watershed land area, but represents the single largest population and water supply withdrawal in the watershed. Bucks, Montgomery, Chester, and Delaware Counties are suburban areas bordering Philadelphia that make up the middle of the watershed and represent suburban areas surrounding the city with varying amounts of development. Berks, Carbon, Lebanon, Lehigh, and Schuylkill Counties in the upper reaches of the watershed are the least developed areas.

As shown in Figure 3.1.3-2, the most recent studies by the USDA have estimated that the Schuylkill River Watershed is 28% developed, 34% agricultural, and 32% forested. Table 3.1.3-1 and Figure 3.1.3-3 both provide the details of this breakdown in five-year

intervals spanning the period from 1982 until 1997. Based on the changes in land use from 1982 to 1997, the amount of developed land has increased by over 30% in the past 15 years, while agricultural land in the watershed has decreased by almost 14% and forested lands decreased by just under 5%.

Figure 3.1.3-2 Overview of Schuylkill River Watershed Land Use (%)

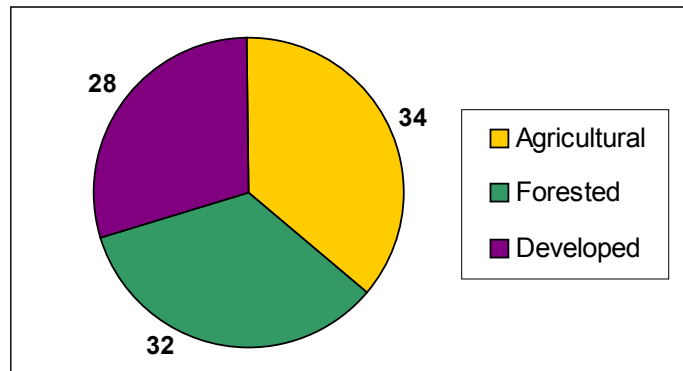


Table 3.1.3-1 Land Use Changes in the Schuylkill River Watershed: 1982-1997

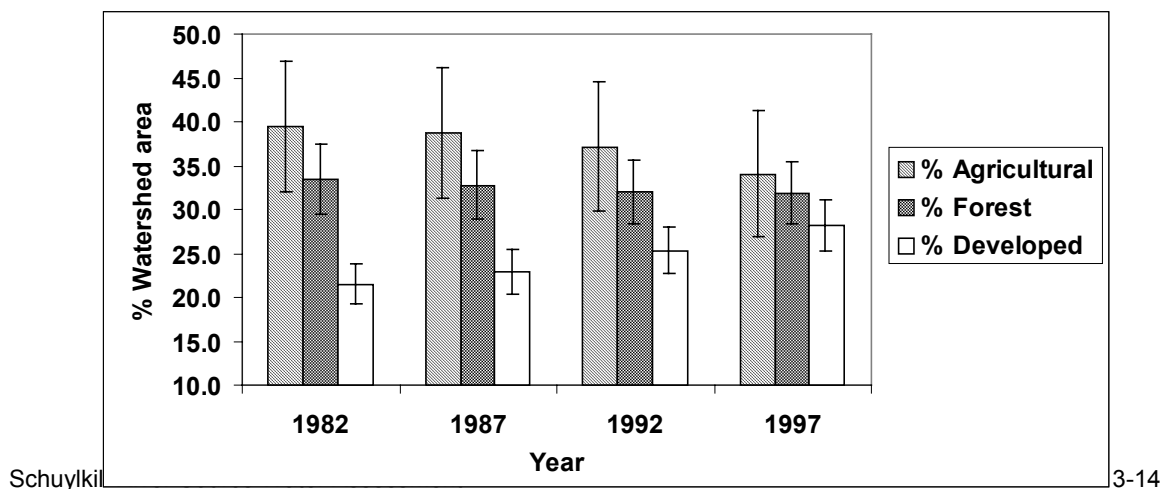
Year	% Agricultural	% Developed	% Forested
1982	39.5	21.5	33.5
1987	38.8	22.8	32.8
1992	37.2	25.3	32.1
1997	34.0	28.3	31.9

Source : NRI, 2001

Note: To calculate % change in agricultural land from 1982 to 1997: $[(34.0-39.5)/39.5] * 100 = -13.9\%$

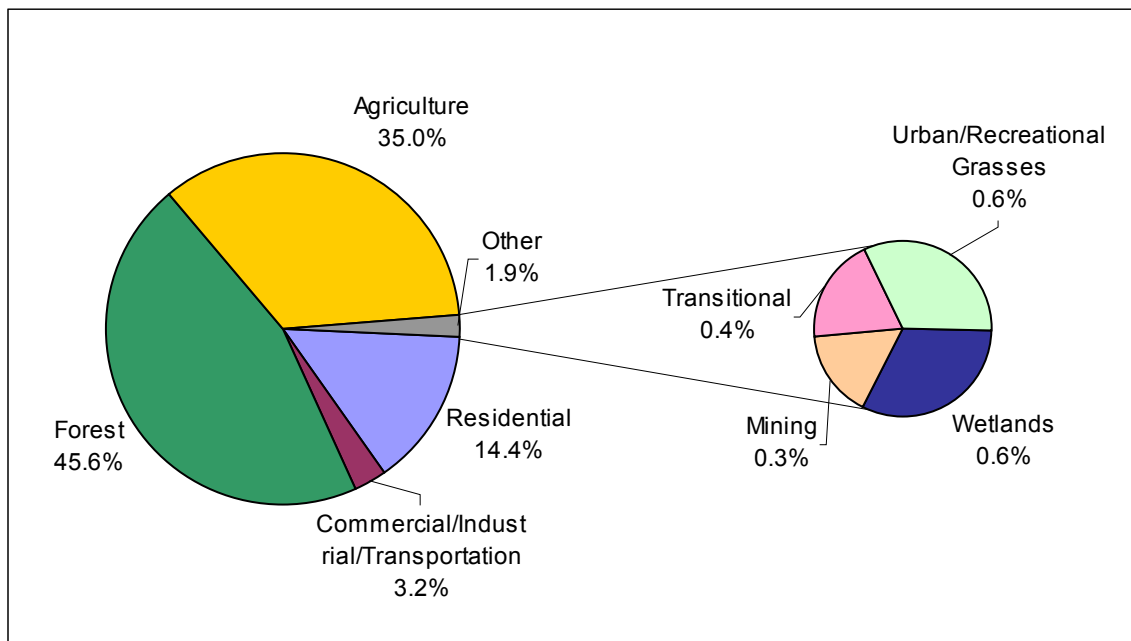
Figure 3.1.3-3 Changing Land Use in the Schuylkill Watershed

Data is from the National Resources Inventory, 2001. Error bars indicate 95 % confidence intervals for data in broad land use categories. Agricultural land includes all pasture, grazing and croplands. Developed land includes all urban land and rural transportation lands.



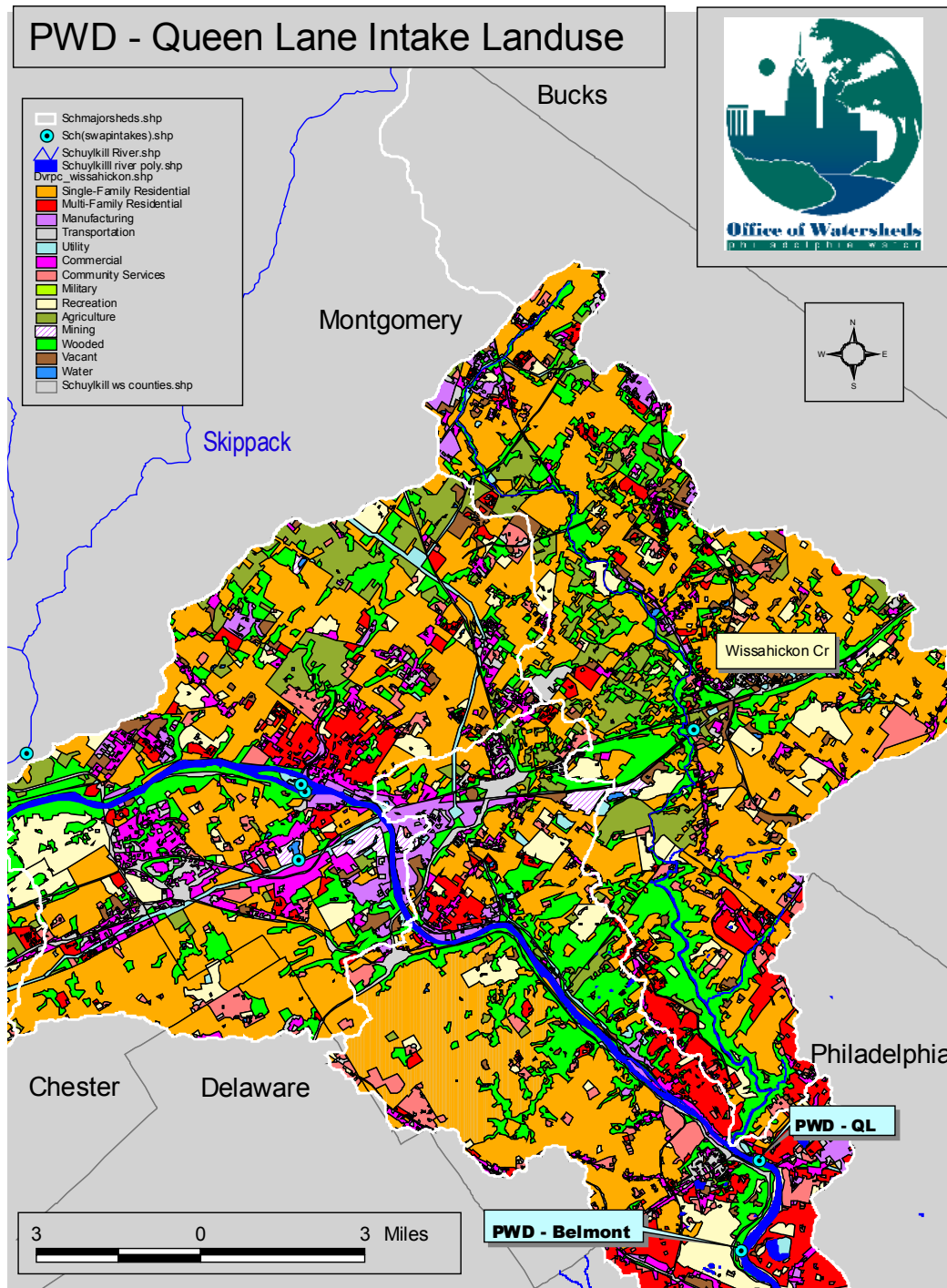
The USGS's National Land Cover Dataset (NLCD) landuse coverage, detailed in Section 1.2.5, characterizes the entire Schuylkill Watershed. Figure 3.1.3-4 shows the updated NLCD coverage for the Schuylkill Watershed Area within the Zone B delineation for the PWD Queen Lane Intake. According to this information, over 80% of this area is characterized as agriculture, forests, or wetlands. The majority of the remaining 20% is developed area.

Figure 3.1.3-4 Updated NLCD Land Use for PWD Queen Lane Intake Zone B Delineation



As shown in Figure 3.1.3-5, the area surrounding the Queen Lane Intake is primarily wooded, commercial, and residential areas. Across the river from the intake, the land is mostly forested. Besides the immediate area surrounding the intake, most of the land is used for residential purposes.

Figure 3.1.3-5 Queen Lane Intake Land Use (DVRPC)



3.1.4 Drinking Water System

Key Points

- **The 85 MGD Queen Lane Water Treatment Plant provides water to about 900,000 people in the northwestern section of Philadelphia.**
- **The Queen Lane Water Treatment Plant (WTP) has won several awards for its outstanding treatment performance.**

The Philadelphia Water Department's Queen Lane Water Treatment Plant (PWSID 1510001), located 12 miles from the mouth of the Schuylkill River in Philadelphia County, is shown in figure 3.1.4-1. Raw water is pumped from the Schuylkill River at a daily average flow rate of 85 MGD. Located in the East Falls section of the city, the Queen Lane Water Treatment Plant provides water to about 900,000 people in the northwest region of Philadelphia. The service area is outlined by the Schuylkill River to the west, Roberts Avenue and Tabor Road to the south, and the borders of the city to the north and east.

Figure 3.1.4-1 Philadelphia Water Department's Queen Lane Water Treatment Plant



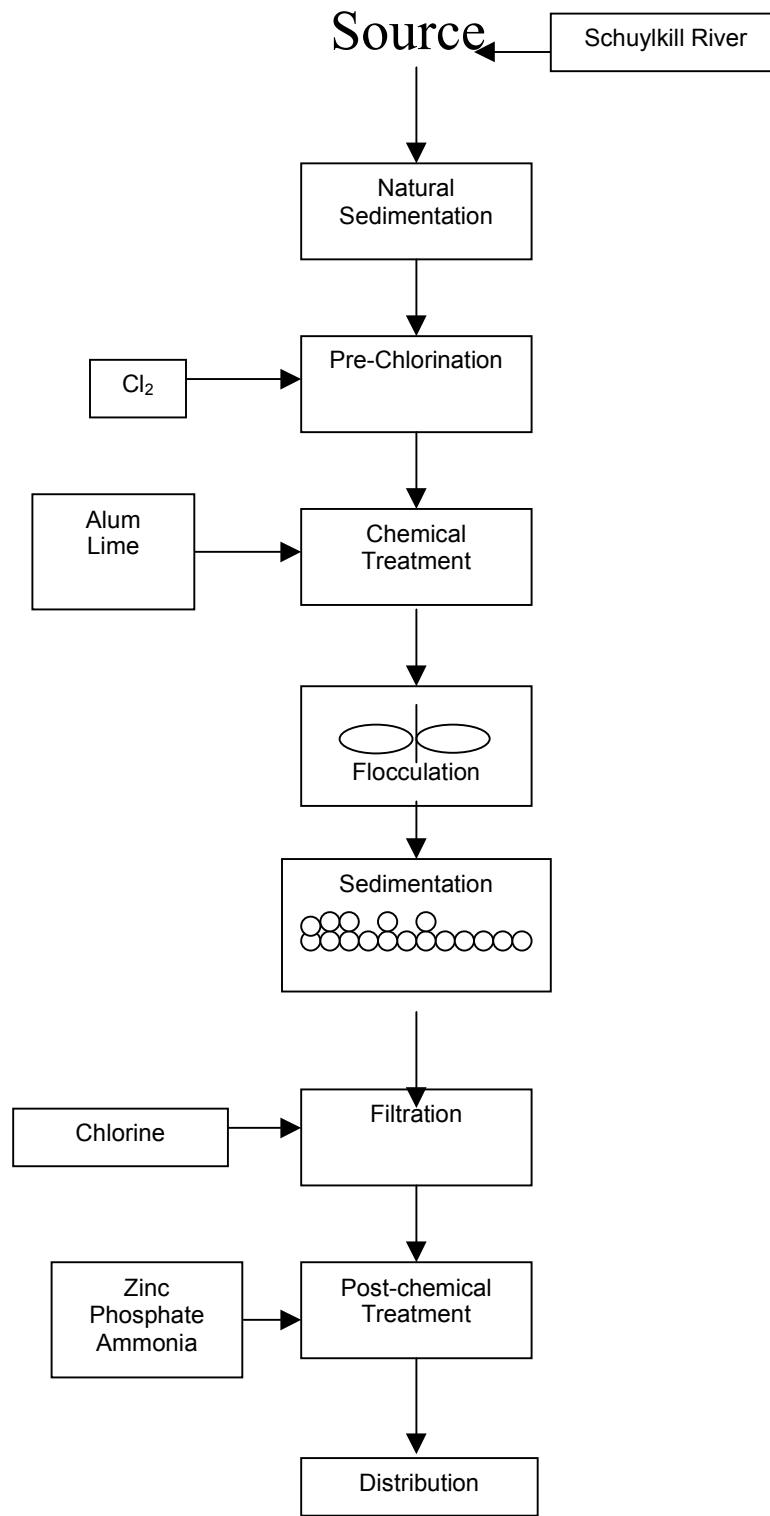
A process treatment schematic is shown by Figure 3.1.4-2. Raw water pumped from the Schuylkill Intake passes through screens for removal of large debris (leaves, branches, etc.) and is then held in a reservoir for at least 20 hours. The reservoir allows silt, sand, and other large particles to settle prior to downstream conventional treatment. The pre-sedimentation basin has the particularly important role of removing pollutants during rain events or high flow conditions when high concentrations of silt and large particles result in re-suspension of river sediment and runoff. Additionally, an oxidant or powdered activated carbon (PAC) may be added to the pre-sedimentation basin to mitigate algae or taste and odor episodes.

The reservoir is located on a hill, so that the height of the reservoir provides sufficient hydraulic pressure to allow water to flow through the plant by gravity. This saves considerable money in pumping and electrical costs. After pre-sedimentation, ferric chloride or aluminum sulfate (alum) is used as a coagulant to destabilize viruses and small particles such as clay. Following coagulant addition, two-stages of flocculation with gentle mixing are provided to allow the destabilized particles to agglomerate. Flocculation detention time is about 60 to 70 minutes. Once floc is formed, it settles in basins with two to four hours of detention time. The floc settles to the bottom of the basin and is removed as sludge that is sent to a City of Philadelphia Water Pollution Control Facility (WPCF). A chemical addition point for chlorine, polymer, or pH adjustment is available after sedimentation.

Clarified water is then treated with dual media filtration or rapid sand filtration. Dual media consists of anthracite coal and sand and removes remaining suspended material. Filters are usually terminated after two days time, prior to severe headloss or break-through. Thirty-five filters are available at Queen Lane. At average daily flow, the loading rate is less than two gallons per minute per square foot (gpm/sf). Upon termination, a filter is backwashed and spent backwash water is sent to the WPCF.

Disinfection at Queen Lane is achieved through the addition of chlorine in the pre-sedimentation basin and after sedimentation. After filtration, ammonia is added for chloramination. This maintains a total chlorine residual of about two milligrams per liter (mg/L) in the distribution system for microbial control. After filtration, fluoride and zinc orthophosphate are also added to prevent tooth decay and for corrosion control, respectively. Filtered water is then stored in two clearwells and eventually pumped to the distribution system of the west and southwestern sections of Philadelphia.

Figure 3.1.4-2 Process Treatment Schematic for the Queen Lane Water Treatment Plant



3.1.5 Raw Water Quality

Key Points

- Schuylkill River Water Quality is monitored to assess potential health risks, aesthetics, and treatment requirements.
- The Philadelphia Water Department routinely monitors pH, color, alkalinity, hardness, total dissolved solids, conductivity, turbidity, coliform, *Giardia* and *Cryptosporidium*, total organic carbon, UV absorbance, bromide, nitrogen, phosphorus, iron, manganese, sulfate, chloride and sodium at the Queen Lane Intake. Many other parameters are monitored as part of special studies.
- Turbidity and other suspended contaminants in the river tend to increase as a function of precipitation, runoff and river flow.
- Salt levels in the river appear to fluctuate seasonally, perhaps in response to the application of road salts during the winter.
- Conductivity, alkalinity, chloride, sodium and 15 other water quality parameters have increased at the Queen Lane Intake over the past decade. Increased pollution from runoff is the most likely source of these changes.
- Almost 70% of the 809 stream miles within the Lower Schuylkill River Watershed has been assessed to determine compliance with existing water quality standards.
- Water quality standards were attained along two-thirds (370 miles) of the streams that were assessed.
- Stormwater runoff from urban and residential areas and municipal point sources were responsible for the majority of stream impairments within the Lower Schuylkill River Watershed.
- Over 90% of the Wissahickon Creek Watershed has been designated as impaired.

3.1.5.1 Water Quality Summary

Water Quality Parameters and Their Significance

A variety of parameters can be used to measure the health of our streams and rivers, as well as the suitability of these surface waters as a source of potable water supply. Table 3.1.5-1 summarizes the specific parameters sampled for at PWD's Queen Lane Intake, as well as the frequency of sampling, and the time period when sampling occurred. Most of the data was collected during routine sampling by staff at the water treatment plant (WTP). That data is supplemented by data collected for compliance with the Information Collection Rule and by data collected at a pilot treatment facility located at the WTP.

Table 3.1.5-1 Queen Lane Intake Sampling Summary

Parameter Group	Parameter	Frequency of Sampling	Time Frame	
Physical Parameters	pH	Weekly	Jan-90	Dec-99
	Apparent Color	Weekly	Jan-90	May-93
	Alkalinity	Weekly	Jan-90	Dec-99
	Hardness	Monthly	Jan-90	Dec-92
	Total Dissolved Solids	Monthly	Jan-90 Nov-96	Jun-93 Jan-99
	Conductivity	Weekly	Jan-90	Dec-99
Particulates & Microbial Contaminants	Turbidity	Weekly	Jan-90	Dec-99
	TSS	Monthly	Jan-90	Jun-93
	Total Coliform	Sporadic Weekly	Mar-91 Apr-95	Jan-95 Dec-99
	<i>E. coli</i>	Monthly	May-95	Dec-99
DBP Precursors - (Organic Compounds)	TOC	Weekly	Sep-93	Feb-00
	UV Abs @254nm	Weekly	Jul-93	May-99
Inorganic Compounds – Nutrients	Ammonia	Weekly	Jan-90	Feb-99
	Nitrite	Monthly	Jan-90	Jun-93
	Nitrate	Monthly	Jan-90	Jun-93
	D. Orthophosphate	Weekly	Jan-90	Jun-93
	T. Phosphate	Weekly	Jan-90	Jun-93
Inorganic Compounds – Metals	Lead	Bimonthly Quarterly	Feb-90 Feb-93	Dec-92 Jun-99
	Iron	Weekly	Jan-90	Jun-99
	Manganese	Weekly	Jan-90	Jul-99
Inorganic Compounds – Secondary Contaminants	Sodium	Monthly	Jan-90	Nov-99
	Chloride	Bimonthly Monthly	Jan-90 Jan-93	Oct-92 Dec-99

Summary Table 3.1.5-1 shows that an extensive amount of data has been collected from 1990 to the present in order to characterize almost all parameter groups at the Queen Lane Intake. A significant data set for parameters such as total suspended solids, metals, and nutrients, was available for detailed analysis of spatial and temporal trends. Data was very sparse for synthetic and volatile organic compounds, as well as for radionuclides.

Statistical summaries were developed for the parameter groups with sufficiently large data sets. In the statistical summaries, the minima and maxima are presented in order to show the range of values and variability of the data. The means and medians are presented to show the central tendencies of the parameters – typically measured levels. A mean that is significantly greater than the median indicates that one or two high values are affecting the mean. Similarly, a mean that is significantly lower than the median indicates that one or two low values are reducing the average. The number of samples shows how many points were included in the statistics. The count is related to the sampling frequency and time period given in Table 3.1.5-1. The number of non-detect measurements and the detection limit are also listed, where applicable. These were not included in computations of the minima, maxima, means, and medians.

Statistical results are discussed with respect to drinking water standards, which apply to the treated water. Although these standards or Maximum Contaminant Levels (MCLs) apply to treated water, they provide a good perspective on the quality of the raw water. Raw water quality results are also discussed with respect to impacts on treatment and finished water quality. Water quality parameters of interest are described below.

Physical Parameters

Physical parameters such as pH, alkalinity, color, taste, odor, and conductivity may not be directly related to health risks but can be important measures of consumer satisfaction, as well as treatability.

The presence of very low levels of compounds that cause taste and odor events in drinking water can generate consumer complaints. Color, if not treated properly, can also affect public perception of the water. Colored water generally indicates a higher level of organics or iron. Acid mine drainage from the upper watershed may be contributing to manganese, and consequently color. Excessive nutrients can cause algal blooms, which are related to the taste and odor compounds. Compounds that cause taste and odor or color do not generally pose health risks. However, these compounds must be controlled to produce water that consumers want to drink. Expensive chemicals such as powdered activated carbon, potassium permanganate, or ozone may need to be added during treatment to control formation. Effective watershed management can potentially save significantly on chemical treatment costs.

Two important parameters in maintaining effective treatment of drinking water are pH and alkalinity. They are monitoring tools that are essential to the drinking water treatment process. A water supply with high alkalinity may have increased chemical costs, because more pretreatment chemicals will be required for pH adjustment. Higher

alkalinity is usually a naturally occurring phenomenon based on the hydrology of the region. Elevated pH levels can be indicative of algal blooms in the raw water supply. Algae are a concern because they can potentially clog WTP filters and because they can release very low levels of taste and odor compounds.

Conductivity measures the amount of ions (positive and negative) in the water and the ability of the water to conduct electricity. High levels of conductivity usually indicate high levels of salts, metals, or nutrients in the water. This parameter is a cheap and easy measurement used frequently in most water quality studies. Table 3.1.5-2 summarizes levels of physical parameters measured at PWD's Queen Lane Intake.

Table 3.1.5-2 Physical Parameters at Queen Lane Intake

Parameter	Units	Min	Max	Mean	Median	Number of Samples
pH ^[1]	pH units	7.1	9.2	7.8	7.8	506
Apparent Color	CU	2	100	30	25	170
Alkalinity	mg/L as CaCO ₃	30	128	77	78	505
Hardness	mg/L as CaCO ₃	64	223	136	137	306
TDS	mg/L	113	402	254	260	65
Conductivity	µmhos/cm	146	775	425	419	495

[1] pH MCL represents a "reasonable goal for drinking water quality"

The statistics for the physical parameters show that the Schuylkill River is typical of most rivers in the northeast. The maximum pH of 9.2 at Queen Lane is indicative of the algal blooms that can occur in late spring and early summer. The range in apparent color can be related to rain events. Apparent color measures color due to particulates and turbidity, as well as naturally occurring dissolved organic material. Consequently, apparent color values are influenced by rain events that increase the turbidity in the river.

The range in alkalinity is quite wide. In general, changes in alkalinity are related to base flow changes in the river. The median alkalinity and hardness of about 80 and 140 mg/L as CaCO₃ respectively, are reflective of moderately hard water. Increased hardness and alkalinity can increase chemical costs associated with reducing pH at the water treatment plant. Variability in total dissolved solids and conductivity may be due to changing salt levels in the river. Salt levels appear to fluctuate seasonally with the use of road salt in winter.

Turbidity and Microbial Contaminants

Turbidity measures the clarity of the water. As it gets cloudier, the turbidity increases. This indicates that fine suspended materials that obscure light rays are present in the water. Turbidity can be caused by nearby roads, construction, erosion, and agricultural runoff. Levels of turbidity depend on the type of soils, slopes, land cover, and rain intensity.

Levels of microbial contaminants or pathogens determine whether a stream is safe for recreational swimming and help gauge the amount of fecal pollution entering it. Typical pathogen testing includes total coliforms, fecal coliforms, viruses, *E. coli*, *Giardia*, and *Cryptosporidium*.

As Table 3.1.5-3 shows, levels of particulates and microbial parameters are influenced by rain and runoff. On average, river turbidity and total suspended solids at Queen Lane are quite low, with medians of four NTU and 12 mg/L, respectively. Maximum values of 95 NTU and 408 mg/l show how turbidity and solids can increase significantly as a result of rain events. As river flow increases above the annual median flow of 1,600 cfs, turbidity generally increases, requiring increased chemical usage at the WTP. The pre-sedimentation basin at the Queen Lane WTP is used to settle out much of these solids prior to treatment.

Table 3.1.5-3 Particulate and Microbial Contaminants at Queen Lane

Parameter	Units	Min	Max	Mean	Median	Number of Samples	MCL
Turbidity ^[1]	NTU	0.2	95	7.8	3.9	500	1
TSS	mg/L	0.10	408	41	12	60	
Total Coliforms	Col/100 mL	6	95000	6150	3000	234	≤ 5% of monthly samples may be positive
<i>E. coli</i>	Col/100 mL	0.3	9000	885	420	223	≤ 5% of monthly samples may be positive

[1] Turbidity MCL for unfiltered supplies

Microbials will also increase during rain events, similar to the other particulates. Accordingly, median values for total coliforms and *E. coli* are one to two orders of magnitude lower than the maximum values. Although these parameters increase during rain events, disinfection with chlorine kills the *E. coli* and total coliform prior to distribution to consumers. However, disinfectant demand and associated costs may increase.

Table 3.1.5-4 summarizes the *Giardia* and *Cryptosporidium* detected at the Queen Lane WTP Intake for 2000.

Table 3.1.5-4 *Giardia* and *Cryptosporidium* Detected at the Queen Lane WTP Intake in 2000

Pathogen	N	Min	Max	Median	Average	Total Volume Examined (L)	# positive samples	% positive samples
<i>Cryptosporidium</i>	16	0	1	0	0.11	182.33	6	38%
<i>Giardia</i>	16	0	20.75	1.375	3.72	182.33	13	81%

All concentrations in oocysts/L unless otherwise noted

As shown, *Giardia* is found frequently, thus indicating that sewage discharges upriver routinely impact the river, while *Cryptosporidium* is detected in only one of five samples collected. The cumulative average raw water *Cryptosporidium* concentration from 1994 to 2000 was 0.08 oocysts/L.

PWD has been studying *Giardia* and *Cryptosporidium* in the water supply since 1994. Since then, a number of special studies have been conducted to identify the sources and influences on the concentrations of these pathogens in the river. However, the technology to adequately detect and analyze water samples for *Cryptosporidium* is not considered reliable or accurate enough for risk assessments and detailed quantitative comparisons. Given the limitations of the analytical methods the following observations have been observed:

- *Giardia* and *Cryptosporidium* are detected more often in the river during storm events.
- *Giardia* and *Cryptosporidium* are typically found at higher concentrations in the river during storm events and correlate with higher turbidity concentrations.
- *Giardia* and *Cryptosporidium* are typically found at higher concentrations during winter and spring when water temperatures are colder and oocyst survival is improved.
- *Giardia* and *Cryptosporidium* is routinely found in sewage effluents.

The previous findings indicate that runoff and sewage discharge influence the presence and concentrations of *Cryptosporidium* and *Giardia* in the Lower Schuylkill River Basin. Figure 3.1.5-1 provides a theoretical description of the cycle of how the pathogens are moved from one source to another and eventually into the river or water supply. As shown in Figure 3.1.5-2, one calf can produce as much *Cryptosporidium* in a day as 1,000 infected persons or more than 100 adult cattle. Therefore, keeping young animals away from sensitive water supply areas is prudent.

Information to date suggests that the treatment process is sufficiently removing these pathogens. No cases of cryptosporidiosis reported in Philadelphia from 1997 to 1999 were related to drinking water. In fact, the main risk factors for cryptosporidiosis were identified as travel, swimming, contact with an infected person, day care, or farm animal contact. This is further corroborated by the observation that more cases of cryptosporidiosis are reported during the summer months when travel and swimming occur. During the summer months, *Cryptosporidium* and *Giardia* are found at their lowest levels in the local rivers and streams.

Figure 3.1.5-1 Theoretical Pathogen Transport Cycles in a Multi-Use Watershed

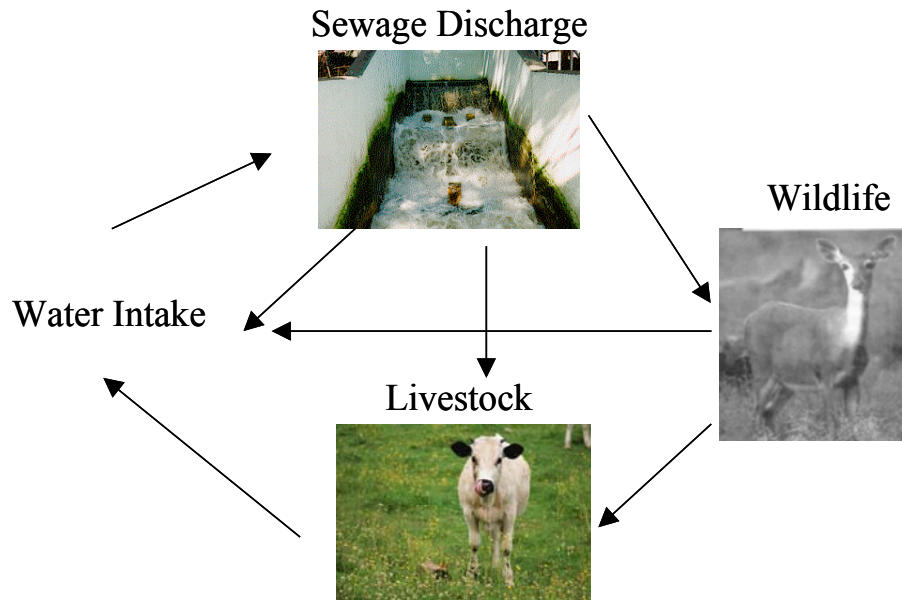
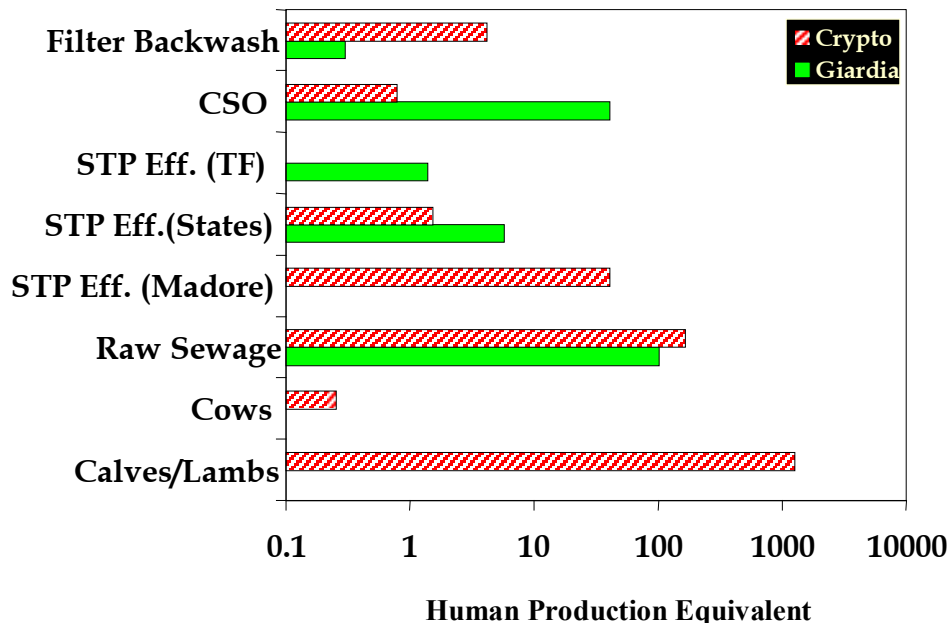


Figure 3.1.5-2 Comparison of Amounts Produced by Various Sources of Cryptosporidium and Giardia

(Note: STP effluent values based on discharge of 10 mgd)



Disinfection By-product Precursors

Precursor compounds react with other chemicals (such as chlorine or ozone) used in the disinfection process to create disinfection by-products (DBPs). High levels of DBPs may cause human health impacts. Some of the precursors that are tested for include bromide, total organic carbon, and UV absorbance.

Total organic carbon (TOC) may include volatile organic compounds (VOCs) and synthetic organic compounds (SOCs), but is mostly comprised of natural organic matter from decomposition of leaves and plants. The naturally occurring compounds that comprise TOC form chlorinated organic compounds, such as chloroform. These chlorinated organics may be carcinogenic at certain levels of exposure. Absorbance of UV light is a good surrogate for dissolved natural organic matter and does not require the same level of technical laboratory analysis as TOC.

Bromide is a concern because it reacts with ozone to form bromate, a potential carcinogen. Bromide also reacts with chlorine and organics to form brominated chlorine by-products that may pose health risks. The analytes shown in Table 3.1.5-5 are typical measures of DBP precursors. Comparing the mean and median values of TOC at Queen Lane, it indicated that the TOC levels are typically less than three mg/L. The maximum TOC value of 7.1 mg/L may be rain/run-off related, because TOC measures particulate organics. TOC increases seasonally during the summer and early fall due to greater plant growth and decomposition. Formation of chlorination by-products is of particular concern during those seasons. UV shows similar trends as TOC.

Table 3.1.5-5 Organic Compounds – DBP Precursors at Queen Lane Intake

Parameter	Units	Min	Max	Mean	Median	Number of samples
Total Organic Carbon	mg/L	1.7	7.1	2.9	2.7	298
UV Abs@254nm	cm ⁻¹	0.037	0.337	0.086	0.075	167

Inorganic Compounds - Nutrients

Nutrients can cause excessive algal growth that can harm fish and impact water treatment. These measurements can identify the impacts of nutrient runoff from lawns, gardens, farms, and other sources. Some of the nutrients measured are nitrate, ammonia, phosphorus, and orthophosphate. High levels of nutrients cause algal blooms. The algae can then clog filters at the water treatment plant or upon dying release very small amounts of chemicals (parts per trillion levels) that can make the water taste or smell bad. Though these chemicals are not harmful, water treatment must add chemicals such as powdered activated carbon to remove them, which is usually expensive.

Table 3.1.5-6 provides an overview of the nutrient content of the Lower Schuylkill River at Queen Lane and its variability. Nitrite values are of particular concern in drinking water treatment due to blue baby syndrome. Median levels of the nutrients are fairly low and do not significantly affect drinking water treatment. The maximum value of

total nitrite and nitrate measured, 0.10 mg/L and 4.8 mg/L, respectively, are well below the general guidelines of one mg/L MCL of nitrite and a ten mg/L MCL of nitrate.

Table 3.1.5-6 Inorganic Compounds – Nutrients at Queen Lane Intake

Parameter	Units	Min	Max	Mean	Median	Number of Samples
Ammonia	mg/L as N	0.01	0.88	0.14	0.12	429
Nitrite	mg/L as N	0.03	0.10	0.05	0.05	42
Nitrate	mg/L as N	0.63	4.8	3.2	3.3	129
Dissolved Orthophosphate	mg/L as P	0.04	1.4	0.27	0.25	168
Total Phosphate	mg/L as P	0.02	1.4	0.27	0.25	279

Inorganic Compounds – Metals

The presence of metals can have various types of impacts on drinking water. Some metals, such as lead, may pose health risks at certain concentrations, if not removed at the WTP. The presence of lead in raw water is usually indicative of an industrial source. Lead is usually removed from the raw water by filtration. It may later leach into the water supply from distribution system pipes, but this can be controlled by chemical treatment.

Manganese is a concern for drinking water treatment because it can cause an unsightly color in the water at very low concentrations. Treatment of manganese with powdered activated carbon or potassium permanganate can be very costly. High levels of metals may also impact aquatic life. Metals are usually found at high levels in the Schuylkill Watershed in areas impacted by acid mine drainage. PWD monitors levels of lead, iron and manganese, as shown by Table 3.1.5-7.

Table 3.1.5-7 Inorganic Compounds – Metals at Queen Lane Intake

Parameter	Units	Min	Max	Mean	Median	Number of Samples	# of Non-Detects	Detection Limit
Lead	Mg/L	0.001	0.06	0.006	0.003	43	3	0.001
Iron	Mg/L	0.025	25	0.81	0.37	623	0	
Manganese	Mg/L	0.005	1.59	0.108	0.09	575	0	

Median lead levels in the Schuylkill River, before treatment, are below the current MCL of 0.015 mg/L. Lead is usually easily treated with corrosion inhibitors prior to distribution. The iron values shown in Table 3.1.5-7 are quite variable, with a median of 0.4 mg/L and a maximum of 25 mg/L. Iron levels can increase significantly at Queen Lane due to rain events. Higher iron levels increase treatment costs of chemical additions and sludge disposal. The manganese data also shows variability that can be attributed to rain events. The median value of 0.09 mg/L is in excess of the Maximum

Contaminant Level for finished water of 0.05 mg/L. At Queen Lane, this is treated using potassium permanganate or chlorine, which increases overall treatment costs.

Inorganic Compounds – Secondary Contaminants

Salts are the primary secondary contaminant considered. Salts indicate whether the stream is a freshwater or saltwater environment. Salts are not typically removed by the water treatment process. High levels of salt in the drinking water are not desirable for those with low-sodium diets. Sodium and Chloride are the two major constituents of salts measured.

Table 3.1.5-8 summarizes sodium and chloride levels measured at the Queen Lane Intake. Salt levels have been found to increase during the winter. From a drinking water perspective, high sodium values can be an area of concern for those individuals with hypertension. The median/mean value of about 27 mg/L is above the EPA guidance value of 20 mg/L. Use of road salts in the winter should be limited.

Table 3.1.5-8 Inorganic Compounds – Secondary Contaminants at Queen Lane Intake

Parameter	Units	Min	Max	Mean	Median	Number of Samples
Chloride	mg/L	10	128	44	44	150
Sodium ^[1]	mg/L	0.01	76	27	27	140

[1] 20 mg/L is a guidance value not an MCL

Synthetic Organic Compounds

Pesticides and herbicides comprise most of the synthetic organic compounds (SOCs). Synthetic organic compounds are manufactured chemicals that generally last a long time in the environment and may have toxic effects on human and aquatic life. Dozens of pesticides and herbicides exist which can be tested for in water. Generally, atrazine, a herbicide used for farming and agriculture, is the most heavily used and widely found. The EPA website has more details about pesticides and herbicides, if more information is required.

Synthetic Organic Chemicals (SOCs) are characterized as environmentally resistant and usually linked to various health impacts. As shown in Tables 3.1.5-9 and 3.1.5-10, a number of SOC that have been banned or have limited use are still being detected in the river. In addition, though 6 of the 18 SOC detected were related to farming, the others appear to be related to urban, residential, commercial, transportation, or industrial activities (please see Table 3.1.5-12). It is also interesting to note the diversity of chemicals detected in upstream watershed areas such as the Wissahickon Creek. The detection of a number of pesticides and herbicides in this stream suggests that there is still significant use of herbicides and pesticides in this mainly residential watershed.

Table 3.1.5-11 compares the SOC detected in or near the PWD Schuylkill Intakes with those detected in the Delaware Watershed based upon preliminary results of the USGS NAWQA study. As shown, there are a number of common SOC such as atrazine, alachlor, metolachlor, and simazine. These are all herbicides that are associated with

agricultural activities. These similarities suggest that these activities have impacts on water resources throughout the Delaware River Basin and are not unique to the Schuylkill River.

Table 3.1.5-9 Herbicides, Pesticides, and SOC Results for the Queen Lane and Belmont WTPs

	1995	1996	1997	1998	1999	2000
PESTICIDES						
Alachlor	ND	ND	ND	NA	NA	+
Aldicarb	NA	ND	NA	NA	NA	NA
Aldicarb Sulfone	NA	ND	NA	NA	NA	NA
Aldicarb Sulfoxide	NA	ND	NA	NA	NA	NA
Atrazine	+	+	ND	+	ND	+
Carbaryl	NA	ND	NA	NA	NA	ND
Carbofuran	ND	ND	ND	NA	NA	ND
Chlordane	ND	ND	ND	NA	NA	NA
Hexachlorocyclopentadiene	ND	ND	ND	NA	NA	+
Lindane	ND	ND	ND	NA	NA	ND
Methomyl	NA	ND	NA	NA	NA	NA
Methoxychlor	ND	ND	ND	NA	NA	ND
Oxamyl	ND	ND	ND	NA	NA	ND
Simazine	ND	ND	ND	NA	NA	+
3-Hydroxycarbofuran	NA	ND	NA	NA	NA	NA
HERBICIDES						
Dalapon	+	ND	NA	NA	NA	NA
Dicamba	NA	ND	NA	NA	NA	NA
Endothall	ND	ND	ND	NA	NA	ND
Metolachlor	+	ND	NA	NA	NA	NA
Metribuzin	NA	ND	NA	NA	NA	NA
Pentachlorophenol	+	+	ND	ND	ND	+
Picloram	ND	ND	ND	NA	NA	ND
Propachlor	NA	ND	NA	NA	NA	NA
SYNTHETIC ORGANIC CHEMICALS						
Benzo[a]Pyrene	ND	ND	ND	NA	NA	ND
Di-2(ethylhexyl)Adipate	ND	ND	ND	NA	NA	ND
Di-2(ethylhexyl)Phthalate	+	+	ND	ND	ND	ND
1, 2-Dibromo-3-Chloropropane	ND	ND	ND	NA	NA	ND
Ethylene Dibromide	ND	ND	ND	NA	NA	ND

NA = Not Analyzed; ND = Not Detected; + indicates a positive detection

Table 3.1.5-10 SOCs Detected in Lower Schuylkill River Watersheds during Fall 2000 Monitoring Study

Chemical Name	MDL	Concentration Ranges	Wissahickon Creek	Manayunk Canal
Lindane*	0.0038	0.0052	Yes	ND
Dieldrin	0.0038	0.004-0.03	ND	ND
Alachlor	0.15	0.21	ND	Yes
Diethylphthalate	0.04	0.05-0.13	Yes	Yes
Fluorene	0.02	0.02	Yes	Yes
Phenanthrene	0.02	0.02-0.06	Yes	ND
Dibutylphthalate	0.11	0.11-0.19	Yes	Yes
Pyrene	0.02	0.05-0.09	Yes	Yes
Benzo(a)anthracene	0.02	0.03 - 0.05	Yes	ND
Chrysene	0.02	0.03 - 0.05	Yes	Yes
Benzo(a)fluoranthrene	0.05	0.05 - 0.07	Yes	Yes

**Insecticide for seed, lumber, livestock, pest control, most use restricted in 1980's*

Table 3.1.5-11 Comparison of SOCs Detected to Date by USGS NAWQA Study in the Delaware River Watershed

Chemical Name
Atrazine
Metolochlor
Simazine
Prometon
Diazinon
Carbaryl
Alachlor
Chlorpyrifos
Cyanazine
Acetochlor

Note: Shaded chemicals were also detected at the PWD WTPs in the Schuylkill River Watershed

**Table 3.1.5-12 Uses and Possible Sources of Herbicides, Pesticides, and SOC's
Detected at the PWD WTPs**

Synthetic Organic Chemical	Use	Associated Activity
Atrazine	Herbicide	Farming (96% used for corn & soybeans)
Hexachlorocyclopentadiene	Pesticide	Chemical/Petroleum Processing
Simazine	Herbicide	Farming
Dalapon	Herbicide	Farming
Metolachlor	Herbicide	Farming - used to control certain broadleaf and annual grassy weeds in field corn, farming, highway right of ways, and orchards
Pentachlorophenol*	Herbicide	Wood finishing / furniture
Di-2(ethylhexyl)phthalate	SOC	Unknown
Lindane**	insecticide	Farming, golf courses, orchards, landscaping
Dieldrin	insecticide, termiticide	Residential/agricultural termite / pesticide application
Alachlor	herbicide on corn and soybeans	Farming
Diethylphthalate	plasticizer, component in the processing of polyvinyl chloride (PVC)	PVC manufacturing, solvent; aircraft lubes; insect repellent, stp effluents, landfill leachate, tire manufacturing
Fluorene	Resins and dyes	Wastewater, petroleum production, landfill leachate, urban runoff, combustion, resins, dyes
Phenanthrene	Dyes, explosives, pharmaceuticals, fossil fuels	Wood and fossil fuel combustion, garages, metal foundries, timber processing
Dibutylphthalate	Insect repellent, plasticizer, solvent	Plastic production, landfill leachate, wastewater, pulp mills
Pyrene	Biochemical research and fossil fuels	Crude oil, tire manufacturing, fossil fuel combustion, aluminum manufacturing
Benzo(a)anthracene	Coal Tar/Crude Oil	Exhaust emissions, plastics production
Chrysene	Coal Tar	Exhaust emissions, telephone poles, railroad ties
Benzo(a)flouranthrene	Fossil Fuels	Exhaust emissions

*Wood preservative, herbicide, defoliant - non-wood uses banned in 1987; antimicrobial disinfectant

**Insecticide for seed, lumber, livestock, pest control, most use restricted in 1980's

Volatile Organic Compounds

Volatile organic compounds (VOCs) are synthetic, lightweight compounds that vaporize or evaporate easily. Some VOCs such as vinyl chloride and benzene are known to be carcinogenic, while others such as chloroform are suspected to be cancer-causing agents. Industrial point sources account for most direct discharges into surface waters, but municipal wastewater plants constitute a second major source. In general, VOCs are used in solvent and degreasing compounds. Some VOCs are frequently connected with hazardous waste sites. These pollutants, a result of industrialization, are usually present at extremely low concentrations that do not appear to pose immediate health risks. Note that most organic compounds in water are naturally occurring and VOCs only comprise ten percent of the total organic material found in water.

Measurements of VOCs at the Queen Lane Intake are sparse compared to the other parameters. Table 3.1.5-13 is a summary of the available data. The data was broken into two sets due to time of sampling. The first set was based on mostly monthly sampling from January, 1990 through November, 1992. The second set was a discrete sampling event on May 14, 1991.

Table 3.1.5-13 Volatile Organic Compound Summary at Queen Lane

	# of Parameters Analyzed	Parameters	Frequency of Sampling	Total # of Samples	# of Non-Detects	Time Frame	
Set 1	48	See Table 3.1.5-13, below for those detected	Monthly*	1036	964	1/90	11/92
Set 2	38	None detected	Discrete	38	38	5/14/91	

**Generally monthly – some parameters had less and some more*

Forty-eight different parameters were analyzed in the first data set yielding a total number of 1,036 samples. However, VOCs were only measured above the detection limit in 72 of those samples. The data for those compounds with detectable concentrations are further summarized in Table 3.1.5-14. In the discrete sampling event on May 14, 1991, 38 volatile organic compounds were analyzed, but none were measured above the detection limit of 0.5 µg/L.

In Table 3.1.5-14, all of the compounds found in the raw water were well below the required limits for treated water. VOC levels at the Queen Lane Intake are very similar to those found at Belmont Intake for the same sampling period. One exception is bromodichloromethane, which was not detected at the Belmont Intake but was found on eight occasions at Queen Lane, with a maximum of six µg/L. Chloroform was also detected at higher levels at Queen Lane (8.9 compared to 1.8 µg/L) than at the Belmont Intake. Chloroform, dibromochloromethane, bromodichloromethane and total trihalomethanes all constitute trihalomethanes. Their presence is indicative of chlorine in the river, either due to an industrial source, chlorinated wastewater discharges, or road salt.

Table 3.1.5-14 Summary of Detectable VOCs at Queen Lane Intake

Compounds Detected	Units	Min	Max	Number of Samples (# detected)	Detection Limit	MCL
Chloroform	µg/L	0.3	8.9	27	0.3	100
Bromodichloromethane	µg/L	0.3	6	8	0.3	TTHM < 80
Dibromochloromethane	µg/L	0.3	1.7	5	0.3	TTHM < 80
total trihalomethanes	µg/L	0.4	17	21	0.3	TTHM < 80
Methylene chloride	µg/L	0.5	0.7	3	0.3	5
1,2,3 trichloropropane	µg/L	1	1	1	0.3	0.8*

Compounds Detected	Units	Min	Max	Number of Samples (# detected)	Detection Limit	MCL
Benzene	µg/L	0.3	0.4	2	0.3	5
o-dichlorobenzene	µg/L	0.3	0.4	2	0.3	600
Toluene	µg/L	0.3	0.5	3	0.3	1000

The data summarized on Table 3.1.5-14 also indicates that benzene, toluene, and o-dichlorobenzene were well below their MCLs. Benzene and toluene are associated with fuel oil. O-dichlorobenzene is associated with production of pesticides and dyes. One, two, three trichloropropane at one µg/L was the only compound detected in the raw water in excess of the proposed finished water limit of 0.8 µg/L.

A further examination of regulatory VOC monitoring for 21 chemicals at the Queen Lane Intake from 1994 to 1999 did not observe VOCs related to source water impacts (see Table 3.1.5-15). Typically, other than the occasion of a gasoline, fuel oil, petroleum pipeline break, or related spill, VOCs from point or non-point sources have not had a routine or regulatory impact on water quality in the 1990s at the Queen Lane WTP Intake.

Methyl tertiary-butyl ether (MTBE) is a VOC that is produced as a gasoline additive and used to reduce air pollution. However, it is quite persistent and is easily tasted or smelled at very low concentrations and can impact drinking water aesthetics. PWD monitored MTBE during from 1996 to 2000. The maximum concentration detected was 3.8 ug/L, well below the recommended limit of 20 ug/L. Data to date for the Schuylkill River indicates that concentrations are greatest during the summer periods when recreational boating is at its peak in the river. Recreational boat engines and in particular, jet skis or Wave Runners have been observed by studies in California to represent the most significant source of MTBE. Boat engines and jet skis can release uncombusted gasoline directly into the water.

Table 3.1.5-15 Regulatory VOCs Tested for in PWD's Drinking Water

Contaminant Name	MCL	MDL
Benzene	0.005	0.0005
Carbon Tetrachloride	0.005	0.0005
1, 2-Dichloroethane	0.005	0.0005
o-Dichlorobenzene	0.6	0.0005
p-Dichlorobenzene	0.075	0.0005
1, 1-Dichloroethene	0.007	0.0005
cis-1, 2-Dichloroethene	0.07	0.0005
trans-1, 2-Dichloroethene	0.1	0.0005
Dichloromethane	0.005	0.0005
1, 2-Dichloropropane	0.005	0.0005
Ethylbenzene	0.7	0.0005

Contaminant Name	MCL	MDL
Monochlorobenzene	0.1	0.0005
Styrene	0.1	0.0005
Tetrachloroethene	0.005	0.0005
Toluene	1	0.0005
1,2,4-Trichlorobenzene	0.07	0.0005
1, 1, 1-Trichloroethane	0.2	0.0005
1, 1, 2-Trichloroethane	0.005	0.0005
Trichloroethene	0.005	0.0005
m,p-Xylenes	10	0.0005
o-Xylene	10	0.0005

Results in mg/L

MCL = Maximum Contaminant Level

MDL = Method Detection Limit

Note: These chemicals were not detected in the finished water

Radionuclides

Radioactivity is not typically a major health concern in surface waters based on actual concentrations and frequency of detections. Nevertheless, surface waters may be susceptible to radioactive contaminants from nuclear industrial accidents. Increased use of radioisotopes in the health industry may also be a potential source of pollution. Some radionuclides are naturally occurring due to soil and rock decomposition. Naturally occurring radionuclides are found at much higher concentrations in groundwater, than in surface water. The major concern with radionuclides is that they cannot be removed by known chemical or physical treatment and are generally very persistent in the environment. Natural decay can be an extremely slow process.

Radioactivity in water may be caused by four general categories of radiation: alpha and beta particles, gamma rays and neutrons. Chronic effects of radiation are still not well identified, so pending further research, health authorities have followed a basic tenet of keeping exposure to the lowest level. Maximum contaminant levels (MCLs) of gross alpha particles, gross beta particles and combined radium isotopes (226 + 228) are 5 pCi/L, 4 mrem/yr, and 5 pCi/L, respectively. Strontium-90 is another isotope of particular concern due to its toxicity and persistence.

Radionuclide data was available from a report prepared by Exelon Nuclear for locations downstream of the Limerick Generating Station (LGS) 10 to 20 miles upstream of the Norristown plant. Exelon prepares annual Radiological Environmental Operating Reports in accordance with LGS Technical Specifications. The reports summarize the Radiological Environmental Monitoring Program (REMP). The report provides the data needed to evaluate whether the LGS is impacting downstream drinking water quality.

Sampling for the 2000 REMP spanned January 1 through December 31, 2000. Data for surface water and drinking water samples were examined for potential impacts at the

PWD Intakes. The LGS has a permitted storage facility for contaminated soils, sediments and sludges from onsite treatment. In order to assess whether any radionuclide transport is evident, surface water samples are taken at Vincent Dam, 1.75 miles southeast of the storage site. Samples are also taken from control locations that should not be affected by transport from the storage site. The results from 2000 surface water sampling are found below in Table 3.1.5-16.

Table 3.1.5-16 Radionuclide Summary – Surface Water Stations near Limerick Generating Station ^[1]

Analyte (pCi/L)	Lower Limit of Detection (LLD) ^[4]	# of Analyses	Indicator Locations ^[2]		Control Locations ^[3]		MCL	Location w/ Highest Annual Mean
			Range	Mean	Range	Mean		
Tritium	2000	11	52 to 157	108	-6 - 157	80	20,000	Vincent Dam (Indicator)
Gamma Spec		31						Perkiomen PS (Control)
Mn-54	15		-1.3 to 2.5	0.2	-1.2 to 2.9	0.6		
Co-58	15		-2 to 1.9	0.1	-2.7 to 3.5	0.5		
Co-60	15		-1.3 to 2.2	0.3	-0.8 to 3	0.7		
Fe-59	30		-0.1 to 5.6	1.9	-3 to 7.3	1.8		
Zn-65	30		-8 to 5.7	-1.6	-7 to 8.2	-0.3		
Zr-95	30		-3 to 5.3	1.0	-3 to 6.8	1.3		
Nb-95	15		-1.6 to 2.5	0.6	-0.7 to 3.4	1.3		
Cs-134	15		-7 to 2.4	-2.5	-11 to 4.8	-2.2		
Cs-137	18		-1.5 to 3.4	0.3	-2 to 3.3	0.8		
Ba-140	60		-3 to 27	4.5	-4 to 18	4.0		
La-140	15		-1.9 to 7.8	1.0	-1 to 4.2	1.4		

Notes:

[1] Data is from Appendix A of LGS 2000 Annual Radiological Environmental Operating Report.

[2] Indicator Location is Vincent Dam - 1.75 miles SE of storage site

[3] Control Locations are Perkiomen Pumping Station - 7.3 miles E & the Limerick Intake - 0.2 miles SW of storage site.

[4] LLD is defined as the smallest concentration of radioactive material that would yield a net count with only a 5% possibility of falsely concluding a blank observation

Results may be shown as negative values because background activity is subtracted from the sample activity. Very small changes in radioactivities were measured. Consequently, higher background levels were often reported as compared to the levels reported from the measured samples. Overall, surface water sampling clearly indicates no radionuclide transport from the storage site at the LGS. Tritium levels were slightly higher on average at the indicator location compared to the controls. However, levels were well below the Lower Limit of Detection and the MCL. Gamma Spec samples were all measured higher at the control location, than at the indicator site. The REMP report also states that levels of radiological activity in surface water samples were less than baseline levels before LGS became operational.

In addition to the surface water locations, the REMP obtains samples at nearby drinking water intakes. The intake sampling locations on the Schuylkill River include Philadelphia Suburban Water Company, Phoenixville Water Works, Citizen's Utility, and the Pottstown Water Authority. Pottstown, at river mile 53, is upstream of LGS and is a control location for the drinking water sampling program. Citizen's Utility, two and

one-half miles downstream, is the closest water intake to LGS. Table 3.1.5-17 summarizes the radiological sampling at the drinking water stations of the REMF.

Table 3.1.5-17 Radionuclide Summary – Drinking Water Locations near Limerick Generating Station⁽¹⁾

Analyte (pCi/L)	Lower Limit of Detection (LLD) ^[4]	# of Analyses	Indicator Locations ^[2]		Control Locations ^[3]		MCL	Location w/ Highest Annual Mean
			Range	Mean	Range	Mean		
Gross Beta Soluble	4	48	1.4 to 4.6	3.1	1.0 to 5.6	3.0	50	PSWC (Indicator)
Gross Beta Insoluble	4	48	-1.7 to 1.9	0.3	-1 to 1.8	0.3		PSWC (Indicator)
Tritium	2000	16	17 to 157	90	-2.5 to 152	63	20,000	PSWC (Indicator)
Gamma Spec		48						
Mn-54	15		-1.7 to 5.8	0.5	-0.7 to 4.1	0.9		Pottstown Water (Control)
Co-58	15		-1.8 to 3.5	0.4	-0.9 to 2.7	0.5		PSWC (Indicator)
Co-60	15		-1.9 to 2.9	0.6	-1 to 4.7	0.8		Pottstown Water (Control)
Fe-59	30		-1.6 to 11	1.6	-2.5 to 8.3	1.2		PSWC (Indicator)
Zn-65	30		-8 to 5.9	-1.3	-5 to 5.7	-0.6		Citizen's (Indicator)
Zr-95	30		-1.4 to 7.4	1.2	-1.0 to 7.3	1.3		PSWC (Indicator)
Nb-95	15		-1.7 to 6.4	0.8	-0.9 to 3.1	0.4		PSWC (Indicator)
Cs-134	15		-9 to 4.6	-2.5	-5 to 4.4	-1.4		Pottstown Water (Control)
Cs-137	18		-1.1 to 4.2	0.7	-2.5 to 3.8	0.5		Citizen's (Indicator)
Ba-140	60		-9 to 23	3.0	-4 to 11	2.7		PSWC (Indicator)
La-140	15		-1.1 to 4.4	0.8	-0.9 to 4.7	1.1		Pottstown Water (Control)

Notes:

[1] Data is from Appendix A of LGS 2000 Annual Radiological Environmental Operating Report.

[2] Indicator Locations are Citizen's Home Utility, PSWC - Sch. River Intake, & Phoenixville Water Works

[3] Control Location is Pottstown Water Authority - 5.84 miles WNW of LGS.

[4] LLD is defined as the smallest concentration of radioactive material that would yield a net count with only a 5% possibility of falsely concluding a blank observation

Similar to the surface water locations, tritium was the only radionuclide that was measured somewhat higher on average at the indicator locations than at the control. Tritium values were again well below the LLD and the MCL. Gross beta and gamma spec results were very low, with no significant differences between the indicators and control. Exelon concluded in the 2000 Annual Report that the LGS was having no adverse impact on the environment (Exelon, 2000). Drinking water quality at PWD's Schuylkill River Intakes does not appear to be affected by current operations at the Limerick Generating Station.

The presence of the Limerick Nuclear Generating Station requires monitoring for the presence of radionuclides in PWD's finished drinking water. As shown in Table 3.1.5-18, only Gross Beta radionuclides have been detected, at levels far below the regulated limits in the finished water from Schuylkill River sources. No other radionuclides have been detected.

Table 3.1.5-18 Radionuclides in PWD Drinking Water Effluents (1999)

Parameter	MCL	MDL	Effluent Concentration (pCi/L)
Gross Alpha	15 pCi/L	3 pCi/L	ND
Gross Beta	50 pCi/L ~ 4 mrem	4 pCi/L	4.79
Strontium-90	8 pCi/L	2 pCi/L	ND
Tritium	20,000 pCi/L	1000 pCi/L	ND

MCL = Maximum Contaminant Level – a regulatory limit by the USEPA or PADEP

MDL = Method Detection Limit – the level of a contaminant that can be detected by current testing methods

NA = Not Analyzed

ND = Not Detected (less than the MDL)

Algae and Taste and Odor Compounds

Blue green algae can have significant impacts on the taste and odor of the water and require costly treatment to remove its unpleasant impacts. Typically, the impacts of blue-green algae may be seen during the spring in April and May when water temperatures are colder; instances of blue-green algae may also occur in the fall and winter. Diatoms impact treatment operation by clogging filters and reducing filter run times. Diatom blooms usually occur during the summer months. Table 3.1.5-19 provides a summary of the monthly total algae and diatom concentrations in the Schuylkill River. Concentrations are mainly dictated by the availability of nutrients. As shown, diatoms make a significant portion of the total algae observed in the water supply during the summer months.

Table 3.1.5-19 Monthly Concentrations of Algae and Diatoms at the Queen Lane WTP Intake -1999

Month	Total Algae			Total Diatoms		
	Average	Minimum	Maximum	Average	Minimum	Maximum
July	51,683	700	268,600	51,650	700	268,600
August	3,225	900	9,000	3,225	900	9,000
September	567	200	1,300	567	200	1,300
April	4,100	3,400	5,100	3,967	3,400	4,800
May	2,775	1,400	3,900	2,775	1,400	3,900
June	6,920	900	29,400	6,860	900	29,200

3.1.5.2 Temporal Water Quality Analysis

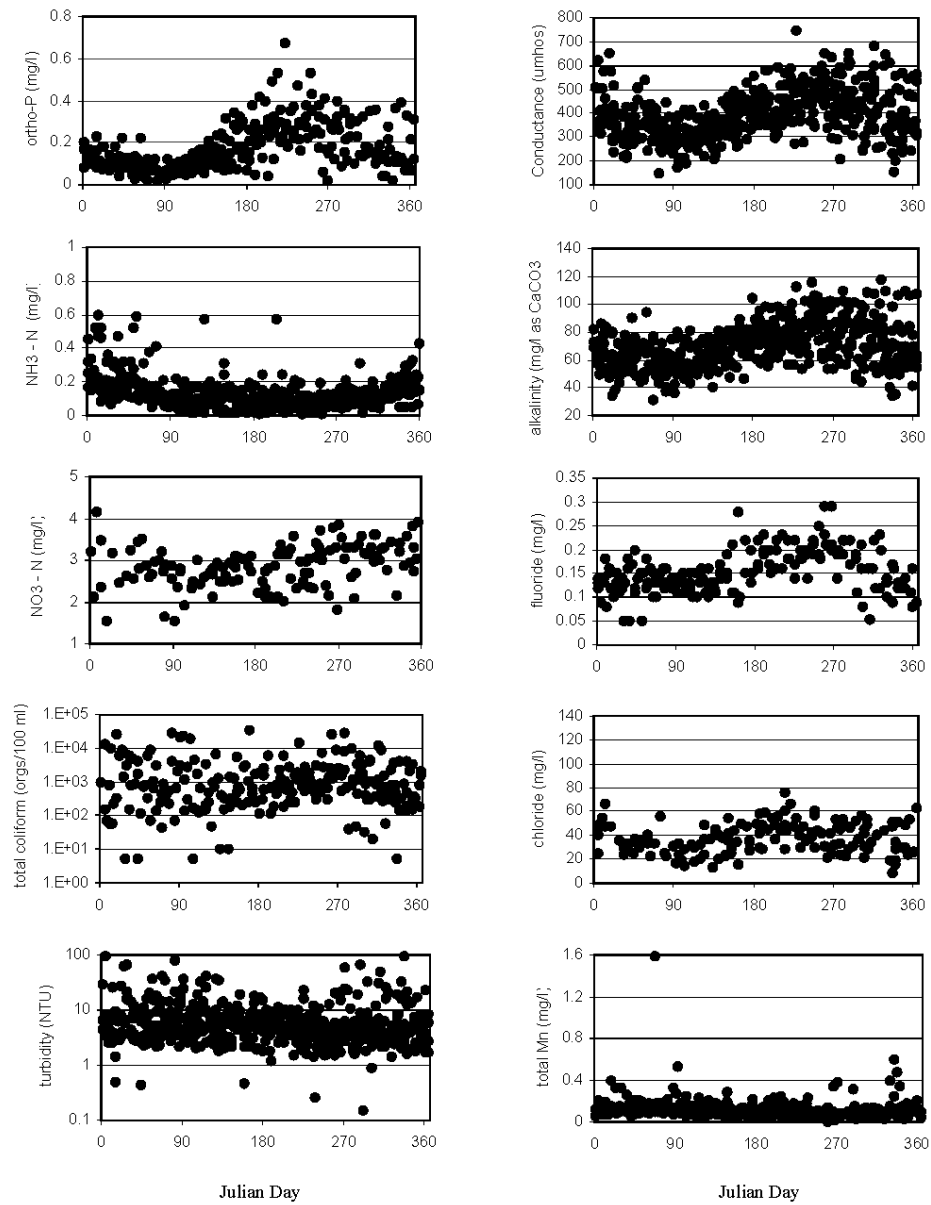
PWD operates two drinking water intakes on the Schuylkill River in Philadelphia. As the intakes are in close proximity, it was first assumed that watershed scale properties and recent temporal trends in the Schuylkill River Valley would similarly affect the source water quality at both intakes. With this in mind, an analysis of water quality data from both intakes was conducted. This analysis consisted of assessing variation in climate, flows and water quality over a variety of time scales. Weather patterns and river flow rates were studied over the period of record, typically on the order of the past century. General trends in water quality were assessed using data collected in the Schuylkill River at Philadelphia by the USGS and PWD over the period 1973-1999. Trends in precipitation chemistry and water quality data collected exclusively at the Queen Lane and Belmont Intakes were assessed for the past decade, with available data from 1990 through 1999.

Seasonal trends at the Queen Lane Intake were similar to those observed at Belmont just a short distance downstream (Figure 3.1.5-3). Dissolved orthophosphate was generally associated with flow conditions, with the lowest levels associated with high flows in the spring. Highest concentrations were observed in late summer along with annual low flows. Dissolved inorganic nitrogen, measured as ammonia and nitrate, was typically lowest in springtime, with ammonia exhibiting maximum concentrations in January when temperatures were lowest. Conductivity and alkalinity were generally a function of flows, and were highest in late summer and fall. Fluoride concentrations followed patterns similar to conductivity. Extreme elevated levels of fluoride in late summer may indicate the influence of residual dissolved solids from upstream wastewater treatment plants. Chloride levels exhibited an additional seasonal peak during the winter months, associated with road salt loading for winter storm deicing.

Long-term trends in water quality at Queen Lane were qualitatively similar to those observed at the Belmont Intake. Most measures of dissolved solids loading increased significantly through the decade. The rates of increase at Queen Lane were slightly higher than those found at Belmont, suggesting an additional source of solids loading to water drawn at Queen Lane. While ammonia levels have decreased, annual fluctuations still occur, with maximum levels exceeding 0.4 mg/l most winters. Increases in alkalinity levels, particularly during summer months, can potentially affect treatment processes at Queen Lane, by increasing the levels of acid addition needed for effective coagulation in solids removal operations.

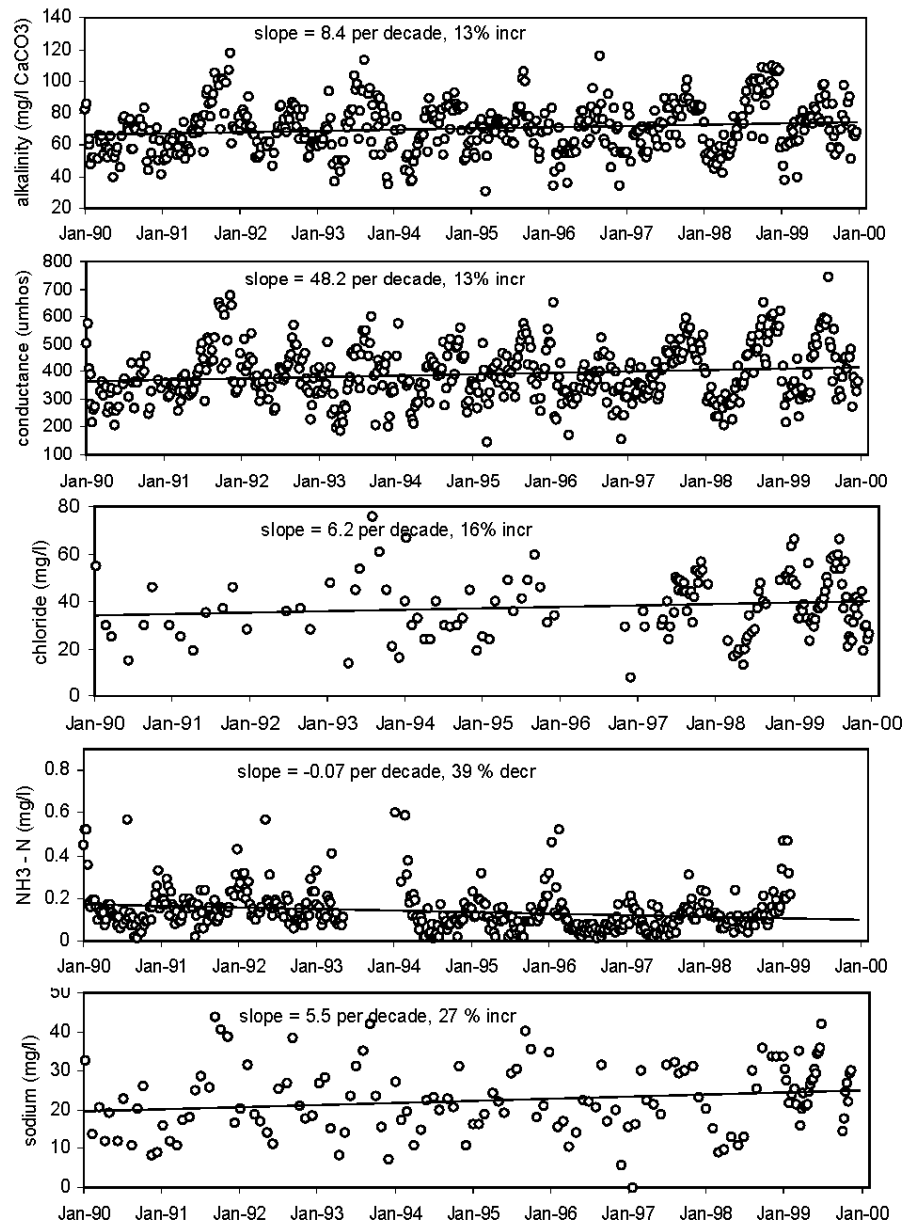
Unlike the Belmont Intake, the Queen Lane Intake appears to be heavily impacted by water quality in Wissahickon Creek, a tributary entering the Schuylkill River just upstream from Queen Lane. As a result, levels of many water quality parameters including ortho-P, nitrate and coliform bacteria are higher at Queen Lane than at Belmont, and other locations in the Schuylkill River between Flat Rock Dam and Fairmount Dam. Levels of manganese, however, were lower at Queen Lane than at Belmont, but the reason for this is undetermined.

Figure 3.1.5-3 Seasonal Patterns in Water Quality at Queen Lane Intake



The impact of Wissahickon Creek on water quality at Queen Lane has generally been driven by flow rates. When flows are high, a greater proportion of the water collected at Queen Lane originated from Wissahickon Creek. Based on simultaneous nitrate measurements made in the Schuylkill above Wissahickon Creek, and those made at the mouth of the creek and at Queen Lane, the Wissahickon Creek can contribute as little as 3% and as much as 87% of the water taken into the Queen Lane plant (Interlandi and Johnson Report in Progress). Water quality in Wissahickon Creek over the long term has varied in similar fashion to water quality in the Schuylkill River. Nutrient levels including total phosphorus and ammonia have decreased since 1970, while levels of nitrate, conductivity and alkalinity steadily increased with increasing levels of development upstream (Figure 3.1.5-4). Nitrate levels appear to have leveled off over the 1990s, and have not exceeded the MCL of ten mg/l in any samples collected since 1988. As a receiving stream for several municipal wastewater discharges, the Wissahickon also has elevated coliform levels, particular during storm flows. As a result, water collected at Queen Lane has higher measured bacterial levels than those found at PWD's Belmont Intake, or other areas in this reach of the Schuylkill River.

Figure 3.1.5-4 Decadal Trends in Water Quality at PWD's Queen Lane Intake



3.1.5.3 Spatial Water Quality Analysis

Spatial analysis of water quality along the Lower and Middle Schuylkill is completed for some of the parameters of interest. This enables a determination as to whether the order of magnitude of data at Queen Lane is consistent with other nearby intakes. Spatial analysis also shows whether temporal peaks and dips at Queen Lane are consistent with the other intakes. Agreement among the various locations helps to validate trends.

Turbidity

A box plot summary of turbidity data at five locations in the Lower and Middle Schuylkill River Watersheds is found in Figure 3.1.5-5. Turbidity data is readily available for the drinking water intakes, since it is the basis for a standard for finished water quality. Turbidity is a surrogate of suspended material. The statistics were based on data over the same time frame, January 1998 through July 2000. The Belmont Intake is the furthest downstream at river mile 10, with Queen Lane at mile 12, Pennsylvania American Water Company at mile 24, Philadelphia Suburban Water Company at mile 34, and Citizen's Home Water Utility at mile 41.

Figure 3.1.5-5 Summary of Turbidity Spatial Trends from Jan -98 – Aug-00

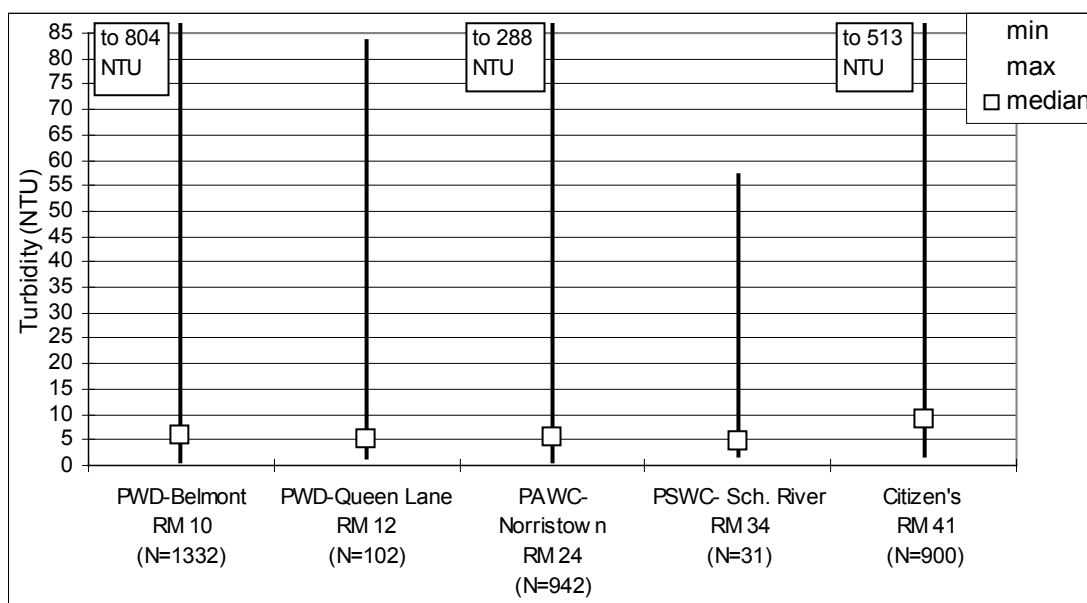
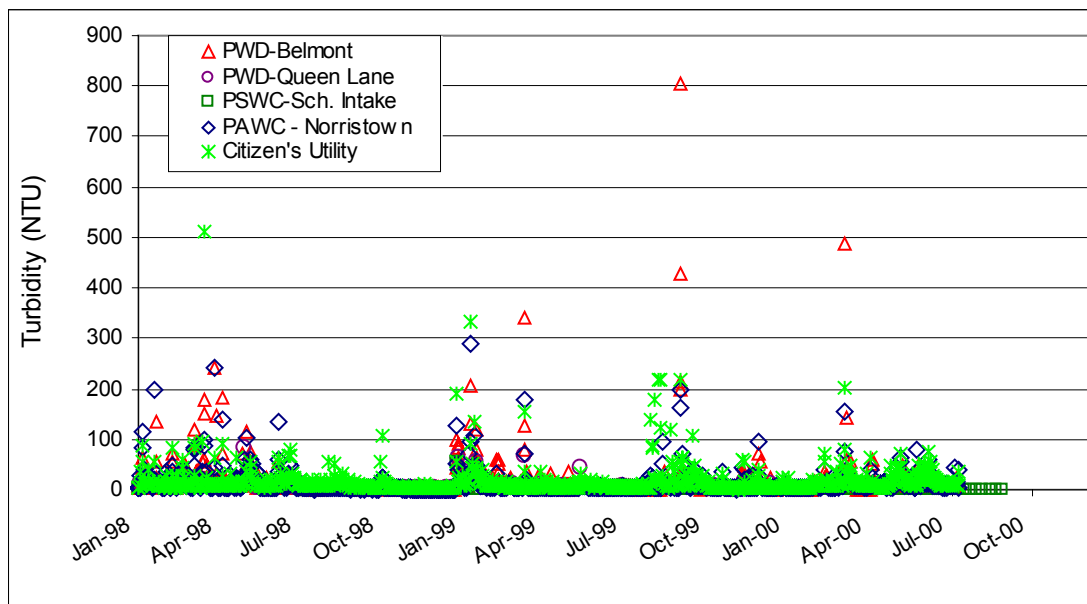


Figure 3.1.5-5 shows that median turbidity agrees well at the different locations and is about five NTU. The exception is the most upstream point of Citizen's Utility with a slightly higher median of ten NTU. A great deal of variability is evident in the maximum values compared to the minima and medians. This variability is tied to run-off of particulates during rain events. Differences in the magnitude of the maximum values with location are due to disparities in the amount and time of sampling. Some locations such as Belmont, with more data, captured a wider range of turbidity. The

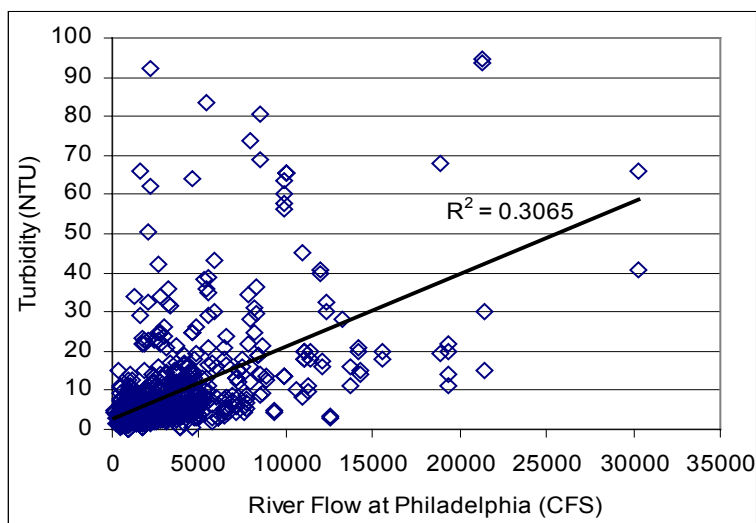
discrete turbidity data for these locations over the same time frame is found in Figure 3.1.5-6.

Figure 3.1.5-6 Spatial Turbidity Trends from Jan-98 through Jul-00



Data at the five locations in Figure 3.1.5-6 follow similar temporal trends. Times of peaks agree well. For example, Hurricane Floyd occurred in mid-September 1999, when peaks in excess of 100 NTU are clearly evident at three of the five locations. Locations that do not show the same peak are because sampling data were not as regular and the event was not captured. This supports that the peaks are run-off related because run-off and rain events generally affect the watershed regionally. A plot in Figure 3.1.5-7 of average daily-river flow and turbidity further substantiates the effect of run-off on increased turbidity levels in the river. Turbidity from Belmont and Queen Lane was combined and plotted as a function of flow for days when data for both parameters were available. An increasing linear trend is clear.

Figure 3.1.5-7 Turbidity/Flow Trends



Metals: Iron and Manganese

Figure 3.1.5-8 on the following page presents a box plot summary of total manganese and iron data at the same four to five locations in the Lower and Middle Schuylkill River Watersheds. Citizen's Utility did not analyze for total iron. The box plot for manganese shows that the median is fairly constant across all locations at about 0.08 mg/L. Median manganese shows a slight increase at the two most upstream locations. Variability at each location, as indicated by the maximum values compared to the minima and medians, may be attributed to rain events. Rain events can increase run-off from land or increase acid mine drainage from upstream Upper Schuylkill Watershed upstream locations. Differences in the magnitude of maximum values among the locations may be due to different sampling dates and times. Maximum manganese values of up to eight mg/L can significantly affect treatment and chemical costs at the water treatment plants.

The box plot for iron shows more variability of median values with location than manganese. Median iron is about 0.3 mg/L for the PWD locations, decreases to 0.1 mg/L at PAWC Norristown and increases to 0.2 mg/L at the PSWC Intake downstream of Phoenixville. Perhaps this is due to different sampling dates over the time frame, but it may also indicate that certain locations are more susceptible to other point or non-point sources of iron. Maximum values are also highest at the PWD Intakes. Iron, similar to manganese and turbidity, has a great deal of variability at each individual location. This may be attributed to sources related to rain events. Discrete iron and manganese data for the time frame of January 1998 to August, 2000 is presented in Figure 3.1.5-9 to further examine some of these trends.

Figure 3.1.5-9 demonstrates that temporal trends are generally consistent at the four to five locations. Similar to Figure 3.1.5-8, the plot shows that at each location, total manganese is typically less than 0.10 mg/L, but excursions occur. More variability is

seen in the iron data. Specifically, data at Belmont is quite scattered compared to PAWC at Norristown. These are the two locations with daily data. This is consistent with the difference in median values noted previously. Iron and manganese trend similarly with time and location, in terms of peaks and dips. Peaks are believed to be related to either increased particulate loads from run-off or increased acid mine drainage from the Upper Schuylkill during rain events. The relation of increased rain to maximum manganese and iron is evident from Figure 3.1.5-8, which shows trends between river flow and manganese and iron concentrations at Belmont and Queen Lane.

As seen in Figure 3.1.5-10, manganese trends well with average daily flow at Philadelphia, while more data scatter is evident in the iron graph. Both graphs show that as river flow increases (due to rain) metal concentrations increase. Rain may be increasing the load due to run-off from the land, particularly construction sites. Rain may also be increasing the load from upstream acid mine drainage locations.

Figure 3.1.5-8 Summary of Manganese and Iron Spatial Trends

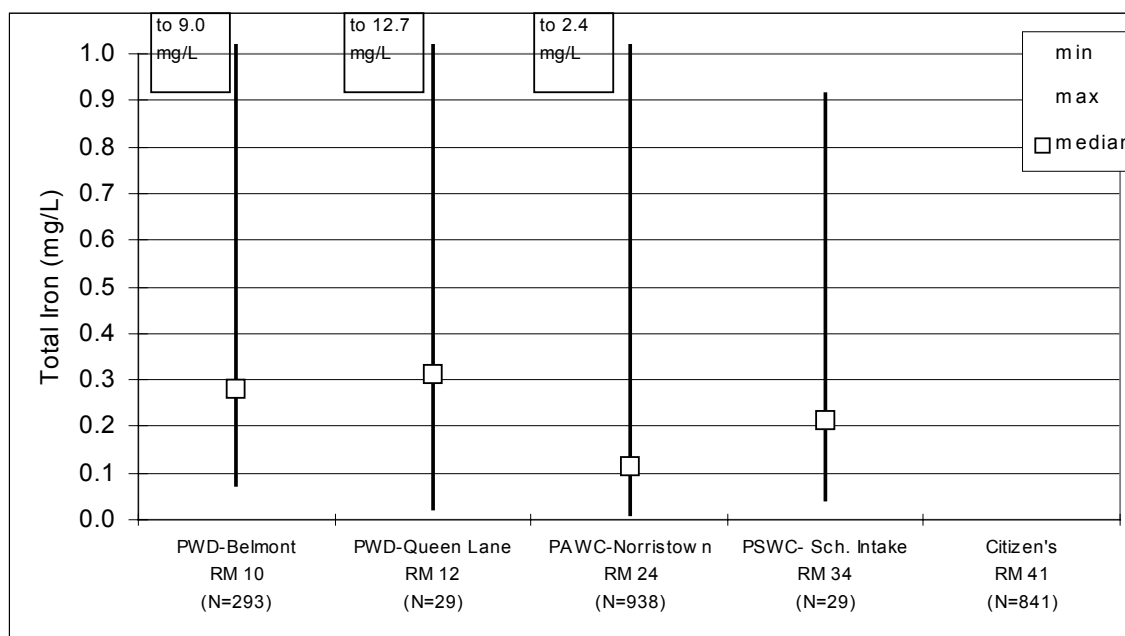
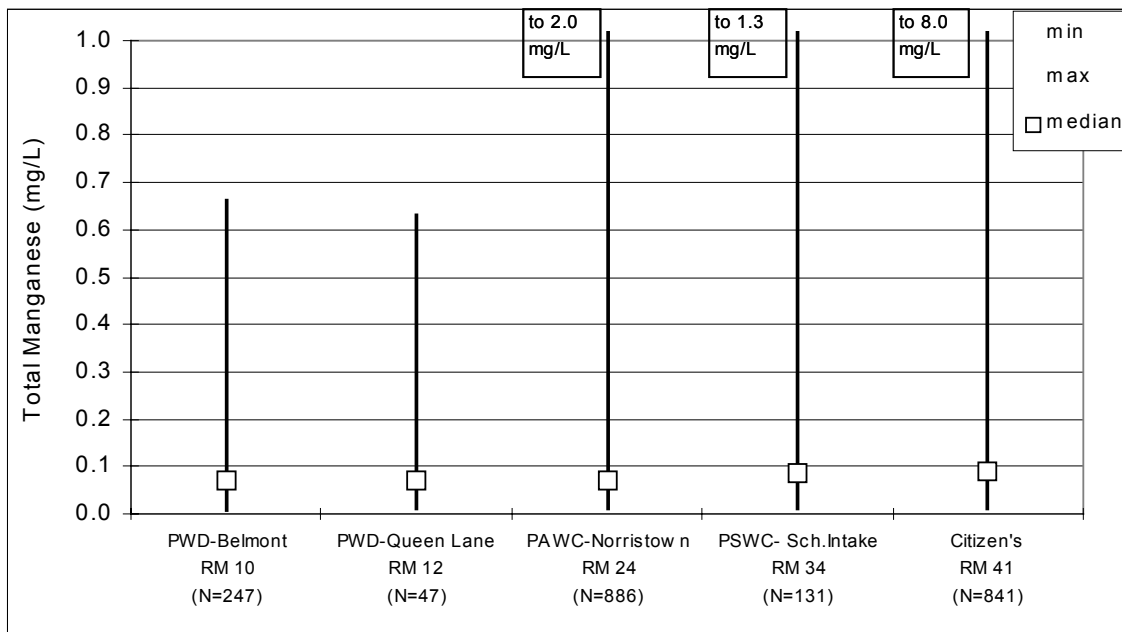


Figure 3.1.5-9 Spatial Trends in Manganese and Iron from Jan-98 through Jul-00

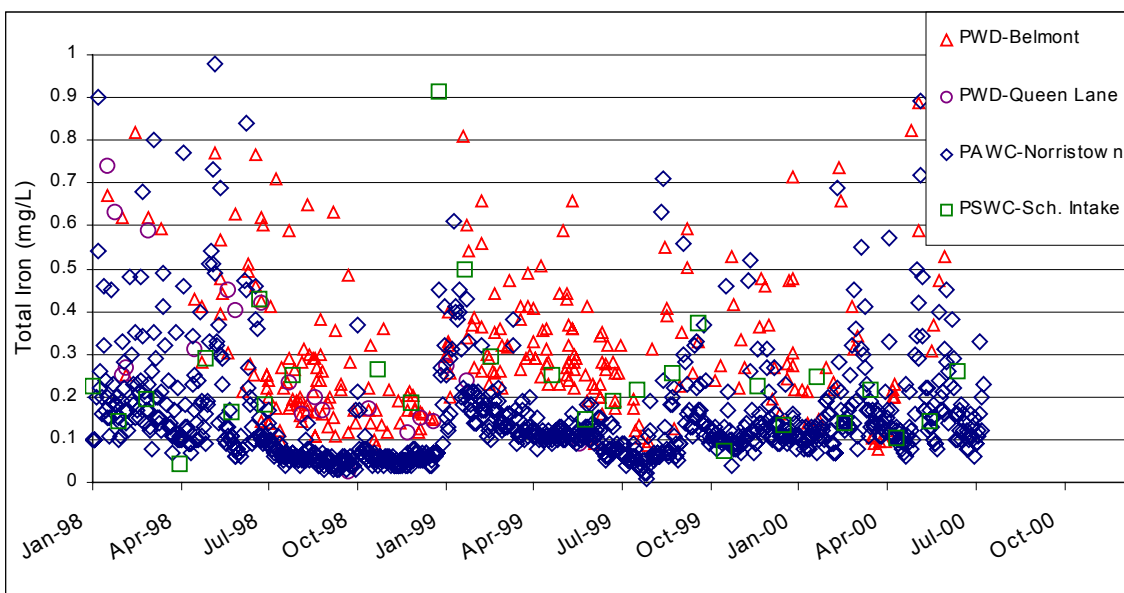
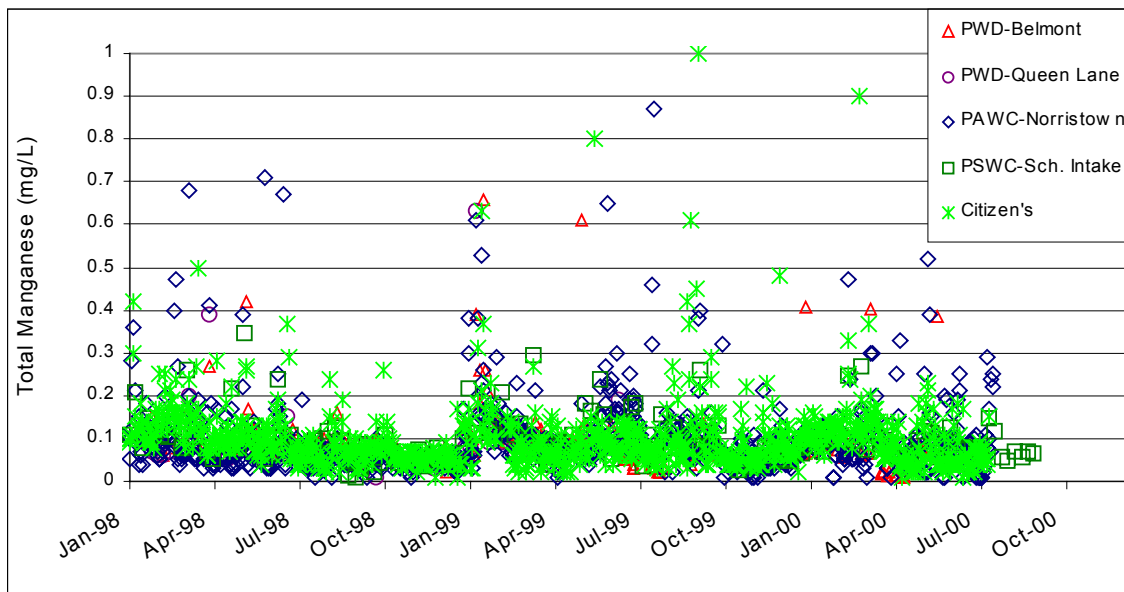
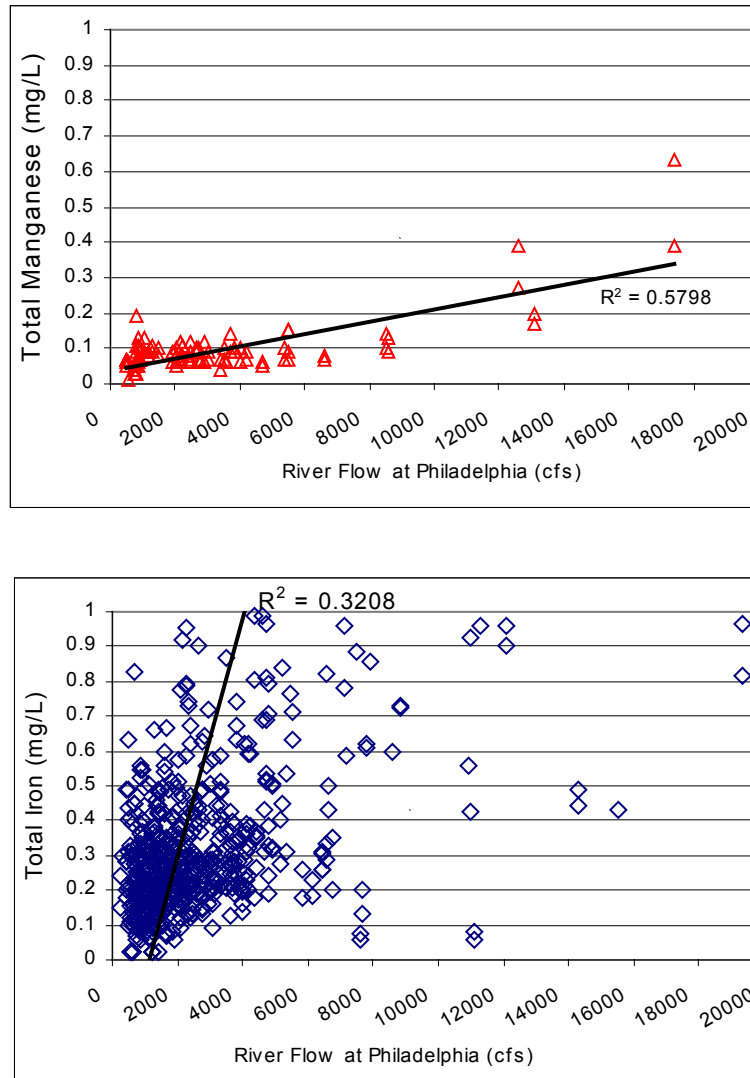


Figure 3.1.5-10 Correlation of Flow with Manganese and Iron from Jan-90 through Jul-99



Nutrients

Figure 3.1.5-11 on the following page presents a box plot summary of available nutrient data for the Lower and Middle Schuylkill River Watershed Intakes. PWD and PSWC had data for total ammonia, total nitrate, and dissolved orthophosphate over the time frame from January 1998 through July 2000. For all three parameters, Queen Lane Intake shows somewhat higher median values. Perhaps this is indicative of an influence

of the Wissahickon Creek at Queen Lane. Maximum values vary most significantly from median and minimum values.

The discrete data used in the summary is found in Figure 3.1.5-12. The discrete data also shows that Queen Lane consistently measures higher nutrient values. Temporal trends as discussed in section 3.1.5.2 are also evident.

Figure 3.1.5-11 Summary of Spatial Trends of Nutrients

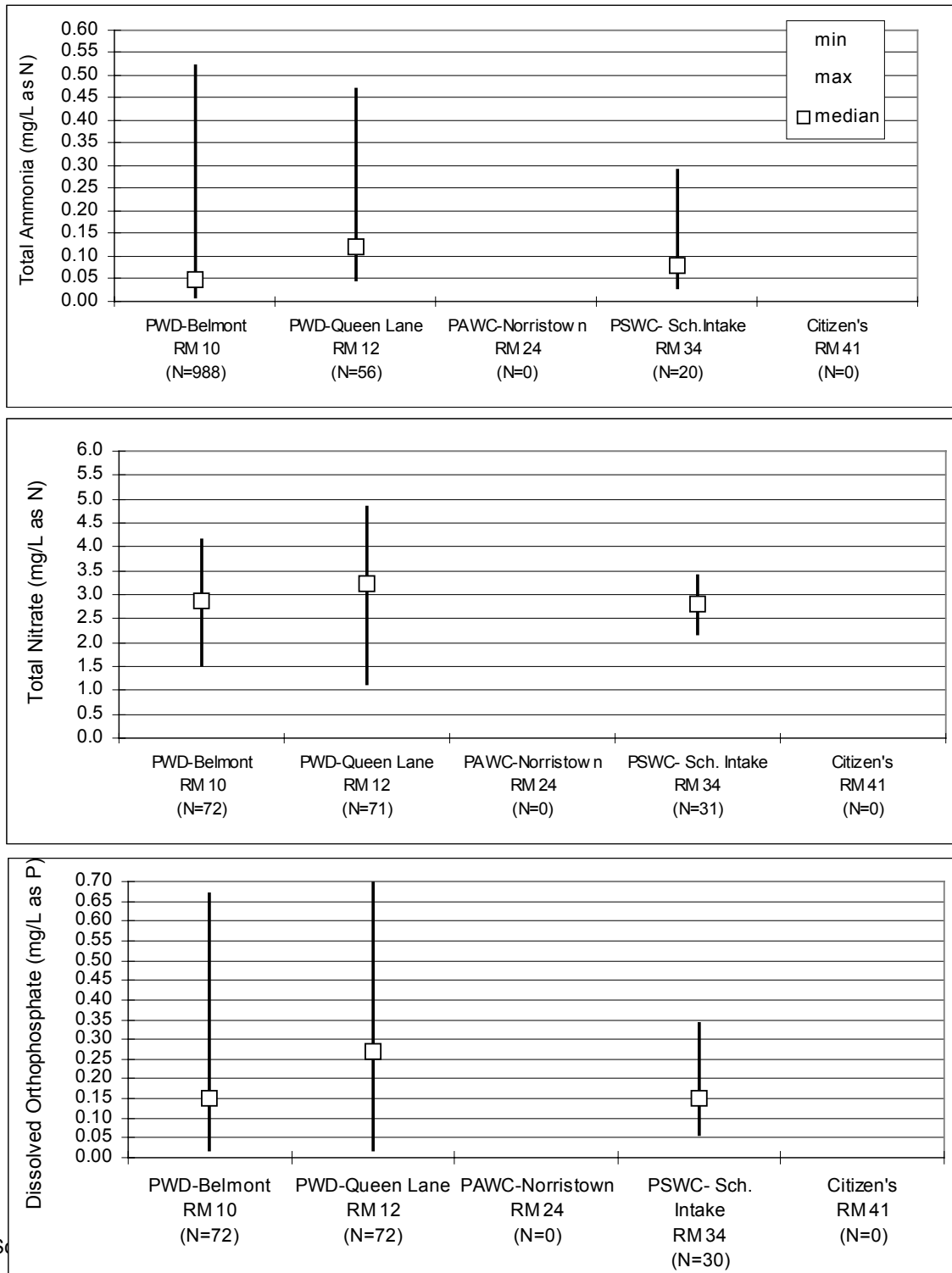
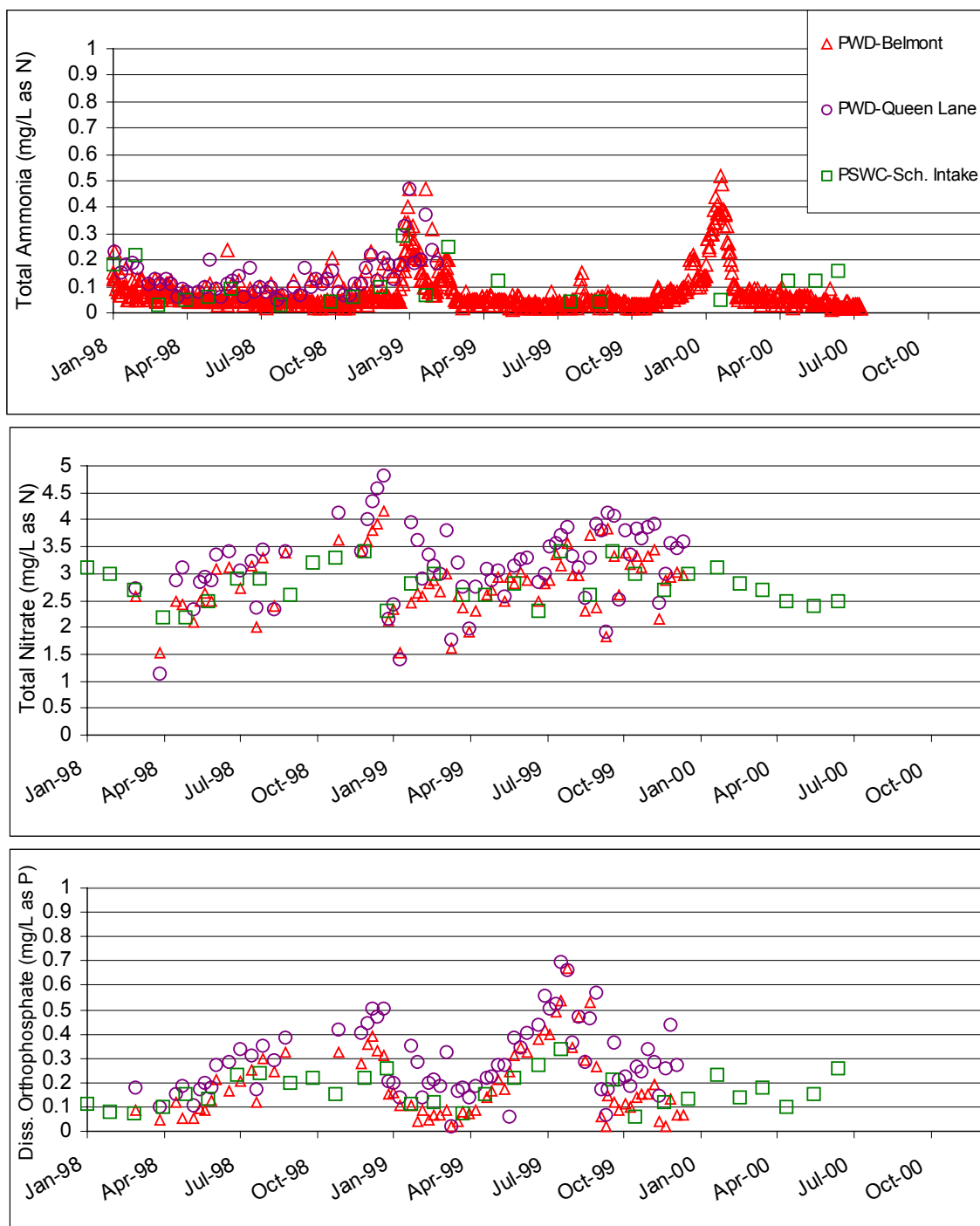
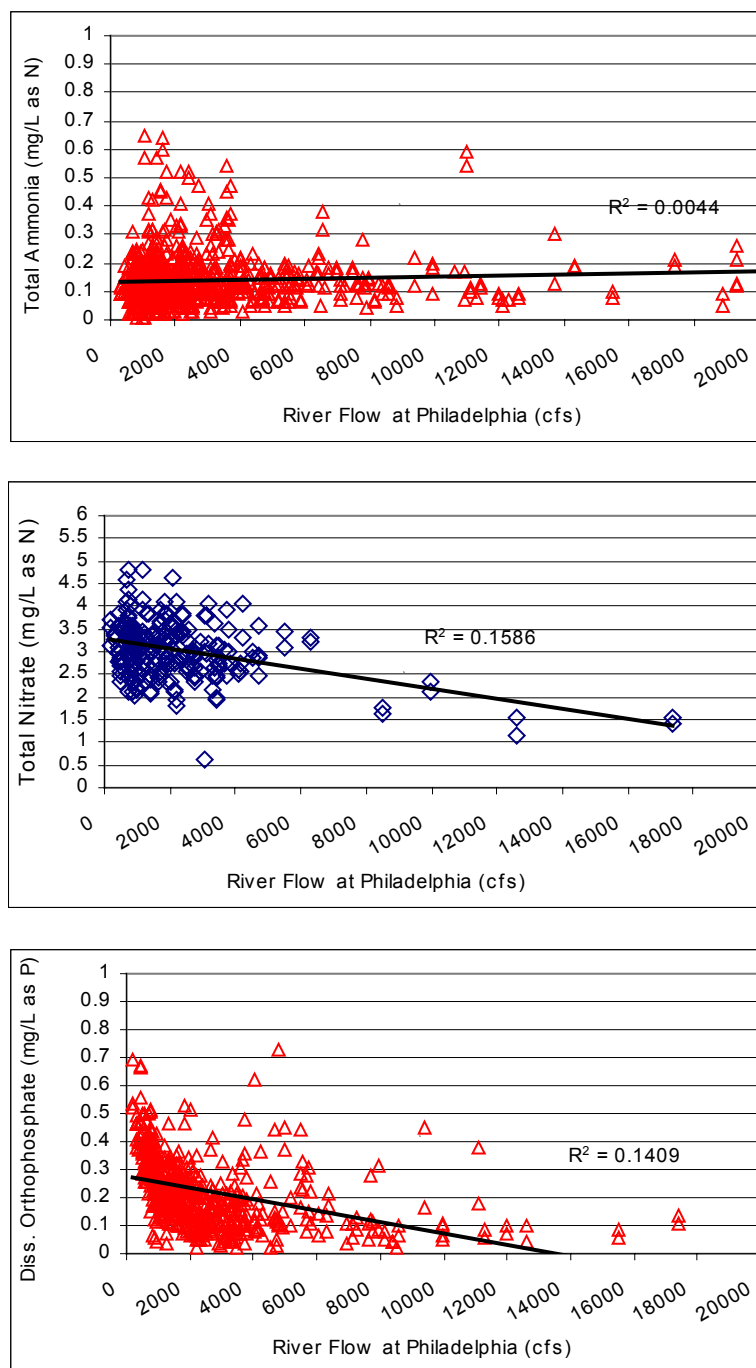


Figure 3.1.5-12 Spatial Trends of Nutrients from Jan-98 through Jul-00



Lastly, Figure 3.1.5-13 examines whether any of the available nutrients trend with river flow. Positive trends would indicate river concentrations of nutrients are runoff related. Ammonia levels in Figure 3.1.5-13 do not increase significantly with flow. Nitrate and dissolved orthophosphate levels decrease with flow, although the linear correlation is poor. This suggests that these nutrients are not greatly influenced by rain and runoff. This is probably because the nutrients analyzed are dissolved in form and not affected by particulate runoff loads.

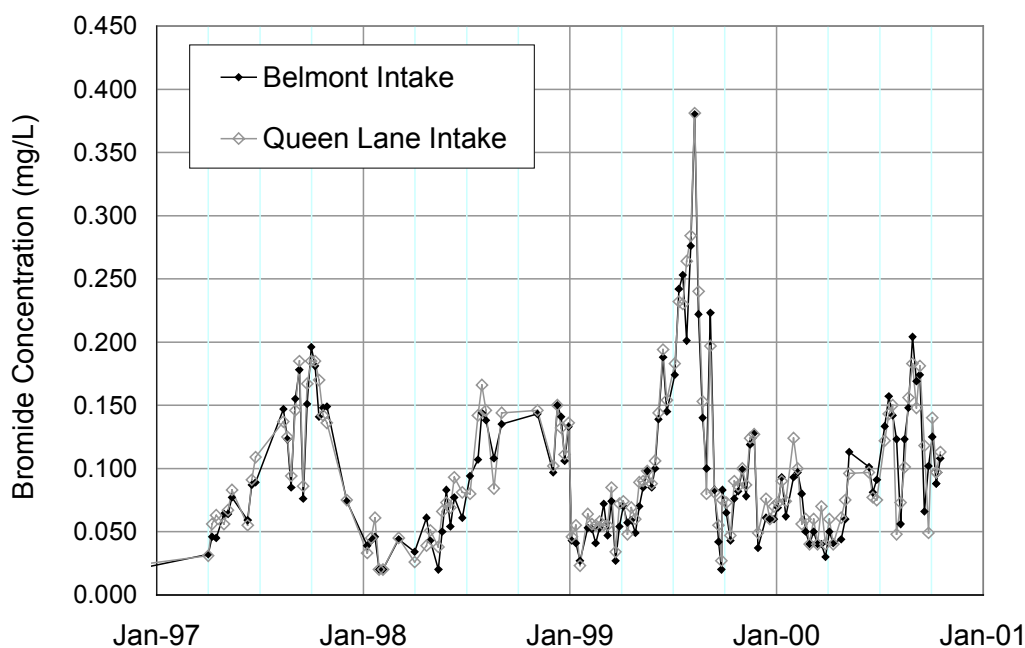
Figure 3.1.5-13 Flow/Nutrient Trends from Jan-90 through Jul-99



Bromide Spatial/Temporal Analysis

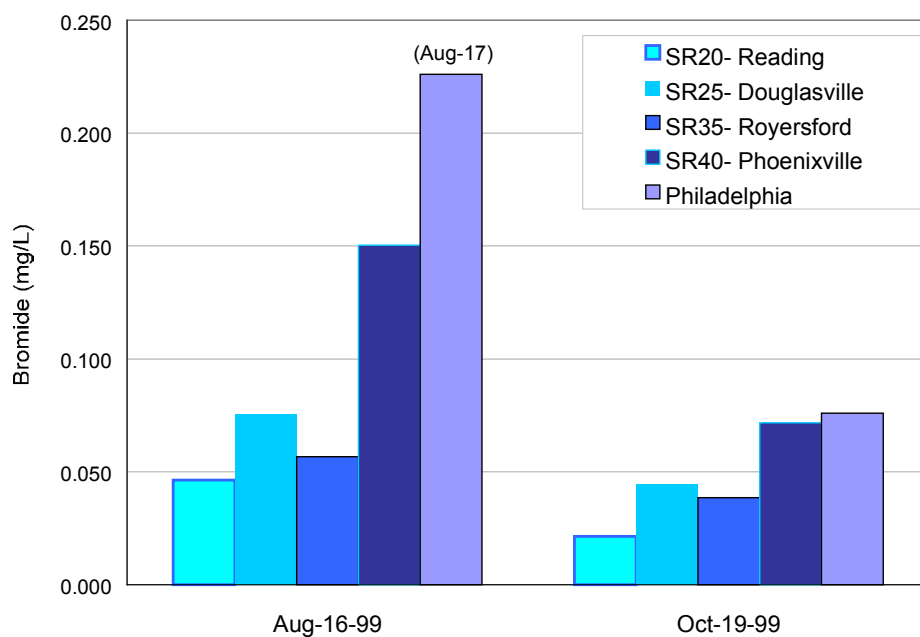
Special studies have been undertaken by the Philadelphia Water Department to understand more about the nature and presence of bromide in the water supply. Bromide is a concern for water treatment because under certain conditions and levels it can react with the chemicals used for disinfection such as chlorine or ozone to create disinfection by-products (DBPs). Exposure to specific DBPs over a lifetime could create chances for chronic illnesses such as cancer. Therefore, identifying and understanding the sources of these chemicals that can create potential DBPs is important. As shown in Figure 3.1.5-14, bromide is typically at its highest levels during periods of low-river flow. This association suggests that the sources of bromide are typically point sources (discharges) or from groundwater that feeds the river during low-flow periods. Further efforts to identify the dominant sources of bromide are underway. Samples collected along the main stem of the Schuylkill River to date suggest that bromide levels almost double between Royersford and Phoenixville, as shown by Figure 3.1.5-15. Whether this is caused by geochemical reactions in soils with groundwater in the area or if it is from point source discharges is still being determined. Bromide sampling locations along the river are illustrated by Figure 3.1.5-16.

Figure 3.1.5-14 Historical Bromide Levels at PWD's Intakes.



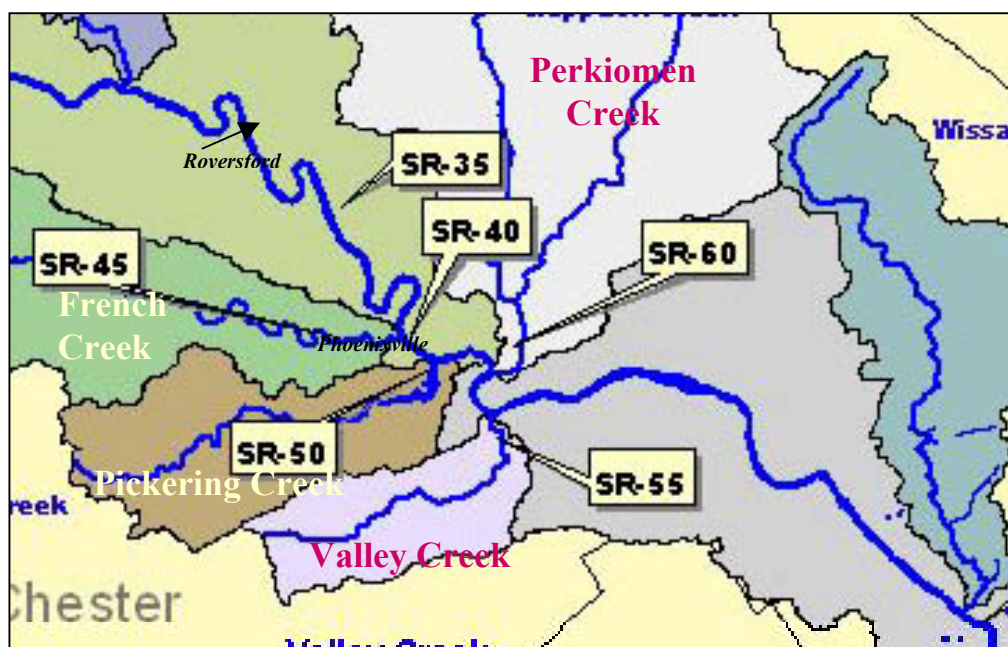
Notice the highest levels are associated with periods of low flow suggesting a groundwater or point source influence.

Figure 3.1.5-15 Spatial Comparison of Bromide Levels in the Schuylkill River



Notice that levels typically double downstream of Phoenixville. (Source: Obolensky, 2000)

Figure 3.1.5-16 Lower Schuylkill River Bromide Monitoring Locations (Obolensky, 2000)



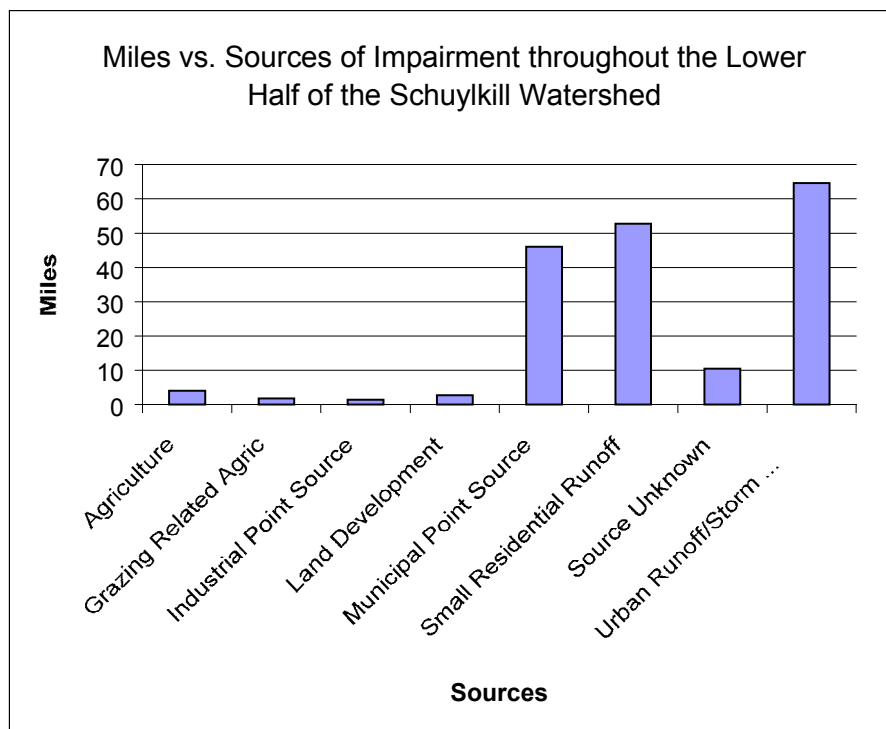
3.1.5.4 Analysis of Stream Impairments and Sources

In accordance with Section 305(b) of the Federal Clean Water Act, the Pennsylvania Department of Environmental Protection (PADEP) prepared a 305(b) Water Quality Assessment Report in 2000. The Report summarizes water quality management programs, water quality standards and point and non-point source controls. The lower half of the Schuylkill River Watershed includes 809 miles of streams and creeks. Almost 70% (553.74 miles) of these stream miles have been assessed to determine compliance with water quality standards. Applicable water quality standards were attained in two-thirds of the stream miles that were assessed (369.94 miles). Streams that were impacted by contaminant sources so much so (point sources, or non-point sources such as storm water runoff or acid mine drainage) that water quality standards are not met are designated as impaired. One-third of the stream miles that have been assessed (183.8 miles) do not meet applicable water quality standards, and are designated as impaired. To date, 255.27 miles, or 31.55% of the stream miles have not been assessed.

Figure 3.1.5-17 displays sources of impairment throughout the lower half of the Schuylkill River Watershed. Stormwater runoff from urban and residential areas and municipal point sources were responsible for the majority of the stream impairments identified in the Lower Schuylkill River Watershed.

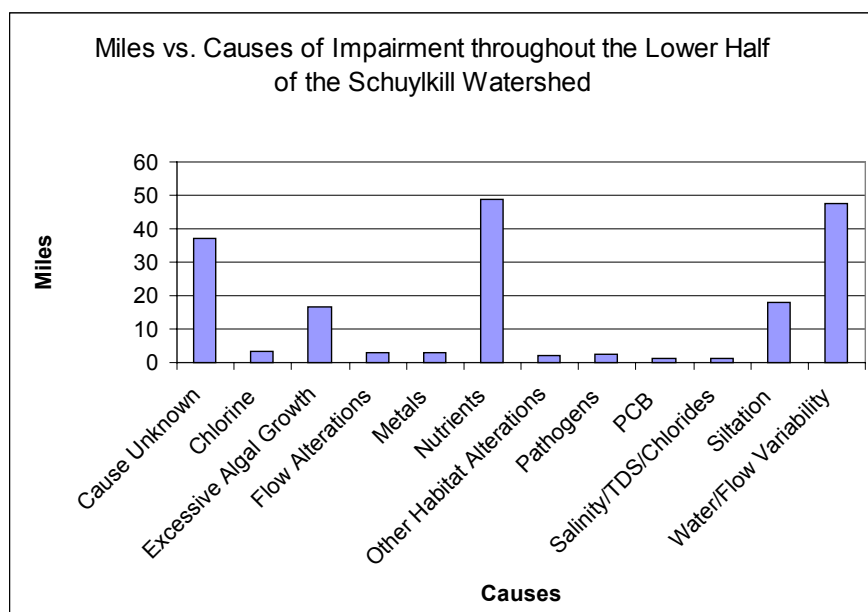
Figure 3.1.5-18 displays the causes of stream impairments throughout the lower half of the Schuylkill River Watershed. The leading causes of impairment are nutrients and water/flow variability. Table 3.1.5-20 summarizes the number of miles impacted by each of the listed sources for each of the subwatersheds within the lower half of the Schuylkill River Watershed. Sources causing impairments vary by watershed. For example, the primary sources of impairment in the Wissahickon Creek are urban runoff/stormwater and municipal point sources. However, the Middle Schuylkill (Two) and Valley Creek have significant portions that are impaired by agricultural related sources. Regardless of the individual characteristics, runoff related sources still play as much, if not more, of a significant role in stream impairments than point sources do.

Figure 3.1.5-17 Summary of Miles Impaired by Primary Sources



(Source: PADEP)

Figure 3.1.5-18 Summary of Miles of Impairment by Primary Causes



(Source: PADEP)

Table 3.1.5-20 Miles of Impairment by Primary Source and Watershed

Watershed	Middle Schuylkill (1)	Middle Schuylkill (2)	Wissahickon	Valley	Pickering	Perkiomen
Agriculture	0	2.58	0	0	0	1.45
Grazing Related Agriculture	0.42	0	0	1.4	0	0
Industrial Point Source	0	0	0	1.41	0	0
Land Development	0	0	0	0	0	2.7
Municipal Point Source	0.5	0	27.99	0	0	17.55
Small Residential Runoff	27.16	2.85	0	0	0	23.63
Urban Runoff/ Stormwater	6.95	0	47.86	3.97	1.82	4
Source Unknown	2.98	0	6.14	0	0	1.36

Note: miles of stream impaired by a given source.

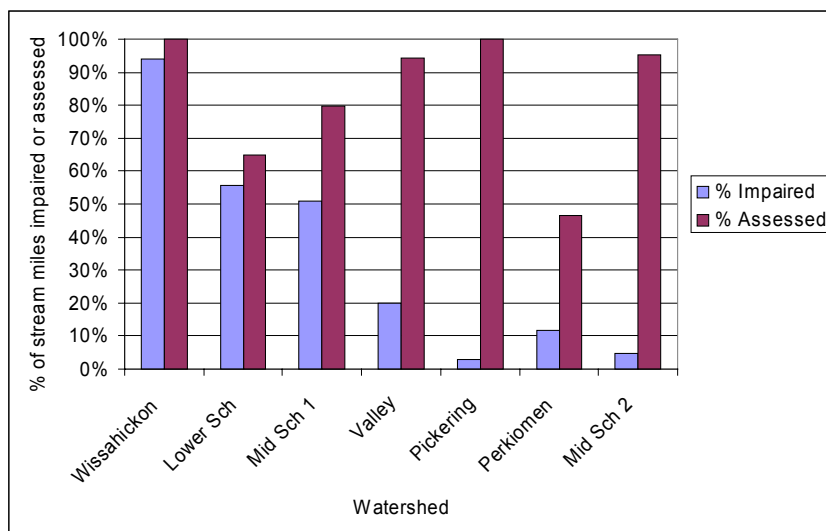
Additionally, Table 3.1.5-21 breaks down the number of miles impacted by each of the listed causes for each of the watersheds within the lower half of the Schuylkill River Watershed. Table 3.1.5-21 shows that each of the six watersheds is impacted by different contaminants. For example, the Wissahickon and Perkiomen Creeks have significant portions impaired by water and flow variability. However, the Valley and Pickering Creeks are primarily impaired by nutrients or unknown causes. Overall the Pickering Creek had the least impaired stream miles (3%), while the Wissahickon Creek had the greatest amount of impaired stream miles (94%) (see Figures 3.1.5-19 and 3.1.5-20).

Table 3.1.5-21 Breakdown of Miles of Impairment by Primary Cause and Watershed

Watershed	Middle Schuylkill (1)	Middle Schuylkill (2)	Wissahickon	Valley	Pickering	Perkiomen
Chlorine	0	0	3.51	0	0	0
Excessive Algal Growth	0	0	0	0	0	16.38
Flow Alterations	0	2.85	0	0	0	0
Metals	2.98	0	0	0	0	0
Nutrients	0.42	0	33.33	5.37	0	9.66
Other Habitat Alterations	0	0	2.29	0	0	0
Pathogens	0	2.58	0	0	0	0
PCB	0	0	0	1.41	0	0
Salinity/TDS/Chlorides	0	0	0	0	0	1.14
Siltation	0.65	0	10.46	0	0	6.48
Water/Flow Variability	8.36	0	23.01	0	0	13.79
Cause Unknown	24.68	0	6.14	0	1.82	0

(Source: PADEP)

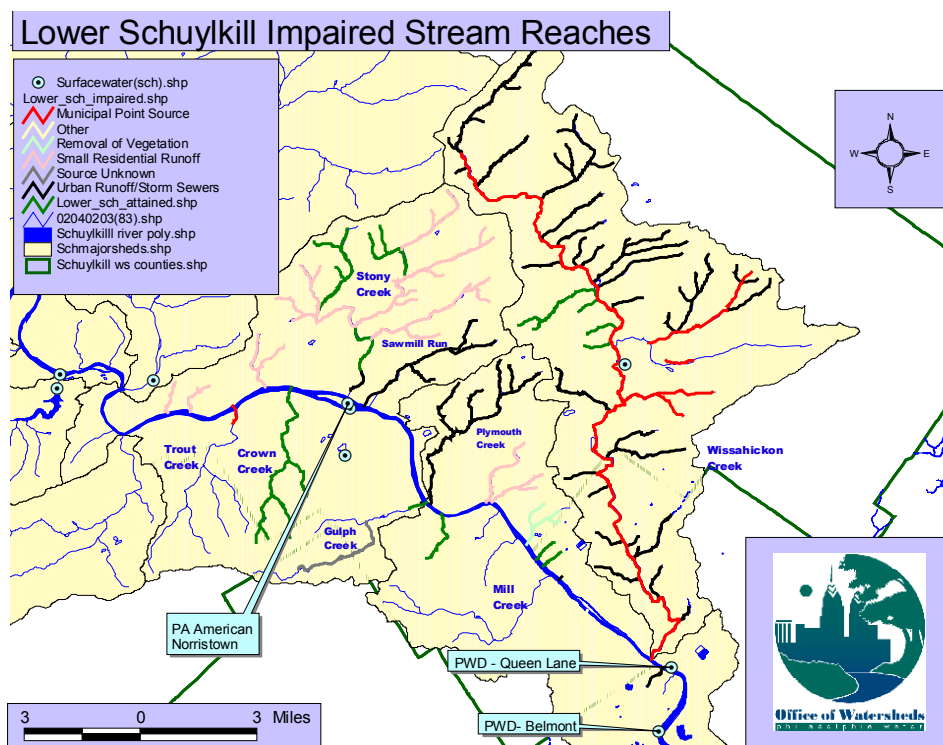
Figure 3.1.5-19 Percentage of Watershed Miles Impaired and Assessed in the Lower Schuylkill River Basin



(Source: PADEP)

Figure 3.1.5-20 Impaired Stream Reaches in the Lower Schuylkill River Basin

Red lines indicated municipal point sources, black lines indicate urban runoff, and pink lines indicate small residential runoff as a primary source of impairment. Green lines indicate stream reaches that have attained their designated use and are not impaired. Light blue lines indicate areas impaired by removal of vegetation.



3.2 Source Water Assessment

3.2.1 Delineation of Source Water Assessment Zones

Key Points

- **Zone A**, the area within a five-hour time of travel of the Philadelphia Water Department's Queen Lane Intake, includes 73.7 square miles of the Schuylkill River Watershed.
- **Zone B**, the area between the 5-hour and the 25-hour time of travel of the Queen Lane Intake, includes 1,271 square miles of the watershed.
- **Zone C**, the area beyond the 25-hour time of travel incorporates the remainder of the 1,900 square-mile Schuylkill River Watershed.

The Queen Lane water supply intake receives water from a drainage area greater than 1,900 square miles. Identification of all potential contaminant sources within such a large area requires a systematic approach to examine the area in such a way as to identify all pertinent sources. This approach defined by the PADEP's SWAP Plan involves a segmentation approach that divides the watershed into zones based on the proximity of a potential contaminant source to a water supply intake. This method assumes that proximity is directly linked to a potential source's impact on a water supply in most cases. Using this logic, the PADEP's SWAP Plan divided the source water assessment area for a given intake into the following three zones and prioritized all contaminant source identification accordingly:

Zone A - This is the critical area of highest potential impact on the water supply, since proximity to the water supply intake results in reduced response times and potential lower dilution and attenuation of a contaminant. Any potentially significant source within a five-hour time of travel of the water supply, including one-quarter mile downstream and within a one-quarter mile-wide area on either side of the river/stream from the water supply, should be included in the contaminant inventory. These may include large and small discharges, catastrophic event related sources (broken oil pipelines and chemical storage tanks), large runoff sources, or special contaminant sources.

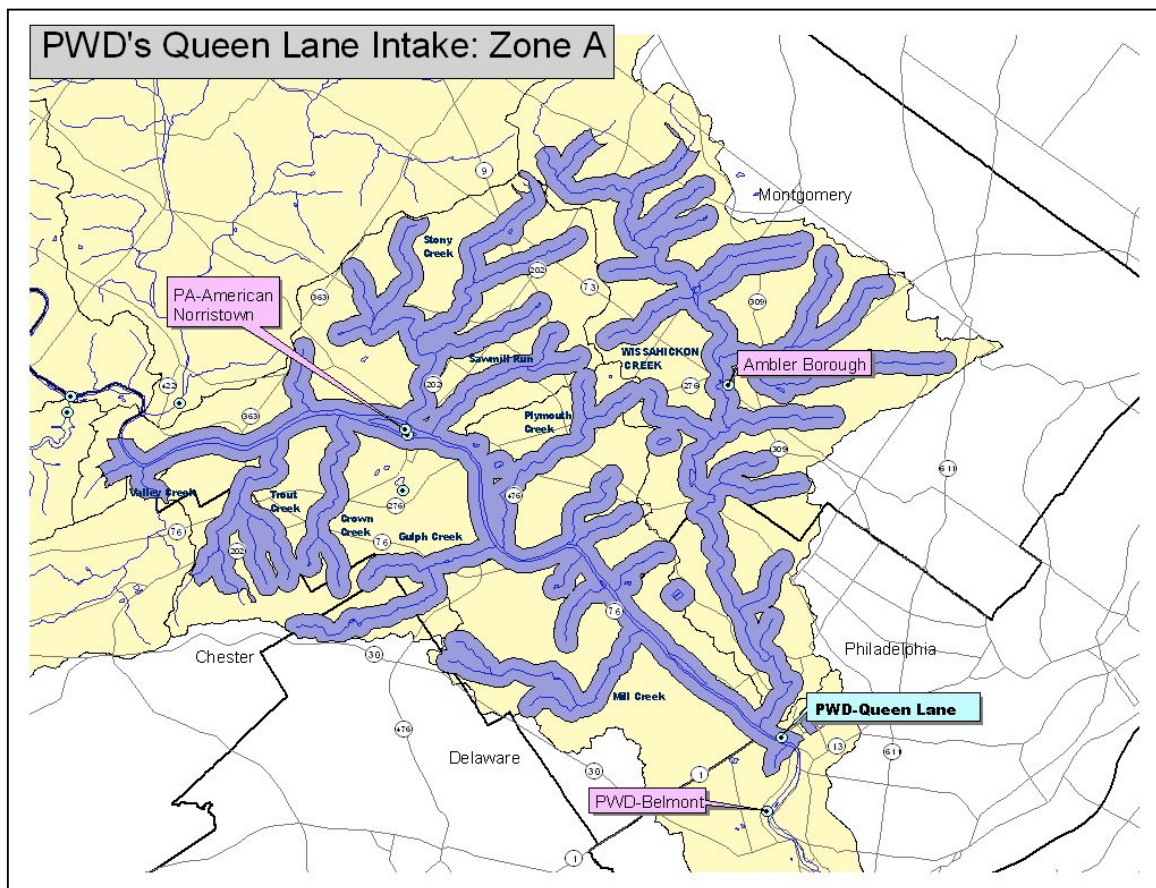
Zone B - This is the area between the 5-hour and 25- hour time of travel to a given water supply intake, including a two mile-wide area on either side of the river or stream extending upstream to the 25-hour time of travel boundary. Only significant potential sources of contamination are identified for inclusion in the contaminant inventory. This generally represents larger discharges (>one million gallons per day), catastrophic event related sources (broken oil pipelines and chemical storage tanks), large runoff sources, or special contaminant sources.

Zone C - This is the area greater than 25-hours time of travel to a given water supply intake. All major potential sources of contamination are identified for inclusion in the contaminant inventory. This generally represents larger discharges (less than one to ten

million gallons per day), catastrophic event related sources (broken oil pipelines and chemical storage tanks), large runoff sources, or special contaminant sources.

Figure 3.2.1-1 displays the different zones delineated for the Queen Lane water supply intake for the Philadelphia Water Department. As shown, Zone A encompasses an area of 73.7 square miles and continues upstream of the intake to river mile 31 at Valley Forge. Zone A consists of almost the entire Wissahickon Creek Watershed and the direct drainages to the Schuylkill River to directly upstream and including portions of Valley Creek. These direct drainages include Stony Creek, Mill Creek, Trout Creek, Gulph Creek, Plymouth Creek and Sawmill Run.

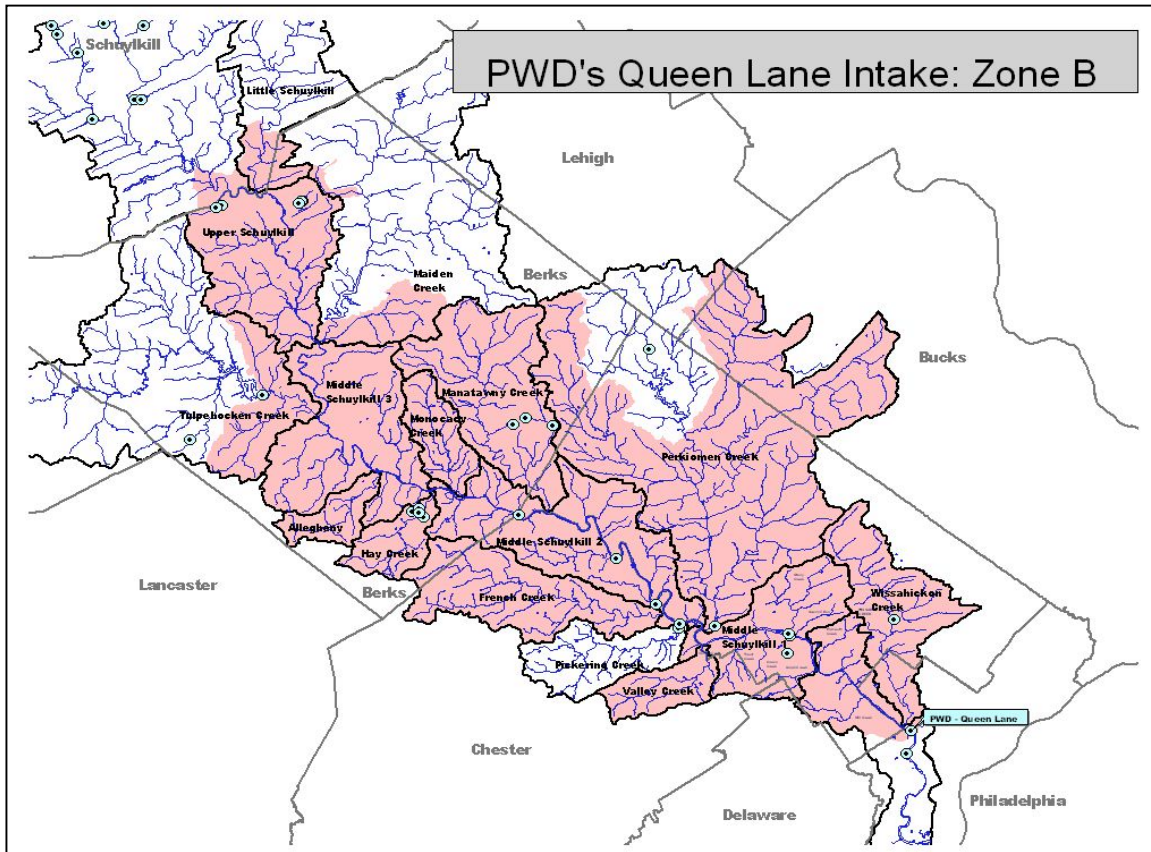
Figure 3.2.1-1 PWD's Queen Lane Intake: Zone A



Zone B encompasses an area of 1,271 square miles and extends upstream to river mile 108. For the Queen Lane Intake, Zone B extends upstream from the intake to the town of Auburn, PA. Zone B also includes all the tributaries below the Maiden and Tulpehocken creeks. Zone B includes about half of the Maiden Creek Watershed, part of the Tulpehocken Creek Watershed below Blue Marsh Reservoir, and part of the Little Schuylkill River up to Greenawald, PA. Zone C consists of the remainder of the watershed, primarily the headwaters of the Schuylkill River, most of the Little Schuylkill

River, the majority of the Tulpehocken Creek Watershed and the headwaters of the Maiden Creek Watershed.

Figure 3.2.1-2 PWD's Queen Lane Intake: Zone B



The locations of other water supply intakes within the zones delineated for the water supply are also shown in Figure 3.2.1-2. As shown in Figures 3.2.1-1 and 3.2.2-2, the Zone A or B from the Queen Lane Intake overlaps with the Zone A or B from numerous intakes. This overlapping of zones allows for a more detailed assessment of potential sources for the whole watershed area.

As described above, the time of travel of a release from a potentially significant source of contamination combined with the characteristics of that source will determine whether it is included in the contaminant inventory.

All of the zones of delineation were determined and provided by the United States Geological Survey (USGS) and approved by PADEP for use in the Source Water Assessments. These zones of delineation were considered the most accurate descriptions available and improved upon the zone criteria described above.

3.2.2 Point Source Contaminant Inventory

Key Points

- Over 3,000 potential point sources were identified within the 1,900 square-mile Schuylkill River Watershed.
- Most of these potential sources do not now, and will never, discharge to the Schuylkill River. They have been identified so that water suppliers can assess their potential impacts upon the water supply, and identify appropriate protective measures.
- Over 1,400 RCRA facilities are located upstream of the Queen Lane Intake.
- Most of the RCRA facilities are not large quantity generators.
- Sewerage systems, dry cleaners, and commercial print shops were the most common industrial facilities identified.
- VOCs, metals, and petroleum hydrocarbons were the most frequently reported contaminants.

3.2.2.1 Method

Based on PADEP guidelines for the Statewide Source Water Assessment Program (SWAP), a contaminant inventory of point and non-point sources was developed. The inventory is an essential part of assessing the drinking water supply for the intake, because it compiles potential contaminant sources for the delineation zones within the 5-hour, 25-hour and beyond 25-hour times of travel. This inventory is a powerful list enabling the water suppliers to better understand their source water. The inventory is also the stepping stone to prioritizing potential contaminant sources. The prioritization or ranking of contaminant sources is completed in the Susceptibility Analysis step.

The focus of this report section is the point source contaminant inventory. Non-point sources are discussed in land use sections 1.2.5 and within intake section 3.2.3. Point source data was compiled from various Federal and State databases available on the Internet, as well as from self-assessment data provided by water suppliers. Sources were checked by stakeholders and verified for correct active status and location. An Access database was developed to efficiently store and manage information on the point sources.

Database Compilation

The following Federal databases were accessed for point sources in the Schuylkill Watershed:

- Permit Compliance System (PCS);
- Resource Conservation and Recovery Act Information System (RCRIS);
- Comprehensive Environmental Response, Compensation, and Liability Act Information System (CERCLIS); and
- Toxic Release Inventory (TRI).

Regulated aboveground storage tanks (ASTs) were also compiled from the PADEP Storage Tank Program. Another initial source of data was provided by self-assessment forms. The self-assessment, required by the State SWAP, provides intake-specific input as to which sources are of priority concern.

The databases were queried for facility, process, and violation information. Facility information included items such as name, facility identification numbers, owner, and location (street address and/or latitude, longitude). GIS information was used to locate the Schuylkill Watershed sources were within the Queen Lane delineation zones. Process information included data on which contaminants were on-site and the quantities and/or loading rates. Violation information was related to type (administrative versus operation or effluent violation) and frequency.

Database Population

For many of the facilities, certain pieces of information required for ranking, such as contaminants and quantities, were still missing upon compiling the source database. This data was simply unavailable through the Federal databases for many of the minor dischargers and RCRA facilities. Consequently, missing information was populated based on educated assumptions using the known data. Details on data population are available in Appendix S.5. Data population of missing fields affects the susceptibility analysis more than the inventory. The inventory discussed in this section is based on actual downloaded data.

Note that individual site contaminants were downloaded, where available, for each facility. Each contaminant was associated with one of ten categories. These categories were generally based on contaminant groups described in the PADEP SWAP guidance document. The contaminant categories were subgrouped into non-conservative (total/ fecal coliform, turbidity, nutrients, VOC/SOCs, metals) and conservative (*Cryptosporidium*/*Giardia*, nutrients, DBP precursors, petroleum hydrocarbons, and salts) categories. Nutrients were included in both the non-conservative and conservative categories, because phosphorous is mostly associated with particulates and nitrogen compounds are typically dissolved.

3.2.2.2 Results

Point Source Contaminant Inventory

After the database compilation and population were completed, inventories specific to each intake were developed. PWD's Queen Lane Intake was delineated into three zones based on travel time. Zones A and B, the area of the watershed within a 25-hour travel time, encompass over 1,300 square miles. Zone C extends beyond 25 hours of travel time and essentially captures the remainder of the Schuylkill Watershed. Consequently, the inventory of sources throughout the three zones is quite extensive for Queen Lane.

The completed inventory for Queen Lane compiles about 3,000 sources and is too voluminous to append within this report. The complete inventory is available for downloading from the Schuylkill Source Water Assessment website – <http://www.schuylkillswa.org>. The inventory is sorted into three sections for zones A,

B, and C and sub-sorted by source type, PCS, RCRA, etc. The inventory indicates facility information such as name, city, and county. The source of the data is also indicated, that is, RCRA, PCS, etc. Other pertinent information includes industry classification by SIC code, whether the facility is a Large Quantity Generator for RCRA sites, and a major discharger for PCS sites. If information was available for a specific facility, such as on-site or discharged chemicals, quantities of chemicals, capacity of the site, and discharge flow rates, it is listed.

Inventory Characterization

Data from the complete Queen Lane inventory, summarized in Table 3.2.2-1, identifies the most common source types and the zones in which they are concentrated. The characterization also seeks to find common industries or dischargers and the most common contaminants by category. The table is organized by source type (PCS, RCRA, etc.) and zone of delineation (A, B, or C). Note that there is overlap for some facilities with source type. For example, the same facility may be a permit holder (PCS), a RCRA facility and/or a TRI facility.

Even accounting for overlap among source types, Table 3.2.2.1 indicates that a number of sources are found upstream of Queen Lane. On a positive note, the least number of sources across the various source types is typically found within five hours of travel time. The most sources are found within zone B, between 5 and 25 hours of travel time. RCRA facilities are the most numerous with greater than 1,400, followed by PCS dischargers, and aboveground storage tanks. Over 400 direct discharges are being made into the watershed upstream of Queen Lane, however only 45 are within zone A. These sources are ranked for significance with respect to other criteria, such as contaminant category, quantity, and violations, in Section 3.2.4.

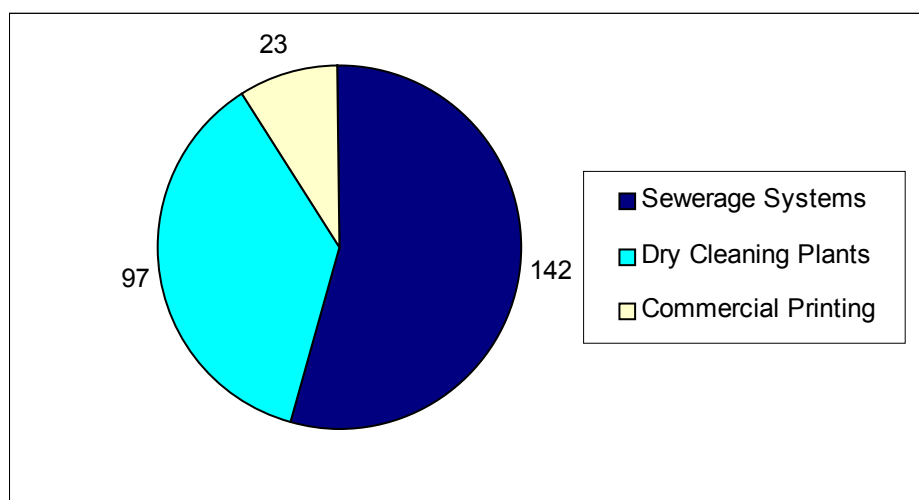
Table 3.2.2-1 Summary of Point Source Types Delineation Zone

Source Type	Zone A, < 5hr	Zone B, >5 hr and < 25 hr	Zone C, > 25 hr	Total
PCS	45	239	125	409
RCRA	237	1009	186	1432
AST	61	279	53	393
TRI	26	198	52	276
CERCLA	34	235	63	332
Self-Assessment	25	107	24	156
Total	428	2,067	503	2,998

Figure 3.2.2-1 shows the three most common industry types, based on SIC code, throughout the Queen Lane delineation zones. The data is somewhat limited due to the amount of missing SIC codes, especially for the dischargers. Despite its limitations, the data gives an insightful overview of the prevalence of various industry types within the

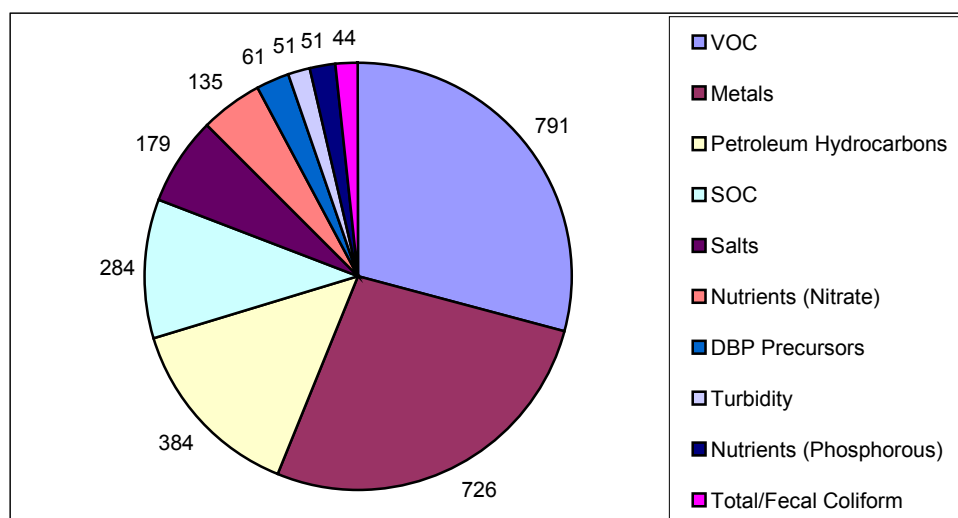
overall delineation zone. Sewerage systems were most numerous, followed by dry cleaning plants, and commercial printing operations.

Figure 3.2.2-1 Prevalent Industry Types for the Queen Lane Intake



Similar to Figure 3.2.2-2, parameter groups are summarized based on prevalence throughout the Queen Lane delineation zones. This is again based on a limited data set. Contaminant information was most complete for TRI sources. With this in mind, available data shows that VOCs are the most common contaminant reported by the sources, followed by metals and petroleum hydrocarbons. This is useful for water suppliers to keep in mind in monitoring efforts and surveillance of raw water.

Figure 3.2.2-2 Prevalent Contaminant Categories for the Queen Lane Intake



PCS Dischargers

A characterization of dischargers or PCS facilities within Queen Lane’s delineation zone is examined in Table 3.2.2-2. Out of 409 dischargers, 40 are major (<1 MGD).

Wastewater treatment plants comprise the largest component, 142, for both major and minor dischargers. After sewerage systems, gasoline and water suppliers are the most common discharger types.

Table 3.2.2- 2 PCS Discharger Summary

Total Dischargers	409
Major Dischargers	40
Major Sewerage Systems	35
Facilities with SIC Codes	362
Top 3 Discharge Types by SIC Code	
4952 - Sewerage Systems	142
5541 - Gasoline Service Stations	13
4941 – Water Suppliers	13
Dischargers with Available DMR Data	51
Most Common Parameters with DMR Data	Total Suspended Solids BOD5 Ammonia Nitrogen Total Copper Total Phosphorus
Discharge Flow Rate Range (from DMRs)	1 – 43 MGD

Because so many of the dischargers are minor, Discharge Monitoring Report (DMR) data was available for 51 sites. The data spanned June 1984 through January 2001. The most common parameters found in the DMRs and effluent limits are indicated in Table 3.2.2-2. The common DMR parameters – TSS and BOD5 – correlate with turbidity and TOC (DBP precursor), which are more of a concern from a source water perspective. Copper poses some concern in drinking water supplies, but other metals are much more toxic with respect to human health risks. The prevalence of nutrients is expected due to the number of wastewater plants.

Discharge Monitoring Report (DMR) data for Queen Lane sources is further summarized in Table 3.2.2-3 based on maximum reported quantities and parameter groups. This summary is quite similar to a watershed-wide summary presented in Section 1.5 and 2.2.2, because the delineation zones for Belmont and Queen Lane are very close. Both cover the majority of the Schuylkill Watershed. The parameter groups generally follow those laid out in the PADEP SWAP guidance document. These groupings are used to rank potential contaminant sources in the intake report sections.

Since the ranking analysis is based on DMR maximum quantity data, this data is compiled in Table 3.2.2-3 to provide a frame of reference. The data also gives an idea, on a pounds-per-day basis, as to the “worst case” order of magnitude of releases. Note

from Table 3.2.2-3 that this data was available for 51 of the 409 dischargers in the delineation zone for Queen Lane. Available data was generally linked to major dischargers. With that in mind, the data truly represents a worst-case estimate of individual loads being discharged into the Schuylkill within the delineation zone of Queen Lane.

Table 3.2.2-3 Summary of Available DMR Data

Parameter Group	Parameters with DMR Max Quantities ^[1]	Range of Max Quantity Reported			Mean Max Quantity	Count of Max Quantities
Cryptosporidium/ Giardia	Not Available					
Nutrients	Ammonia as N	0	-	32550	113	2527
	Nitrate-Nitrite as N	0.00023	-	7.2	1.2	22
DBP Precursors	BOD5	0	-	21727	546	1045
Petroleum Hydrocarbons	Oil & Grease	0.00005	-	164	22	322
Salts	Not Available					
Total/Fecal Coliform	Fecal Coliform (col/day)	46	-	84	65	2
Turbidity	Total Suspended Solids	0.002	-	802396	659	5588
Nutrients	Phosphorus, Total as P	0	-	527	21	581
VOC	1,1,1-Trichloroethane	0.001	-	0.09	0.03	37
	1,1,2-Trichloroethane	0.001	-	0.07	0.01	18
	1,1-Dichloroethane	0.001	-	0.02	0.01	18
	1,1-Dichloroethylene	0.000	-	0.05	0.01	83
	1,2-Dichloroethane	0.001	-	0.02	0.01	18
	1,2-Dichloropropane	0.001	-	0.02	0.01	19
	1,2-trans-Dichloroethylene	0.001	-	0.02	0.01	18
	1,3-Dichloropropylene	0.001	-	0.02	0.01	18
	2-Chloroethylvinyl ether	0.038	-	0.08	0.07	3
	Acrolein	0.045	-	0.80	0.43	36
	Acrylonitrile	0.005	-	0.92	0.32	58
	Benzene	0.001	-	0.02	0.01	18
	Bromoform	0.004	-	0.05	0.02	14
	Carbon Tetrachloride	0.001	-	0.02	0.01	18
	Chlorobenzene	0.001	-	0.02	0.01	18
	Chloroethane	0.001	-	0.02	0.01	18
	Chloroform	0.001	-	0.51	0.07	84
	Dibromochloromethane	0.004	-	0.05	0.02	14
	Dichlorobromomethane	0.004	-	0.05	0.02	14
	Ethylbenzene	0.001	-	0.02	0.01	18

Parameter Group	Parameters with DMR Max Quantities ^[1]	Range of Max Quantity Reported			Mean Max Quantity	Count of Max Quantities
	Methyl Bromide (Bromomethane)	0.004	-	0.09	0.03	14
	Methyl Chloride (Chloromethane)	0.001	-	0.09	0.02	32
	Methylene Chloride	0.001	-	0.02	0.01	18
	Tetrachloroethylene	0.001	-	0.09	0.03	56
	Toluene	0.001	-	0.02	0.01	18
	Trichloroethylene	0	-	1.13	0.08	90
	Vinyl Chloride	0.001	-	1.21	0.04	39
SOC	1,2,4-Trichlorobenzene	0.001	-	0.02	0.01	17
	1,2-Dichlorobenzene	0.001	-	0.02	0.01	19
	1,3-Dichlorobenzene	0.001	-	0.02	0.01	17
	1,4-Dichlorobenzene	0.001	-	0.02	0.01	17
	2,4-Dichlorophenol	0.001	-	0.02	0.01	18
	2,4-Dimethylphenol	0.001	-	0.04	0.02	18
	2,4-Dinitrophenol	0.003	-	0.11	0.05	18
	2,4-Dinitrotoluene	0.001	-	0.02	0.01	18
	2,6-Dinitrotoluene	0.001	-	0.05	0.01	18
	2-Chlorophenol	0.001	-	0.02	0.01	17
	2-Nitrophenol	0.001	-	0.02	0.01	17
	4,6-Dinitro-o-Cresol	0.001	-	0.06	0.02	18
	4-Nitrophenol	0.001	-	0.02	0.01	18
	Acenaphthene	0.001	-	0.02	0.01	18
	Acenaphthylene	0.001	-	0.02	0.01	18
	Anthracene	0.001	-	0.02	0.01	18
	Benzo (a) Anthracene	0.001	-	0.02	0.01	18
	Benzo (a) Pyrene	0.001	-	0.02	0.01	18
	Benzo (b) Fluoranthene	0.001	-	0.03	0.01	18
	Benzo (k) Fluoranthene	0.001	-	0.03	0.01	18
	Bis (2-Ethylhexyl) Phthalate	0.001	-	0.02	0.01	17
	Chrysene	0.001	-	0.02	0.01	18
	Di-n-Butylphthalate	0.001	-	0.02	0.01	18
	Diethyl Phthalate	0.001	-	0.02	0.01	18
	Dimethylphthalate	0.001	-	0.02	0.01	18
	Fluoranthene	0.001	-	0.02	0.01	18
	Fluorene	0.001	-	0.02	0.01	18
	Hexachlorobenzene	0.001	-	0.02	0.01	18
	Hexachlorobutadiene	0.001	-	0.02	0.01	18
	Hexachloroethane	0.001	-	0.02	0.01	17
	Naphthalene	0.001	-	0.11	0.06	62
	Nitrobenzene	0.001	-	0.13	0.02	18
	Phenanthrene	0.001	-	0.02	0.01	18
	Phenol	0.001	-	9.00	0.43	32

Parameter Group	Parameters with DMR Max Quantities ^[1]	Range of Max Quantity Reported			Mean Max Quantity	Count of Max Quantities
	Phenols, total	0.003	-	11.80	1.41	149
	Pyrene	0.001	-	0.02	0.01	17
Metals	Aluminum	0.0005	-	18.50	1.54	92
	Antimony	0.0006	-	0.04	0.02	33
	Arsenic	0.0003	-	0.09	0.01	32
	Beryllium	0	-	0.25	0.02	258
	Cadmium	0	-	1.08	0.07	322
	Chromium	0	-	9.00	0.38	309
	Chromium, hexavalent	0	-	2.20	0.18	466
	Copper	0	-	11.10	1.16	843
	Fluoride	0.27	-	1.79	1.09	32
	Iron	1	-	36.00	7.73	59
	Lead	0.00013	-	4.70	0.19	412
	Mercury	0	-	0.03	0.00	106
	Molybdenum	3.58	-	6.62	5.24	7
	Nickel	0	-	19.90	0.38	427
	Selenium	0.0006	-	0.05	0.02	36
	Silver	0	-	1.40	0.05	184
	Thallium	0.0003	-	0.02	0.01	33
	Zinc	0	-	33.20	2.23	486

[1] All quantities in lbs/day, unless otherwise indicated.

[2] Shading indicates the parameter with the largest maximum DMR value.

Table 3.2.2-3 shows that total suspended solids loads are the highest of any parameter and have the greatest number of reported quantities. Total suspended solids are related to the turbidity parameter group. Turbidity is another indicator, such as TSS, of particulates in the water supply, but is a more meaningful measure of performance in drinking water treatment. Microbial data is very scarce, with only two reportable maximum quantities for fecal coliform. Maximum and average ammonia loads are greater than phosphorus loads. The table also indicates the various VOCs and SOCs discharged into the Schuylkill River. Vinyl chloride has the single largest discharged VOC quantity of 1.2 lbs/day. Relative to the other VOCs, acrylonitrile and acrolein are also large average maximum discharge quantities. Total phenols are the largest discharged quantity for the SOCs. Otherwise, quantities are similar across the many synthetic organic compounds. Of the metals, iron is clearly the largest discharged quantity. High maximum quantities are also reported for aluminum, total chromium, total copper, total lead, total nickel, and total zinc. Chromium and lead pose the greatest risk in drinking water.

RCRA/AST Facilities

As summarized in Table 3.2.2-4, RCRA facilities comprise many of the point sources within Queen Lane’s delineation zones. The breakdown of RCRA facilities for Queen Lane is essentially the same as for Belmont. Only 44 out of the 1,432 RCRA facilities are designated Large Quantity Generators. Data describing the industry type or capacity of the facilities is limited. Taking into account the limited number of SIC codes, most RCRA facilities are dry cleaning plants, followed by automotive repair shops, and printing shops. A relatively low number of RCRA sites are cited as having violations. Capacity information for use in ranking sites is available for merely 50 sites, and contaminant information is not available. A range of 100 to about 100,000 gallons gives an idea of the capacity for the RCRA sites with available data.

Table 3.2.2-4 RCRA Facility Summary

Total RCRA Facilities	1432
Large Quantity Generators	44
Facilities with SIC Codes	462
Top 3 RCRA Industry Types by SIC Code	
7216 – Dry Cleaning Plants	97
7537 – Automotive Transmission Repair Shops	14
2752 – Commercial Printing	14
RCRA facilities with Violations	76
RCRA facilities with Capacity/Volume Data	50
Range of Capacity	100 – 96,500 gallons 107 – 8,220,000 gal/day
Most Common Parameters/Contaminants	Not Applicable – no contaminants linked to RCRA downloads

RCRA data was supplemented with Aboveground Storage Tank information from PADEP. PADEP AST data included useful and detailed information as to tank age, contaminants and volumes. AST data is summarized in Table 3.2.2-5.

Table 3.2.2-5 AST Facility Summary

Total AST Facilities	393
AST Facility overlap with RCRA facilities	71
Total Number of Tanks	1638
Tank Capacity Range	252 gal – 4 MG
Tank Age Range	1 – 98 years
Number of Different Parameters/Contaminants	123
Most Common Parameters and Quantities by Number of Tanks Misc. Hazardous Substance Diesel Fuel Gasoline	556 tanks/3.4 MG 201 tanks/4.4 MG 141 tanks/7.1 MG
Most Common Parameters/Contaminants and Quantities by Total Volume Heating Oil Gasoline Diesel	25 MG 7.1 MG 4.4 MG

Table 3.2.2-5 shows that 393 facilities throughout Queen Lane’s delineation zones, have aboveground storage tanks. Of those facilities, only 71 overlap with the RCRA facilities. This may be due to RCRA sites also comprising underground storage tanks. The AST data is still useful for characterizing potential contaminant sources in the watershed. Tanks range in capacities from about 250 gallons to 4 million gallons and range in age from 1 to 98 years old. Older tanks may pose a greater risk for spills. The tanks contain 123 different substances. The most common of these by volume, as labeled in the original PADEP data, is a non-specific hazardous substance. The specific chemical was not given. After miscellaneous hazardous substances, gasoline and diesel fuels are the most common by volume. The significance of these tanks as contamination sources depends on factors such as the total volume of substance at any one site, tank age, and the time of travel to the intake. These factors are considered in the intake specific susceptibility ranking.

TRI Facilities

A summary of TRI sources is presented in Table 3.2.2-6. As explained in detail in Appendix S.5, a facility is listed in the TRI if a chemical from the inventory is used or manufactured on site. These sites are not necessarily discharges. Data on which chemicals are on-site, quantities of chemicals, and releases are available for the TRI sources. The range of quantities is how much is used or manufactured in a given year. Releases may be to air, water or land. Information regarding how much of a given chemical and which chemical is released is not provided.

With that in mind, Table 3.2.2-6 indicates that 276 TRI facilities are found in the delineation zones for Queen Lane. A SIC code is identified for 268 of these industries.

SIC codes are linked to activities that PADEP identified in the State SWAP document. Based on activity, most TRI facilities are foundries, chemical manufacturers, or machine shops.

Chemical and quantity data is very complete for the TRI facilities, however quantities are presented as ranges. Copper, sulfuric acid, and chromium are the most common chemicals listed by the various TRI sites. Quantity ranges for these chemicals are shown in Table 3.2.2-6. This amount of substance is not necessarily released into a water body. Limited information is available on the number of releases to water for 261 of the TRI facilities. Based on this, chemical manufacturers in Montgomery and Berks counties have had the most reported number of releases.

Table 3.2.2-6 TRI Facility Summary

Total TRI Facilities	276
Facilities with SIC Codes	268
Top 3 Industry Types by Activity	
Foundries or Metal Fabricators	49
Chemical Manufacturer	46
Machine/Metalworking Shops	41
Top 3 TRI Industries by SIC Code	
2899 - Chemical Preparation	8
2834 - Pharmaceutical Preparations	7
3324 - Steel Foundries	6
Facilities with Quantity Data	261
Most Common Parameters for Facilities with Quantity Data	
Copper	0 – 999,999,999 kg/yr
Sulfuric Acid	0 – 49,999,999 kg/yr
Chromium	100 – 99,999,999 kg/yr
Nickel	0 – 9,999,999 kg/yr
Toluene	100 – 9,999,999 kg/yr
Facilities with Release Data	267
Facilities with Greatest Number of Releases	
Chem. Manufacturer–Dyes/Pigments–Berks County	180 releases to water
Chem. Manufacturer-Medicinal Chemicals – Mont. Cty.	96 releases to water
Chem. Manufacturer – Industrial Chemicals-Berks Cty.	84 releases to water

CERCLA Facilities

Although data for CERCLA facilities is limited, Table 3.2.2-7 summarizes what information is available within 25 hours time of travel and beyond for the Queen Lane Intake. Three hundred thirty-two CERCLA facilities are in Queen Lane’s delineation zone, but only 21 are on the final National Priority List. Information for about 80 of the CERCLA facilities is available through the RCRA and TRI databases, where those

facilities are also listed. Only 30 sites are found in the flood plain and 21 sites are on the NPL list for Superfund restoration. Due to the low number of high-risk sites, based on flood plain and NPL status, finding more data is not critical for the majority of the sites. Since information on the Superfund sites is so limited, these sites are screened or ranked narratively. The low number of NPL sites and sites in the floodplain is considered in the narrative screening.

Table 3.2.2-7 CERCLA Facility Summary

Total Number of CERCLA Facilities	332
Number on the NPL List	21
Number also listed as RCRA	62
Number also listed as TRI	18
Number in Flood Plain	30

3.2.3 Runoff Loading Summary

Key Points

- The Schuylkill River Runoff Loading Model was developed to estimate contaminant loadings to the river from storm runoff.
- The model uses the physical characteristics of the subwatersheds, meteorological data, updated land use information, and event mean concentrations for the nine parameters of interest to estimate average daily contaminant loadings within each of the Queen Lane Intake's zones of contribution.
- The developed areas associated with industrial/commercial land use and residential uses are estimated to contribute the highest per-acre loadings of most of the contaminants evaluated, including disinfection by-products, metals, nutrients, petroleum hydrocarbons, salts, and coliforms.
- Unit *Cryptosporidium* and turbidity loadings are higher from agricultural areas.

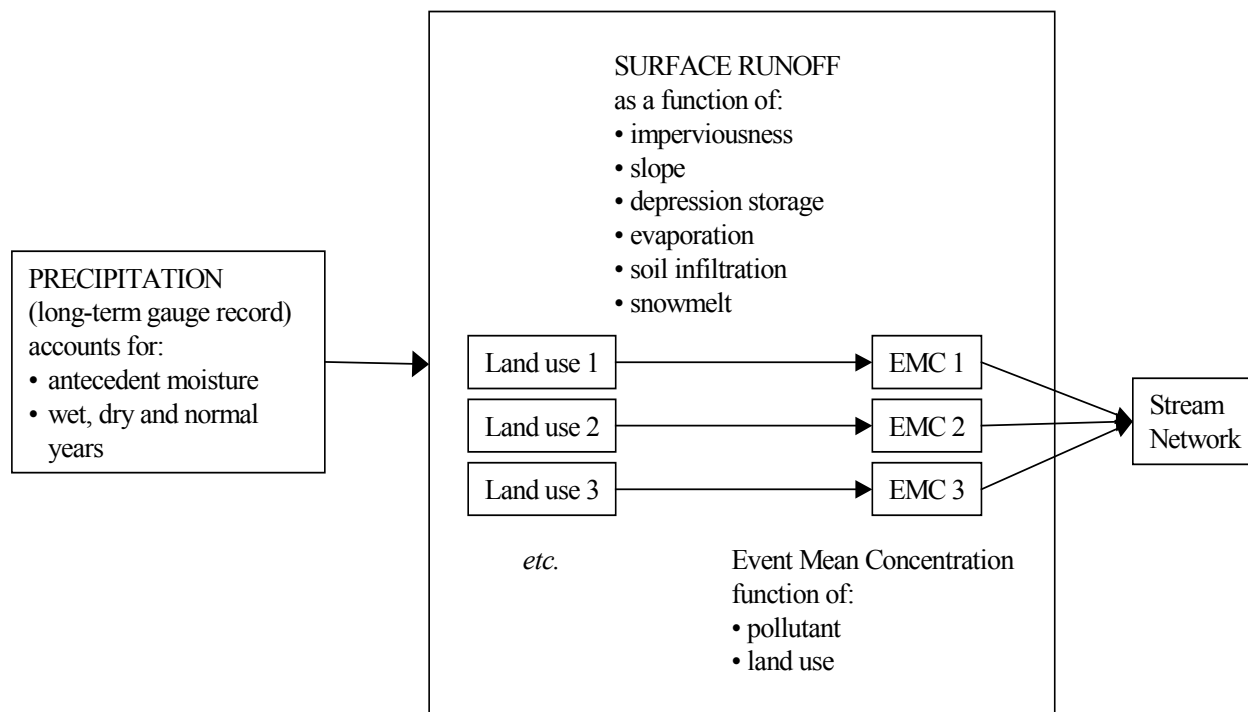
The Schuylkill River Source Water Assessment Partnership developed the Schuylkill Runoff Loading Model (SRLM) in an effort to estimate pollutant loads from rainfall runoff throughout the watershed. The SRLM results provide information on the relative contributions of surface runoff from various land use categories, as well as, from different geographical areas. The procedure incorporates collection of data, model development and simulation, and post-processing of output data for further use in the susceptibility analysis. A database management system (DBMS) was created to assist with storing parameter data, creating the model, and post-processing model outputs.

3.2.3.1 Method

The RUNOFF module of the U.S. EPA's Storm Water Management Model (SWMM) simulates rainfall runoff quantities and quality at specified inlet locations. Figure 3.2.3-1 displays the structure of the SWMM RUNOFF model. The model inputs subshed parameters, rainfall time-series, climatological data, and event mean concentrations (EMCs) for the land use categories, and outputs annual and monthly pollutant loads for the length of the simulation period. The model incorporates infiltration, depression storage, and roughness to estimate runoff flow and ultimately, runoff pollutant quantities.

The amount of a particular pollutant reaching the receiving stream is dependent on the volume of surface runoff and the concentration of that constituent in the runoff. An EMC is the total mass load of a pollutant yielded from a site during a storm divided by the total runoff water volume discharged during the storm. EMCs are related to the constituent of interest and the land use type. For a subshed, the surface runoff from a particular land use predicted by SWMM RUNOFF is multiplied by the EMC for that land use type to yield a loading rate.

Figure 3.2.3-1 Watershed Loading Model Schematic Diagram



Subcatchments

The subcatchments of the Schuylkill River Watershed ultimately drain into the Delaware River Basin. The Schuylkill Watershed is composed of 356 subsheds and the area tributary to the PWD Queen Lane Intake includes 179 of the 356 subbasins, about 57 percent of the Schuylkill Watershed. The subwatersheds were further divided into land use categories to track the contributing pollutant loads from each land use category. The land use categories were based on the USGS's NLCD dataset updated with 2000 Census data for residential and commercial areas, as detailed in Section 1.2.5.

The land use categories distinguish the amount of rainfall that runs off the surface of the subwatershed, as opposed to infiltrating into the subsurface or entering the atmosphere through evapotranspiration. For example, during a storm, more rainfall becomes surface runoff in a residential area than in a forested area, since there are more impervious surfaces such as driveways, roads, and buildings in developed areas. The forested area retains more of the rainfall, which either infiltrates into the ground or evaporates. For modeling purposes, the land use categories were summed for each subwatershed in order to track individual land use loading contributions to the totals for each subwatershed. Figure 3.2.3-2 and Table 3.2.3-1 below summarize the land use characterization for the Schuylkill River Watershed area within the Zone B delineation for the PWD Queen Lane Intake and reflect modifications in residential development and increases in commercial areas based on increases in populations from the Census Bureau. For the defined area, almost 80% is characterized as agriculture, forests, and wetlands. Developed and urbanized areas account for about 20% of the Zone B delineated area for the PWD Queen Lane Intake.

The percentage of impervious area for all land use categories, excluding residential, were estimated according to values extracted from the Water Management Model (WMM) and adjusted during the calibration. The percentage of impervious area for residential areas was calculated using Hick's methodology, which calculates the percentage of total impervious area as a function of the population density.

For pervious areas, the portion of precipitation that runs off is affected by slope, depression storage, infiltration, vegetative cover, and evapotranspiration. Infiltration is determined primarily by the type of soil. The SWMM RUNOFF model simulates infiltration using the Green-Ampt theory for both saturated and unsaturated soils. The Green-Ampt infiltration routine relates infiltration rate to the moisture conditions of the surface and the total volume of rainfall infiltrated. For the SLRM, the soil information was downloaded from the Natural Resources Conservation Service (NRCS) and the soils GIS coverage was intersected with subwatersheds to identify the soil types in each subwatershed.

Figure 3.2.3-2 Land Use Characterization for PWD Queen Lane Intake Zone B

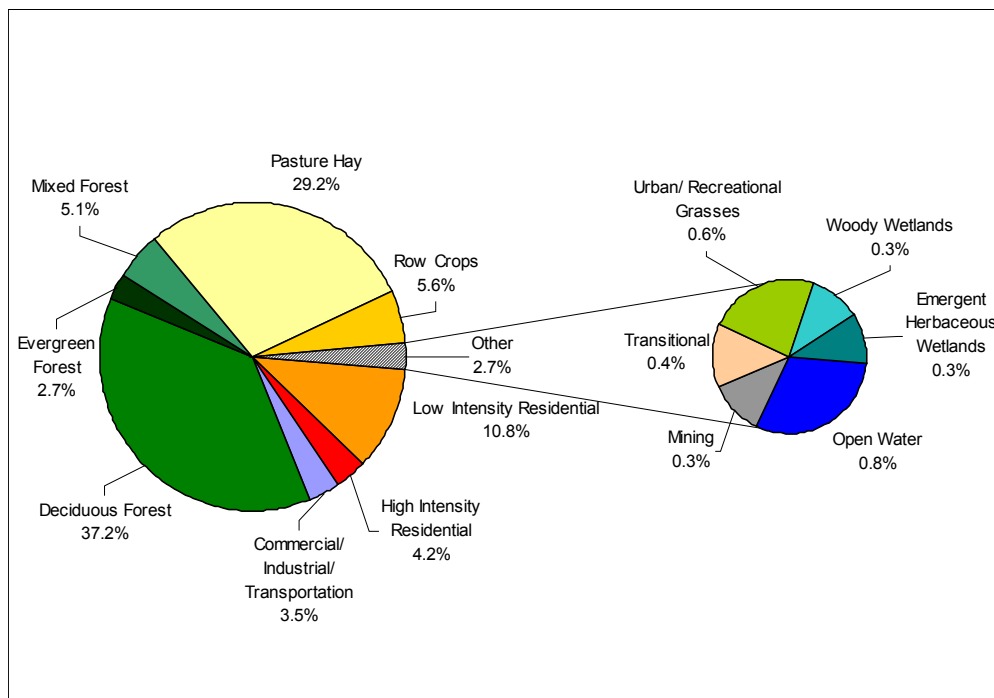


Table 3.2.3-1 Updated Land Use Categories

Landuse Category	Subcategory	Area (acres)	Percentage of Zone B Delineated Area
Agricultural	Pasture/Hay	205033	29.2%
	Row Crops	39024	5.6%
Commercial/Industrial/Transportation		22190	3.2%
Forested	Deciduous Forest	261690	37.2%
	Evergreen Forest	20287	2.9%
	Mixed Forest	35558	5.1%
Open Water		5835	0.8%
Quarries/Strip Mines/Gravel Pits		2104	0.3%
Residential	High Intensity Residential	23991	4.2%
	Low Intensity Residential	76064	10.8%
Transitional		2548	0.4%
Urban/Recreational Grasses		4300	0.6%
Wetlands	Emergent Herbaceous Wetlands	2012	0.3%
	Woody Wetlands	2043	0.3%

Event Mean Concentrations (EMCs)

Applying EMCs to calculated runoff volumes provides reasonable estimates of runoff pollutant loadings. EMCs for the soluble pollutant categories were assigned according to the land use category. The SWMM RUNOFF module allows the model to assume a constant concentration of a constituent for the duration of the storm event. The quantity of a constituent in surface runoff is a function of constant EMCs associated with the land use categories. The RUNOFF model water quality parameters included *Cryptosporidium*, disinfection by-products, metals and heavy metals, conservative nutrients, non-conservative nutrients, petroleum hydrocarbons, salts, turbidity, and total/fecal coliform. For each of these contaminant types, a surrogate constituent was selected. For example, chloride was used as the surrogate for salts and the EMCs for chloride were used in the model.

Runoff volumes are computed for each land use category based on percent imperviousness of the land use, annual rainfall, slope of the subwatershed, evaporation, infiltration, and depression storage. This analysis was performed on a subwatershed-by-subwatershed basis, and the results were used to determine load distributions according to the land use category. The pollutant mass load estimate is computed for each land use within each subwatershed as a product of the EMC and the surface runoff. By estimating the pollutant loading over the area of a land use type within a subwatershed and summing for all land uses, the total pollutant load from a subwatershed can be computed.

Meteorological Data

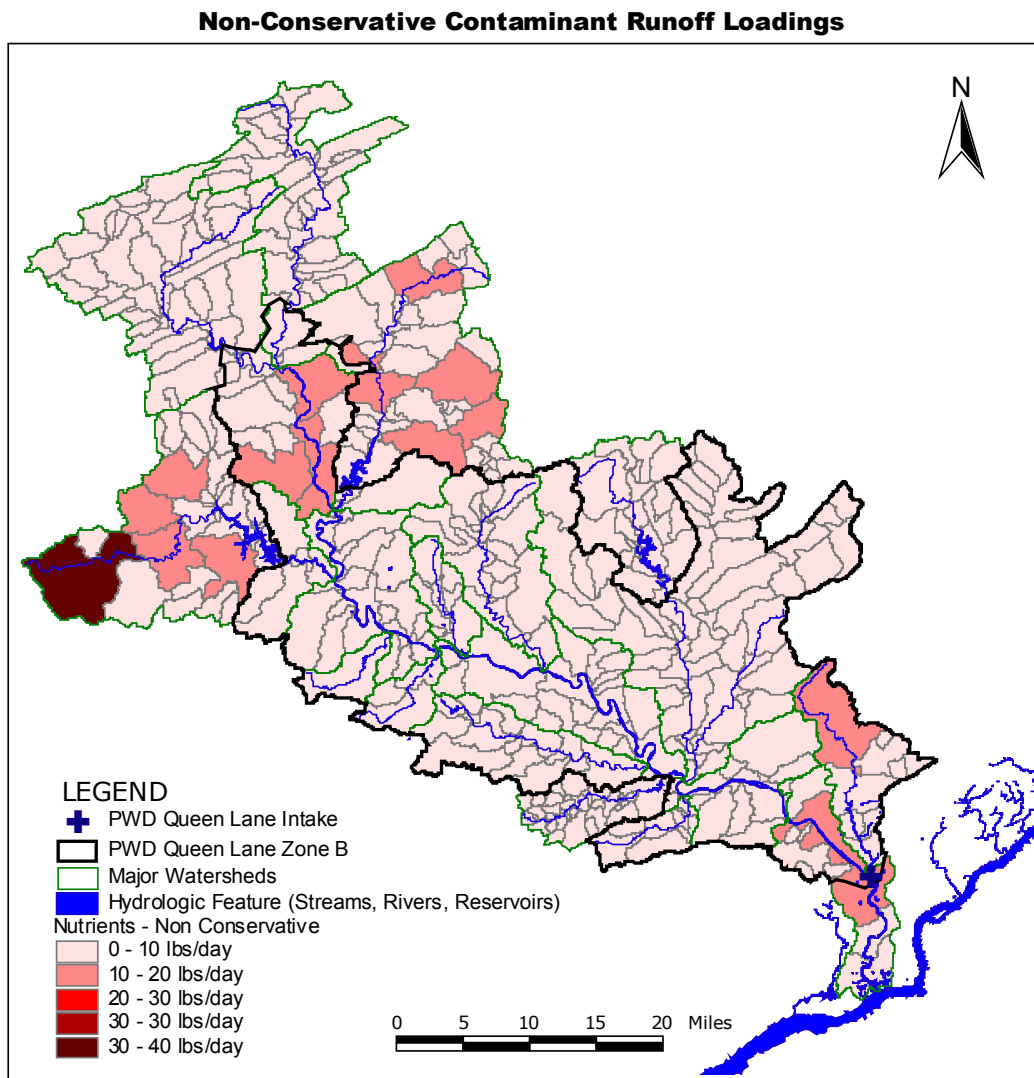
The amount of surface runoff is primarily driven by the precipitation. Long-term climate and precipitation records were used to drive the hydrology of the system. Using a long-term record represents a wide range of hydrologic conditions that occur in a given climate. Using a long-term record on a continuous basis accounts for antecedent moisture conditions and more accurately represents initial conditions at the beginnings of storm events. Snowfall and snowmelt affect the quantity and timing of surface runoff during the winter months and have been included in the long-term continuous simulation.

If available, rainfall, wind, and temperature data for a period over ten years (1990-2000) were collected for RUNOFF model simulations. The hourly rainfall data was obtained from the National Weather Service (NWS) at stations in and surround the Schuylkill Watershed. The hourly data was further discretized into 15-minute increments. To account for snowmelt, the daily minimum and maximum temperatures and average monthly wind speeds were obtained for the period of simulation.

3.2.3.2 Results

The SRLM was used to quantify contaminant loads for all pollutant categories included in the susceptibility analysis except for volatile organic compounds. Generally, the greater contaminant loads are found in the lower portion of the watershed. These areas tend to have more development, and thus greater impervious surfaces and runoff volumes. Figure 3.2.3-3 shows the results for the watershed for non-conservative nutrients for which the surrogate phosphorus was chosen. The darker areas, representing higher load estimates, are located closer to streams and rivers and are observed to be further downstream in the watershed. The lighter areas are less developed and less surface runoff results from rainfall events. The subwatersheds with greater pollutant loads tend to be within the Zone B delineation for the PWD Queen Lane Intake.

Figure 3.2.3-3 Non-conservative Contaminant Runoff Loadings



The Zone A delineated area for an intake is defined as the area within a five-hour time of travel of the water supply including one-quarter mile downstream and within a one-quarter mile wide area on either side of the stream from the intake. For the contaminant loads from rainfall runoff, Zone A includes parts of the Middle Schuylkill, Wissahickon, and Lower Schuylkill Watersheds. Over half of the area is developed, which results in greater runoff volume and, consequently, higher pollutant loads.

Zone B for PWD's Queen Lane Intake encompasses Zone A and area further upstream in the Schuylkill Watershed. Since Zone B contains more area, the pollutant loads are greater for Zone B than for Zone A. As previously described, the area contained in the Zone B delineation is about 20% impervious surfaces, while Zone A contains more than

50% impervious area. The average daily contaminant loadings for each of the Queen Lane Intake's zones are summarized below by Table 3.2.3-2.

Table 3.2.3-2 Calculated Average Daily Contaminant Loadings

Zone	<i>Cryptosporidium</i>	Disinfection By-products	Metals and Heavy Metals	Conservative Nutrients	Non-Conservative Nutrients	Petroleum Hydrocarbons	Salts	Turbidity	Total/ Fecal Coliform
	(oocysts/day)	(lbs/day)	(lbs/day)	(lbs/day)	(lbs/day)	(lbs/day)	(lbs/day)	(lbs/day)	(coliforms /day)
A	4.7E+07	2949	13.5	576	83	975	4886	3.7E+04	2.4E+12
B*	2.4E+08	9364	22.3	2592	480	1815	10105	3.0E+05	4.0E+12
Total A&B	2.8E+08	12313	35.8	3167	563	2790	14991	3.4E+05	6.4E+12

** Zone B values exclude Zone A*

On a smaller scale, the contributions from each of the major subwatersheds are summarized in Tables 2.2.3-3 and 2.2.3-4 below. Table 2.2.3-3 summarizes the total daily loads for each major subwatershed listed from upstream to downstream in the Schuylkill Watershed. Since only portions of some major subwatersheds are included in the Zone B delineation and there are variations in sizes of the major subwatersheds, the values listed in Table 2.2.3-4 are the total daily loads divided by the contributing area of each major subwatershed. For instance, although the Middle Schuylkill One Subwatershed has less contributing area to the Queen Lane Intake than the Middle Schuylkill Two subwatershed, the Schuylkill One has a greater load of metal than the Middle Schuylkill Two. This is because the per acre metal loading of Middle Schuylkill One is significantly higher than the per acre metal loading of Middle Schuylkill Two. This can be caused by greater impervious cover (more runoff), as well as more industrial land use.

Table 3.2.3-3 Daily Contaminant Loads for Major Subwatersheds

Majorshed*	Area (acres)	<i>Cryptosporidium</i> (oocysts/ day)	Disinfection by Products (lbs/day)	Metals/Heavy Metals (lbs/day)	Conservative Nutrients (lbs/day)	Non-Conservative Nutrients (lbs/day)	Petroleum Hydrocarbons (lbs/day)	Salts (lbs/day)	Turbidity (lbs/day)	Total/ Fecal Coliform (coliforms/day)
Little Schuylkill	10750	3.2E+06	215	0.04	46	9	2	54	5.4E+03	5.6E+09
Upper Schuylkill	90330	6.1E+07	1924	1.95	658	132	144	1048	8.6E+04	3.3E+11
Maiden Creek	15212	5.8E+06	241	0.50	87	16	43	239	8.5E+03	9.4E+10
Tulpehocken Creek	25994	1.9E+07	601	1.34	196	38	118	660	2.4E+04	2.4E+11
Allegheny Creek	11442	1.6E+06	76	0.12	15	3	16	92	1.8E+03	2.3E+10
Middle Schuylkill 3	62849	2.6E+07	1455	5.59	283	42	473	2440	2.4E+04	1.0E+12
Hay Creek	14160	1.7E+06	87	0.10	20	4	7	50	2.3E+03	1.8E+10
Monocacy Creek	16495	5.5E+06	139	0.17	59	12	8	100	8.0E+03	1.5E+10
Manatawny Creek	58602	1.3E+07	451	0.64	156	30	44	308	1.9E+04	1.0E+11
French Creek	44912	9.0E+06	369	0.62	88	17	55	323	1.1E+04	1.1E+11
Middle Schuylkill 2	65959	1.8E+07	818	2.73	192	31	244	1272	1.8E+04	5.0E+11
Perkiomen Creek	176313	6.6E+07	2510	6.55	702	131	511	2712	8.1E+04	1.2E+12
Valley Creek	15810	8.3E+06	504	1.96	94	14	152	829	1.0E+04	3.3E+11
Middle Schuylkill 1	40614	2.0E+07	1222	5.61	243	35	429	2160	1.6E+04	1.0E+12
Wissahickon Creek	40754	2.2E+07	1355	6.22	267	39	418	2043	1.8E+04	1.1E+12
Lower Schuylkill	12485	4.7E+06	346	1.66	61	8	125	662	2.7E+03	2.9E+11

* Areas reflect portions of the major shed within the boundary of the Zone B delineation.

Table 3.2.3-4 Daily Contaminant Loads per Acre for Major Subwatersheds

Majorshed*	Area (acres)	<i>Cryptosporidium</i> (oocysts/ day-acre)	Disinfection by Products (lbs/day-acre)	Metals/Heavy Metals (lbs/day-acre)	Conservative Nutrients (lbs/day-acre)	Non-Conservative Nutrients (lbs/day-acre)	Petroleum Hydrocarbons (lbs/day-acre)	Salts (lbs/day-acre)	Turbidity (lbs/day-acre)	Total/ Fecal Coliform (coliforms/day-acre)
Little Schuylkill	10750	296	0.020	3.3E-06	0.004	0.001	0.000	0.005	0.505	5.2E+05
Upper Schuylkill	90330	671	0.021	2.2E-05	0.007	0.001	0.002	0.012	0.948	3.7E+06
Maiden Creek	15212	381	0.016	3.3E-05	0.006	0.001	0.003	0.016	0.557	6.2E+06
Tulpehocken Creek	25994	726	0.023	5.2E-05	0.008	0.001	0.005	0.025	0.912	9.3E+06
Allegheny Creek	11442	141	0.007	1.1E-05	0.001	0.000	0.001	0.008	0.154	2.0E+06
Middle Schuylkill 3	62849	410	0.023	8.9E-05	0.005	0.001	0.008	0.039	0.376	1.6E+07
Hay Creek	14160	122	0.006	7.1E-06	0.001	0.000	0.001	0.004	0.161	1.2E+06
Monocacy Creek	16495	336	0.008	1.0E-05	0.004	0.001	0.000	0.006	0.485	9.0E+05
Manatawny Creek	58602	214	0.008	1.1E-05	0.003	0.001	0.001	0.005	0.332	1.7E+06
French Creek	44912	200	0.008	1.4E-05	0.002	0.000	0.001	0.007	0.247	2.5E+06
Middle Schuylkill 2	65959	269	0.012	4.1E-05	0.003	0.000	0.004	0.019	0.277	7.6E+06
Perkiomen Creek	176313	376	0.014	3.7E-05	0.004	0.001	0.003	0.015	0.457	6.9E+06
Valley Creek	15810	528	0.032	1.2E-04	0.006	0.001	0.010	0.052	0.636	2.1E+07
Middle Schuylkill 1	40614	493	0.030	1.4E-04	0.006	0.001	0.011	0.053	0.403	2.5E+07
Wissahickon Creek	40754	538	0.033	1.5E-04	0.007	0.001	0.010	0.050	0.434	2.7E+07
Lower Schuylkill	12485	379	0.028	1.3E-04	0.005	0.001	0.010	0.053	0.215	2.3E+07

* Areas reflect portions of the major shed within the boundary of the Zone B delineation.

Although the estimated total daily contaminant loads for the Perkiomen Subwatershed are relatively high in all contaminant categories, the load per area is much lower than the Middle Schuylkill and the Lower Schuylkill subwatersheds, since about 90% of the area is agriculture or forested. Also, the Perkiomen Subwatershed is ten times larger and has greater total pollutant loads than the area contributed by the Maiden Creek Watershed to the Zone B delineation, yet the Maiden Creek Watershed has comparable pollutant loads per area for most of the contaminant categories.

The contaminant loading results for the area within Zone B, including Zone A, for the Queen Lane Intake are summarized below:

Cryptosporidium: The concentrated areas of highest pollutant estimates are located in the Perkiomen and Upper Schuylkill through which the main-stem Schuylkill River flows. The Wissahickon and Middle Schuylkill also have high estimates of *Cryptosporidium* loads from runoff. The Tulpehocken and Upper Schuylkill have the highest daily loads per area, because a relatively high percentage of these subwatershed areas are characterized as pasture or hay, which has the highest EMC for *Cryptosporidium*.

Disinfection by-Products: The higher EMCs for disinfection by-products are associated with developed land use categories such as commercial/industrial/ transportation and residential. The areas of highest pollutant loading are located in the Upper Schuylkill and Perkiomen watersheds. Wissahickon Creek, Valley Creek, and Middle Schuylkill One have relatively high daily pollutant loads per area.

Metals/Heavy Metals: The concentrated areas of highest pollutant estimates are located in the Perkiomen, Wissahickon, Middle Schuylkill One and Middle Schuylkill Three watersheds. On a per area basis, Valley Creek, Perkiomen Creek, Middle Schuylkill One and Lower Schuylkill contribute the most metal loading.

Conservative Nutrients: The concentrated areas of highest pollutant estimates are located in throughout the Upper Schuylkill and Perkiomen Creek subwatersheds. The Wissahickon Creek, Tulpehocken Creek, and Upper Schuylkill watersheds have high estimates of daily loads per acre.

Non-conservative Nutrients: The concentrated areas of highest pollutant estimates are located in throughout the Upper Schuylkill and Perkiomen Creek subwatersheds. No watersheds stand out as having high estimates of daily loads per acre.

Petroleum Hydrocarbons: The highest EMCs for petroleum hydrocarbons are associated with commercial/industrial/transportation areas, followed by residential land use categories. The concentrated areas of highest pollutant estimates are located in the Middle Schuylkill, the Wissahickon and the Perkiomen watersheds. The highest daily loads per area occur in lower portions of the watershed, Valley Creek, Wissahickon Creek, and the Lower and Middle Schuylkill River.

Salts: The higher EMCs for salts are associated with developed land use categories such as commercial/industrial/transportation, mining, and residential, listed in decreasing order. The concentrated areas of highest pollutant estimates are located in the Middle Schuylkill, Wissahickon, and Perkiomen watersheds. and Lower Schuylkill. The highest daily loads per area occur in lower portions of the watershed, Valley Creek, Wissahickon Creek, and the Lower and Middle Schuylkill River.

Turbidity: The concentrated areas of highest pollutant estimates are located in the Upper Schuylkill and Perkiomen Creek. On a per acre basis, the highest loads occur in the Upper Schuylkill and Tulpehocken Creek watersheds.

Total/Fecal Coliform: Generally, the concentrated areas of highest pollutant estimates are located in the Middle Schuylkill, the Wissahocken Creek and Perkiomen watersheds. The highest daily loads per area occur in lower portions of the watershed: Valley Creek, Wissahickon Creek, and the Lower and Middle Schuylkill River.

The summary of the results from the SLRM show the pollutant loads over the entire watershed to the smaller subwatershed contributions. The contaminant loads are not only dependent on the land use types, but also soil properties, subwatershed slopes, depression storage, and climate conditions. The estimates from the SLRM were further used in the qualitative loading analysis portion of the susceptibility analysis.

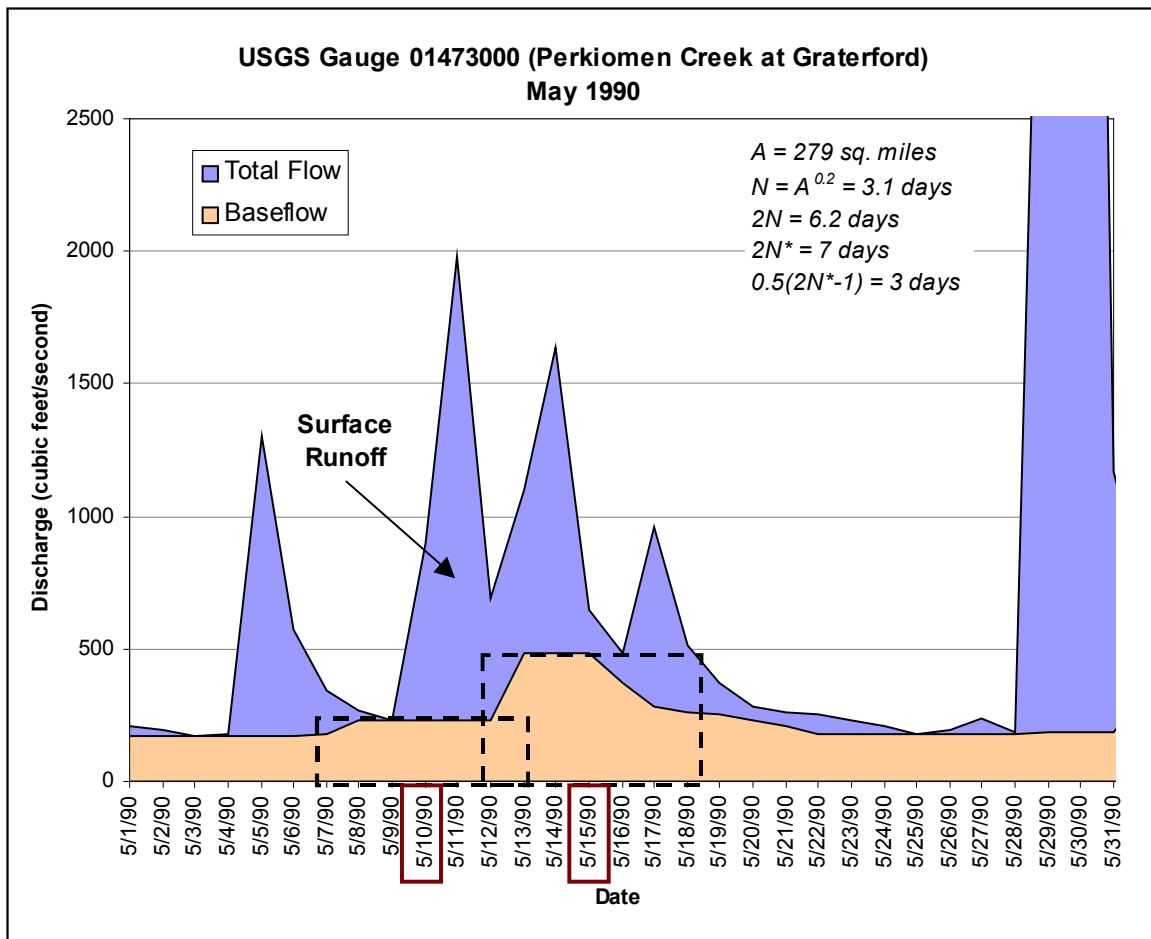
3.2.3.3 Hydrograph Separation for Baseflow and Runoff Calibration

In order to assess the reliability of the pollutant loads from SWMM, a hydrograph separation analysis was done to compare with runoff quantities and water quality loads from the SLRM. A hydrograph separation program was created in SAS® to divide the total flow into baseflow and surface runoff. This program was modeled after the USGS's HYSEP computer program, but assumes only one of its three hydrograph separation methods, the sliding-interval method. The hydrograph separation yields total flow, baseflow, and runoff values in daily, monthly, seasonal, and annual averages. The daily average flows were obtained from the USGS for gauges located in the Schuylkill River Basin.

The sliding-interval method associates a baseflow with a selected day by taking an equal interval before and after that day and assigning the lowest discharge to that day. The intervals are calculated based on the drainage area. For example, as shown in Figure 3.2.3-4, the drainage area for the USGS gauge located in the Perkiomen Creek at Graterford has a drainage area of 279 square miles. The interval after surface runoff is 3.1 days. The interval for finding the baseflow is applied before and after a specified day. Thus, total duration is twice the calculated interval (6.2 days) and then rounded to the nearest odd number greater than that value (7 days) to include the interval before and after and that day as well. Three is the minimum duration used in the sliding interval method. The selected day should be the median with equal durations before and after to associate the lowest discharge within the entire interval. For the Perkiomen Creek at Graterford, the total interval is 7 days and the "windows" for May 10, 1990 and May 15, 1990 are displayed in Figure 3.2.3-4. The baseflow designated to March 10, 1990 is 232 cubic feet per second and March 15, 1990 is 484 cubic feet per second.

The surface runoff is the difference between the total streamflow and the baseflow, as described above. In Figure 3.2.3-4 the darker shaded area (light purple), is the remainder of the total flow that is designated as surface runoff.

Figure 3.2.3-4 Hydrograph Separation Analysis for the Perkiomen Creek at Graterford for May 1990.



The hydrograph separation was conducted for the active USGS gauges in the Schuylkill Watershed. The values are average annual flows in cubic feet per second and inches per year for the period of record available for each gauge. The percent runoff is the amount of total flow that is assumed to be surface runoff. The total flow, baseflow, and runoff values were converted to inches per year by dividing the flows by the drainage area. Excluding the stations that are influenced by interbasin transfers of water supply in the East Branch Perkiomen (Stations 01472620 and 01472810), the average annual runoff is 7.7 inches per year.

Since there is seasonal variation in the flows, the average baseflow and surface runoff values were also calculated by season. Generally, the average seasonal baseflow was highest in the spring, winter, summer, and then fall (in descending order). Often the average season baseflow was two to three times greater in the spring than the summer. Seasonal surface runoff for the winter, spring, summer, and fall averaged 9.9, 9.5, 4.7, 6.1 inches per year, respectively.

The USGS streamflow hydrograph separation results were used to calibrate the results from the SLRM. Since there is evidence of seasonal variability, the calibration of the SLRM was done on a seasonal basis. Comparing the simulated values with the hydrograph separation results, parameters in the SLRM were further refined.

3.2.4 Susceptibility Analysis

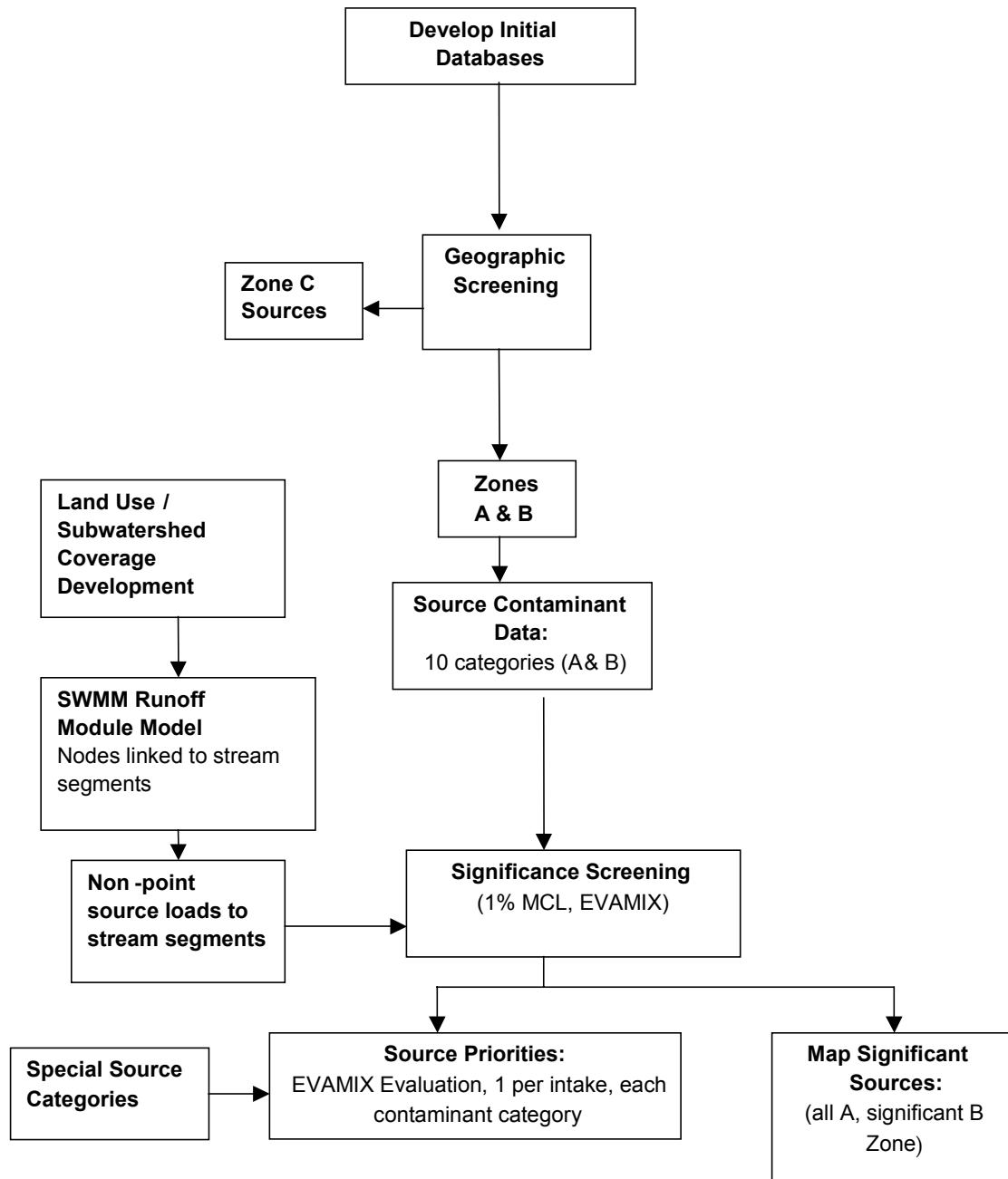
Key Points

- A series of successive screenings was used to identify those sources that have the greatest potential to affect water quality at the Queen Lane Intake.
- Five non-conservative contaminant categories and five conservative contaminant categories were selected to represent all potential contaminants.
- For each category, a threshold value indicative of the significance of the concentrations of contaminants that could result from a potential spill or discharge was defined.
- EVAMIX, a multi-criteria software package, was used along with information from the Technical Advisory Group, to prioritize the potential significance of each of the potential point sources within Queen Lane's Zone A and Zone B, and to evaluate the potential significance of non-point sources estimated by the Schuylkill River Runoff Loading Model.
- NPDES and nonpoint source discharges within the Queen Lane Intake's Zone A and Zone B were determined to have the highest protection priorities in the watershed.
- The potential significance of each source of contamination was designated A (potentially significant source of highest protection priority) through F (Potential source of lowest protection priority). Those sources ranked A through C are potentially significant sources of contamination to the Queen Lane Intake.
- All of the highest ranked sources are either NPDES sites or storm water loadings from specific subwatersheds.
- Contaminant sources actually discharging to the river (e.g., NPDES permitted point sources, or stormwater runoff) are estimated to have greater potential significance than those with only the potential to release contaminants to the river (e.g, a spill or leak).
- EVAMIX was also used to rank potential sources for each contaminant category.

3.2.4.1 Method

Because of the large number of potential sources of contamination that have been identified, the method behind the susceptibility analysis relies on a process of successive screenings. These screenings help focus the efforts of source water protection on those sources that have the greatest potential to affect the water quality of the source water at the intake. The process of screening is shown in Figure 3.2.4-1, and described in this section. The section starts with an introduction to the ten contaminant categories being considered.

Figure 3.2.4–1 Flow Diagram of Screening Process



Contaminant Categories

There are two difficulties faced in trying to prioritize potential sources of contamination of the drinking water. Because the Schuylkill Watershed is very large, there are thousands of potential sources to be assessed. In addition, the assessments must also cover a full range of contaminant types. The PADEP guidance indicates that the best approach is to try to group all potential contaminants into a limited number of contaminant groups, and then assess all sources for each of the contaminant categories. For this study, ten contaminant categories have been developed. For each category, a planning level threshold concentration based either on ambient water quality in the Schuylkill River, or on regulatory standards such as the drinking water standard has been established. This threshold value is used as a relative measure of the significance of contaminant concentrations that could potentially occur due to a spill or discharge from each of the sources. Each category is summarized below.

Non-Conservative Contaminants

There are five contaminant categories that can be considered “non-conservative” contaminants. That means that, once spilled or discharged into the river, the concentration that results will decrease as the spill moves downstream, either because the contaminant dies off, evaporates into the air, or attaches itself to silt particles and settles to the bottom of the river. The non-conservative contaminant categories are:

- 1. Total/Fecal Coliform:** Fecal coliform is used as the indicator contaminant for this category. The suggested threshold value is the recreational water standard of 200 count/100 ml. Fecal coliform tends to die off over time within the river.
- 2. Turbidity:** Turbidity can be measured directly, but most existing data relates to Total Suspended Solids (TSS), and this is used as an indicator for turbidity. The suggested threshold comes from median ambient conditions in the river, approximately ten mg/l. TSS tends to settle to the bottom of the river over time.
- 3. Nutrients:** There are several contaminants in the nutrient category. Phosphorous was selected as one indicator for this category. The suggested threshold value comes from the median ambient conditions in the river, approximately 0.12 mg/l. Some portion of the total phosphorus concentration is associated with phosphorus adhering to silt particles, and tends to settle to the bottom of the river over time.
- 4. VOC/SOC:** This category is particularly challenging because it includes hundreds of compounds. To meet this challenge, it was decided that the total amount of VOC/SOC present at a site would be used as an indicator for this category. Because there are so many different potential threshold values for this large and diverse category, a very conservative threshold of five ug/l is used. This is the drinking water standard for benzene, as well as many other of the most toxic solvents. By comparing the total VOC/SOC concentration generated by a spill or discharge with this conservative threshold, even small spills or discharges will be deemed significant. VOCs and some SOC can evaporate or “volatilize” from the river; others can attach themselves to silt and settle to the bottom of the river. Both have the effect of reducing concentrations in the river over time.

5. Metals: This category is also challenging because numerous metals are included. The total amount of metals present at a site is used as an indicator. Because there are many different potential threshold values for various metals, a conservative threshold of 0.015 mg/l was selected. This is the regulatory standard for lead in drinking water, and is lower than for most metals. Most metals tend to attach themselves to silt and settle to the bottom of the river, lowering concentrations in the river over time.

Conservative Contaminants

Five contaminant categories can be considered to be “conservative”. Concentrations of conservative contaminants are only affected by dilution, and do not decrease through other means. The five categories are:

6. *Cryptosporidium*/*Giardia*: A potential threshold value is difficult to define for this important potential contaminant category for surface water sources. A value of only one oocyst per liter has been selected for a screening threshold based on potential health impacts.

7. Nutrients: Nitrate, a second common nutrient was also selected for analysis because of its prevalence in the watershed. The drinking water standard of ten mg/l was used for the threshold value.

8. DBP Precursors: Disinfection by-products are a concern for drinking water systems that chlorinate. A good indicator for this contaminant category is Total Organic Carbon (TOC). The threshold value was set based on the median ambient concentration in the river of approximately 2.7 mg/l.

9. Petroleum Hydrocarbons: Oil and oil-based products are common contaminants. This category contains a large variety of individual contaminants, and Total Petroleum Hydrocarbons (TPH) was chosen as the indicator contaminant. A threshold value was selected of five mg/l based primarily on standards applied at hazardous waste site remediation.

10. Salts: For this category, chloride was selected as the indicator contaminant. The drinking water standard of 250 mg/l was selected as the threshold value.

Zone Based Screening

The first screen applied to eliminate less important sources makes use of the zone concept recommended by PADEP for use in the SWAP:

- **Zone A:** the critical segment covering $\frac{1}{4}$ mile on either side of the stream upstream of the intake within a five-hour travel time to the intake. All potential sources within this zone are included in the subsequent steps.
- **Zone B:** a second segment located within two miles of either side of the stream upstream of the intake, within a 25-hour travel time to the intake. All potential sources within this zone are also included in the subsequent steps.

- Zone C: the rest of the upstream watershed. These sources remain listed in the database, but are eliminated from further analysis because they are deemed less significant than sources in zones A and B.

The PADEP zone concept is used to narrow the list of sources down to those with higher priority. Zone C sources are dropped from further analysis within this preliminary assessment, leaving those sources within zone A or B for the intake.

Multi-Criteria Evaluation (EVAMIX)

Following the zone based screening, the most important screening and evaluation method used for most of the analysis relied on a multi-criteria evaluation software package called EVAMIX. EVAMIX is a matrix-based, multi-criteria evaluation program that makes use of both quantitative and qualitative criteria within the same evaluation, regardless of the units of measure. The algorithm behind EVAMIX is unique in that it maintains the essential characteristics of quantitative and qualitative criteria, yet is designed to eventually combine the results in a single appraisal score. This critical feature gives the program much greater flexibility than most other matrix based evaluation programs, and allows the evaluation team to make use of all data available to them in its original form.

EVAMIX makes a pair by pair comparison of all contaminant sites under evaluations across all evaluation criteria, resulting in thousands of computations. The computations eventually result in an overall appraisal score. This is a single number, attached to a single alternative, and represents the overall worth of that alternative relative to the other alternatives based on the criteria selected, and the weights attached to the criteria. This number is used to determine the final ranking of alternatives from best to worst, or most important to least important.

EVAMIX offers several important advantages when used in planning studies:

- The alternatives under consideration are clearly defined;
- The criteria used in evaluating the alternatives are explicit and measurable;
- The algorithm can handle both quantitative and qualitative data, utilizing all available data to the highest degree of measurability possible;
- The priorities underlying the evaluation are made explicit and can be flexibly applied to highlight the effect that weighting has on the final ranking; the technique is flexible enough to handle new data as it becomes available; and the technique is applied using widely available software (Excel spreadsheets).

The use of EVAMIX requires the development of a two dimensional matrix consisting of the options to be evaluated (columns) and a set of evaluation criteria (rows). For every combination of options and criteria, a score is assigned. The choice of the criteria is governed, in part, by the need for the scoring to be as objective as possible. By objective, we mean that the scores should represent impartial data and information useful in

making decisions. The criteria must be clear and unambiguously defined, and can be set up as either quantitative criteria (e.g. threshold concentration in percent, time of travel in hours), or qualitative criteria (e.g. discharge frequency, location etc.).

The other input variable required for the evaluation procedure is the selection of weighting factors for each of the criteria. While the scoring process strives to be as objective as possible and is carried out by the project team, the selection of weights is inherently subjective and should be done by the decision makers, planners, or stakeholders. Unlike the matrix of scores, numerous possible weight sets are possible, and all are equally “valid”.

A workshop was held in June 2001, at which members of the Technical Advisory Group participated in exercise designed to develop a representative set of criteria weights. These weights formed the basis for the evaluation.

Point Source Screening

Point source data come from a number of data sources, and each database can contain hundreds of potential sources. Less important point sources needed to be screened out leaving only the most important sources for final ranking. A slightly different screening approach was needed for each type of source because of the data available and the structure of the databases.

The point source screening approaches for each of the main data sources are summarized in this section.

1. PCS Database

This database contained over 500 individual facilities, over 200 of which are wastewater or sewage disposal facilities. These can be divided into major facilities with discharges of more than one MGD and minor facilities with discharges of less than one MGD. Default flows of one MGD for large facilities and 0.1 MGD for small facilities were used along with assumed concentrations based on the site SIC code and existing median concentrations for similar facilities where data were unavailable. The screening approach consisted of calculating potential concentrations of contaminants resulting from each source at the intake, and comparing against threshold values for each contaminant category. The estimated concentration at the intake for each site included in the PCS data was calculated including dilution at the intake but not including decay, volatilization, or die off. If the impact was more than one percent of the threshold, it passed the screen, otherwise it was screened out.

2. CERCLA

There were almost 400 CERCLA sites representing hazardous waste sites of all kinds upstream from the Belmont WTP Intake. These are known sites that have contamination, but cannot easily be fit into a simple point source screening because there is no information on the discharges and concentrations from these sites. For this reason, they

must be handled separately in a narrative analysis that uses simple criteria and engineering judgment to determine which sites are of the most concern.

The narrative evaluation considered the following:

- Presence in the floodplain (FEMA 100 year floodplain);
- Location/Distance/Time of travel to the intake;
- National Priority Site Listing (Superfund);
- Status of cleanup at the site;
- Surface Water Migration Score from SCORECARD (www.scorecard.com) representing potential for migration of contamination from the site to surface water, and
- Identified by stakeholders and water suppliers as site of concern.

A site in the floodplain would be a higher priority for protection. However, this ignores that in some cases, storm sewers could transport contamination to a stream. This is a secondary screen. All remaining sites not in the floodplain will be screened out if they are not an NPL site.

Of all the CERLCA sites, 23 sites are part of the National Priority List. Within that group, several were mentioned by stakeholders as sources of concern.

3. RCRA

There are more than 1,500 RCRA facilities in the study area with little actual data on quantities stored or used at the sites. To address this problem, default quantities were assigned. Chemicals used at each facility were estimated based on SIC codes. Where such codes were unavailable, the State Guidance categories were used.

The screening approach for RCRA sites contained several steps:

1. RCRA sites with only Underground Storage Tanks (USTs) were screened out because they pose little threat to the surface waters.
2. RCRA sites that are not UST or Aboveground Storage Tanks (ASTs) were screened using the following guidelines:
 - Floodplain: if the site is not in the floodplain, it is screened out, and
 - If there are no reported spills, violations, or releases according to the Right to Know data, it is screened out.

3. Those sites with ASTs required a separate EVAMIX screening. There were over 300 sites with listed ASTs. The procedure for performing the impact screening relied on EVAMIX and the following screening criteria:

Total Tank Volume: in gallons of total tank volume. Larger tank volume meant a higher priority.

Volume Weighted Chemical Ranking: an additive score representing the types of chemicals stored onsite, each weighted by the percent of total tank volume used to store that category of contaminant. In this case, the chemicals are rated according to their impact on the treatment system and the ease with which the current treatment can handle the contaminant in the raw water. This results in a ranking of contaminant categories in order of decreasing importance to the treatment process with points assigned as follows: VOCs/SOCs (ten), Cryptosporidium (nine), Metals (eight), Petroleum Hydrocarbon (seven), Nitrate (six), TSS (five), Chloride (four), TOC/DBP precursors (three), Phosphorus (two), Fecal Coliform (one). Each contaminant category gets a score (ten for VOCs, nine for Cryptosporidium etc. down to one for Fecal Coliform. For each category, the rank number is multiplied by the fraction of total tank volume of that contaminant to the total tank volume onsite. The weighted categories are then added up. For example, a site with VOCs (10,000 gal tank) and salts (90,000 gal) would score $10 \times 0.1 + 4 \times 0.9 = 4.6$.

Leaks Reported: a qualitative score of one for a leak, a score of zero for no leak.

Tank Age: a quantitative score in years after date of installation.

Location: a qualitative score that checks if the site is within floodplain or not (score of three), in Zone A (score of two), or in Zone B (score of one).

Travel Time: a quantitative score in hours based on the time of travel from the site to the intake using peak flows.

The criteria were weighted based on the results of the Technical Advisory Group and discussions with the project team. The weights are:

- Tank Age: 12%
- Total Tank Volume: 36%
- Vol. Weighted Chemical Ranking: 15%
- Leak History: 10%
- Location: 21%
- Travel Time: 5%

The screening of RCRA sites resulted in two lists of sites moving through the screen: non-AST sites that reported spills and are within floodplain, and ASTs that pass the EVAMIX screening.

4. TRI Sites

There are over 200 TRI sites that manufacture or use toxic chemicals. These sites, however, do not discharge contaminants. The database lists the contaminants onsite, including: VOCs, metals, nutrients, and chloride. To focus on the high priority sites, an EVAMIX screening was required, based on the following criteria:

Location: if in flood plain (three points), zone A (two points) or zone B (one point):

Chemicals Listed: a score was given based on the acute effects on health of each contaminant category, resulting in the following scores: VOCs/SOCs (ten), Cryptosporidium (nine), Metals (eight), Petroleum Hydrocarbon (seven), Nitrate (six), TSS (five), Chloride (four), TOC, /DBP precursors (three), Phosphorus (two), Fecal Coliform (one). For sites with more than one category, the scores were the sum of the rank of chemicals listed (e.g. a site with VOCs and Metals would score $10 + 8 = 18$).

Amount Stored: based on the range listed in the database, in kg per year

Number of releases to water: total number of releases in database

Travel Time: the time of travel from a spill at the site to the intake.

Criteria weights were applied within the EVAMIX screening as follows:

- | | |
|--------------------------------|----|
| • Location: | 15 |
| • Chemicals Listed: | 20 |
| • Amount Stored: | 35 |
| • Number of releases to water: | 25 |
| • Travel Time: | 5 |

Non-point Sources Runoff Screening

Potential non-point sources were identified using the SWMM model and Event Mean Concentrations (EMCs) to calculate total annual pollutant loading for each subwatershed.

Because there are over 150 subwatersheds, EVAMIX screening was applied using three criteria. These were:

Relative Impact at Intake (weight 60%):

This criterion is based on the concentration of contamination potentially caused by the source at the intake as a percent of the contaminant category threshold value. Since there are potentially ten values, one for each contaminant category, only the highest ranked category or greatest relative impact chemical category was used for this criterion.

Time of Travel (weight 20%):

This is a criterion calculated as the time of travel from source to intake, based on high flow velocity.

Location (weight 20%):

This criterion scored watersheds as two if in Zone A, and one if in Zone B.

The highest ranked subwatersheds passed through to the full ranking of sources.

Source Priorities: Full Evamix Ranking of All Sites

Finally, all the significant (those that passed the screening) point sources and runoff loads (entered as pseudo point sources) were prioritized, accomplishing the main goal of the assessment. There were two types of final rankings. The first ranking was a combined ranking of sites from all categories, compared against each other. The second ranking was by contaminant type, with all significant sources contributing to a particular contaminant category included.

Multi-criteria Ranking using EVAMIX: Combined Sources

EVAMIX was used to rank all sources over the entire range of contaminant categories. Full ranking allowed us to compile a final list of sources, independent of contaminant class. The following criteria were used:

Relative Impact at Intake (weight 12%):

This criterion is based on the concentration of contamination potentially caused by the source at the intake as a percent of the contaminant category threshold value. Since there are potentially ten values, one for each contaminant category, only the highest-ranked category or greatest relative impact chemical category was used for this criterion.

Time of Travel (weight 5%):

This is a criterion calculated as the time of travel from source to intake, based on high flow velocity.

Potential for Release/Controls (weight 14%):

This was developed using the qualitative categories taken from the State SWAP guidelines.

High: no control practices, or a regulated discharge not in compliance with regulations (four points)

Medium/High: a non-point source with no BMP in place, or regulated discharge and in compliance with regulations (three points)

Medium: a non-point source with BMP in place, or a point source not regulated but contained in some way (retaining wall, double-walled tank etc.) with no emergency response plan (two points)

Low: a regulated point source by the State, containment, and/or emergency response plan (one point)

Potential Release Frequency (weight 14%):

A qualitative criterion based on following scores:

Very High: a continuous discharger, five points

High: an intermittent or rainfall related (CSO, SSO, NPS) discharger, four points

Medium: a discharge with roughly a monthly frequency, three points

Low: a discharge with roughly an annual frequency, two points

Very Low: a discharge that occurs only as a catastrophic spill, or a storm related discharge with about a 100-year occurrence frequency, one point

Violation Type/Frequency (10%):

A qualitative criterion based on the following scoring:

High: Operation or Effluent Violations, three points

Medium: Management Violations, two points

Low: Administrative Violations or none, one point

In this case, points are cumulative for each violation within the last three years in each category. For example two violations for not filing paperwork (2 x 1) plus an effluent violation (three points) would result in a score of five points.

Location (weight 5%):

A qualitative criterion based on GIS analysis according to the following categories:

In the Floodplain: three points

In Zone A: two points

In Zone B: one point

Existing Removal Capacity (weight 10%):

A criterion with qualitative scoring based on the chemical released and the ability of the existing treatment to remove it. Scoring was according to the following system:

Not removed (salts, radionuclides, nitrates): three points

Limited removal (*Cryptosporidium*, SOCs, VOCs, Petroleum Hydrocarbons, Phosphorus, TOC): two points

High removal (fecal coliform, TSS, metals): one point.

Scores were cumulative for each category present at the site.

Impact on Treatment Operation (weight 10%):

A criterion with qualitative scoring based on chemical released and its impact to the operation of the treatment systems in place. Scoring was according to the following system.

High (TSS, VOCs, Petroleum Hydrocarbon): four points

Medium/High (metals, TOC): three points

Medium (*Cryptosporidium*, nitrate, phosphorus): two points

Low (fecal coliform, chloride, radionuclides): one point

The score is cumulative over all categories present.

Potential Health Impacts (weight 20%):

A criterion with qualitative scoring based on the contaminant released and its potential acute impact on health if not removed. Scoring was according to the following system:

High (*Cryptosporidium*, SOCs, VOCs, radionuclides, fecal coliform): three points

Medium (TOC, metals, nutrients, nitrate): two points

Low (salts, TSS, phosphorus): one point

The score is cumulative over all categories present.

This ranking resulted in a single list of sources for the intake showing high, medium, and low priority sources from all categories.

EVAMIX Ranking by Contaminant Category

Ranking by contaminant category was completed using six criteria and the multi-criteria evaluation program EVAMIX. Criteria (with weights from the June 2001 Technical Advisory Group Meeting) are given below.

Relative Impact at Intake (weight 40%):

This criterion is based on the concentration of contamination potentially caused by the source at the intake as a percent of the contaminant category threshold value.

Time of Travel (weight 5%):

This is a criterion calculated as the time of travel from source to intake, based on high flow velocity.

Potential for Release/Controls (weight 20%):

This was developed using the qualitative categories taken from the State SWAP guidelines.

High: no control practices, or a regulated discharge not in compliance with regulations (four points)

Medium/High: a non-point source with no BMP in place, or regulated discharge and in compliance with regulations (three points)

Medium: a non-point source with BMP in place, or a point source not regulated but contained in some way (retaining wall, double walled tank etc.) with no emergency response plan (two points)

Low: a regulated point source by the state, containment and/or emergency response plan (one point)

Potential Release Frequency (weight 15%):

A qualitative criterion based on following scores:

Very High: a continuous discharger, five points

High: an intermittent or rainfall related (CSO, SSO, NPS) discharger, four points

Medium: a discharge with roughly a monthly frequency, three points

Low: a discharge with roughly an annual frequency: two points

Very Low: a discharge that occurs only as a catastrophic spill, or a storm related discharge with about a 100-year occurrence frequency, one point

Violation Type/Frequency (weight 15%):

A qualitative criterion based on the following scoring:

High: Operation or Effluent Violations, three points

Medium: Management Violations, two points

Low: Administrative Violations or none, one point

In this case, points are cumulative for each violation within the last three years in each category. For example two violations for not filing paperwork (2x1) plus an effluent violation (three points) would result in a score of five points.

Location (weight 5%):

A qualitative criterion based on GIS analysis according to the following categories:

In the Floodplain: three points

In Zone A: two points

In Zone B: one point

Results from each of the ten contaminant categories based evaluations resulted in a listing of high, medium, and low priority sites for that contaminant category.

Final Ranking Categories

The final results of the rankings are broken down into six major categories according to the PADEP's SWA Plan. These are represented by designations A through F with A representing sources of highest protection priority and gradually decreasing to F for sources of lowest protection priority. This designation process was initially designed for intakes with a limited number of sources where the whole inventory could be ranked. However, given the large number of sources and the ranking process, sources that are represented by designations D through F were screened out in the significance screening process. Therefore, the sources ranked in the document are considered potentially significant sources of contamination and will fall into categories A through C. They are described in Table 3.2.4-1. The numbers indicated on the map correspond to identification numbers for the various sources in the tables.

Table 3.2.4-1 Contaminant Source Ranking Designations

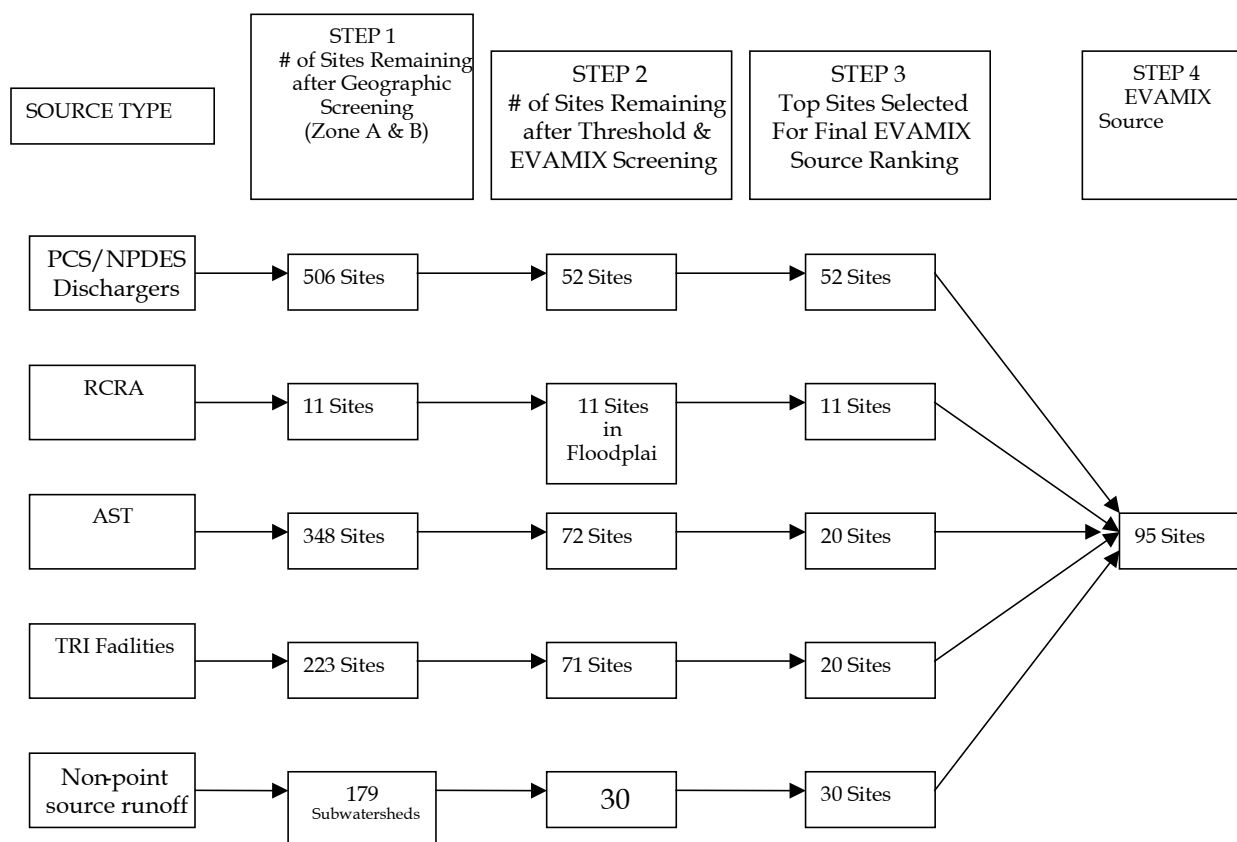
Designation	Description
<i>Potentially Significant Sources of Contamination to Water Supply</i>	
A	Potentially Significant Source of Highest Protection Priority
B	Potentially Significant Source of Moderately High Protection Priority
C	Potentially Significant Source of Moderate Protection Priority
<i>Remaining Sources From Inventory Screened Out By Significance Screening Criteria</i>	
D	Potential Source of Moderately Low Protection Priority
E	Potential Source of Low Protection Priority
F	Potential Source of Lowest Protection Priority

As shown, the sources in categories A through C may require additional ground-truthing in order to provide a more accurate designation of their significance. Sources in category D though not considered potentially significant may need to be evaluated as more information becomes available that may make them more potentially significant.

3.2.4.2 Results

Figure 3.2.4-2 is a flow diagram of the screening and ranking process. The process was used to successively select the most important sites from each of the databases available, and combine them in an organized manner to produce a final list of high priority sites. The process can be compared to a playoff elimination process, with various divisions providing a set number of teams to the overall playoff. Like such playoff structures, it can occur that a site will not be included in the final list because it was eliminated in competition with other sites within its categories. (To follow the analogy, the fourth best team in a division is not invited to the playoffs, even if it is better than the third best team from another, weaker division, because only the top three teams are invited from each division.) Despite this fact, the process does provide the top sites from each database category, and provides valuable insight into the relative importance of category of sites.

Figure 3.2.4-2 Screening and Ranking Process



Enough sites were included from each category to make sure that no highly ranked sites would be overlooked.

The diagram shows that there were several screening steps (or elimination rounds) leading to the final ranking. These are described briefly below.

Zone Based Screening

The lists of potential sources of contamination started with all of the sites included in the PCS, RCRA, AST, and TRI databases. Once all had been located and coordinates assigned, those in Zone C were eliminated from consideration. This left 506 sites from the PCS database (essentially those with a surface water discharge permit), 348 sites listed with above ground storage tanks (ASTs), and 223 facilities from the TRI database (sites that generate or handle toxic chemicals). In addition, all of the subwatersheds that are upstream of the intake and within the travel times of Zone A or B were also included (179 subwatersheds). RCRA sites that only had underground storage tanks were also

eliminated. It was decided that only RCRA sites located within the floodplain were of concern in this round of analysis, and the 11 sites that met this condition were included in the analysis.

Database Based Screening

The zone based screening still left over 1,000 sites that needed to be screened further to a manageable number. This was done either by simple threshold screening, based on the amount of contaminants stored or used, or by a more complex evaluation using several criteria.

Threshold Based Screening

For one of the categories, (PCS) simple threshold screening was an effective approach for screening.

PCS Sites: As described in section 3.2.4.1, the percent change in the concentration of a chemical at the intake due to releases from each site could be roughly estimated, and this was used to screen the 506 PCS (NPDES) sites. This threshold screening was performed to select the largest dischargers. A cutoff of a 1 percent change in concentration at the intake was used as the threshold percentage. The percent change was based on the assumed or actual discharger load being input at the intake. Assuming the load was at the intake was considered to be a conservative approach. Of the 506 sites, only 52 sites could potentially affect concentrations at the intake by more than one percent. Most of the others were much too small to have a measurable impact and were eliminated from further analysis.

Criteria Based Screening

For the AST sites, TRI sites, and the subwatersheds (stormwater pollutant loading), a more sophisticated approach was required to adequately select the most important sites from each category. Several criteria were used, along with the multi-criteria evaluation program EVAMIX to perform each of these screening analyses. Sites were ranked in descending order of importance, and the top sites were selected based on the results of the ranking.

AST Sites: EVAMIX screening resulted in a ranking of all the sites based on six criteria. The criteria were age of the tank, storage volume of the tank, chemical ranking based on the mix of chemicals onsite, whether there have been leaks in the past, the location relative to the river, and the travel time to the intake (see section 3.2.4.1 for details). From the 348 sites, the 72 highest ranked sites passed the screen, and the top 20 sites were included in the final ranking. AST sites in general scored low in comparison to the other types of sites, and fewer were included to allow more room for TRI, PCS, and subwatersheds (NPS or non-point sources). The results of the final ranking (Table 3.2.4 - 1) confirmed that most AST sites had very low rankings.

TRI Sites: EVAMIX screening resulted in a ranking of all the TRI sites based on five criteria. The criteria were amount of chemical stored, chemical ranking based on the mix of chemicals onsite, whether or not releases to water have been reported, the location relative to the river, and the travel time to the intake (see section 3.2.4.1 for details).

From the 223 sites, 71 sites passed through the screening procedure, and the 20 highest ranked sites were used in the final ranking.

NPS Subwatersheds: There were 179 subwatersheds that could be considered to be within the Queen Lane intake's zone A or B. A screening of these 179 subwatersheds for their potential impact due to stormwater pollutant loading was performed using EVAMIX and three criteria. The first criterion was the relative impact, measured as the expected concentration from the pollutant runoff at the intake, divided by the threshold number for that contaminant category. Because there were nine contaminant categories relevant to stormwater runoff, the highest relative threshold was used (excluding fecal coliform). The other two criteria were location and time of travel to the intake. The subwatersheds or NPS sources were relatively important, and the 30 highest ranked subwatersheds were included in the final ranking.

Source Priorities: Full EVAMIX Ranking of All Potential Sources

All of the significant point sources and runoff loads (entered as pseudo-point sources) that passed the screening process were lumped together for a final ranking, once again using EVAMIX. There were 132 mixed sites. Because EVAMIX can only handle evaluations of fewer than 100 sites, the final screening occurred in two steps, eventually producing a list of the top 95 sites for the Queen Lane Intake. This important, final ranking of the mixed group of sites used the nine criteria described above in section 3.2.4.1. The criteria weights were those established during the Technical Advisory Group workshop.

Relative Impact at Intake (weight 12%)

Time of Travel (weight 5%):

Potential for Release/Controls (weight 14%):

Potential Release Frequency (weight 14%):

Violation Type/Frequency (weight 10%):

Location (weight 5%):

Existing Removal Capacity (weight 10%):

Impact on Treatment Operation (weight 10%):

Potential Health Impacts (weight 20%):

Table 3.2.4 -2 lists the 95 point sources and non-point sources that passed the screening. The table is organized into roughly three groups of sites in descending order of priority as calculated by EVAMIX. The table has eight columns.

Column 1: Source ID code: a unique database source code

Column 2: Source Name, the name as listed in the database

Column 3: Primary database containing information about the source used in the analysis

Column 4: Point Source subwatershed (NPS)

Column 5: Zone (either A or B)

Column 6: Estimated time of travel to the intake under high flow conditions

Column 7: Relative impact at the intake

Column 8: The priority group (A is highest, B next highest, and C lowest) based on nine criteria and selected criteria weights

Table 3.2.4-2 Final Ranking of Sources for Combined Contaminant Categories

Source ID	Source Name	Database Used	Subwatershed	Zone	Time of Travel	Relative Impact (%)	Priority
1613	UPPER GWYNEDD TWP	NPDES	Wissahickon Creek	Flood Plain	12.5	9.9	Highest-A
665	UPPER MERION MUN UTILITY AUTH	NPDES	Trout Creek	Zone A	8.0	9.6	Highest-A
2455	POTTSTOWN BORO	NPDES	Schuylkill River	Zone B	19.5	29.4	Highest-A
2480	CROMPTON & KNOWLES CORP GIBRALTAR PLT	NPDES	Schuylkill River	Flood Plain	26.2	4.0	Highest-A
2459	STANLEY G. FLAGG & CO. INC	NPDES	Schuylkill River	Zone B	20.9	0.7	Highest-A
2547	NGK METALS CORP.	NPDES	Laurel Run	Zone B	34.1	7.5	Highest-A
2524	CARPENTER TECHNOLOGY CORP	NPDES	Schuylkill River	Zone B	31.5	15.5	Highest-A
781	MONTGOMERY COUNTY SEW AUTH	NPDES	Perkiomen Creek	Flood Plain	10.5	16.0	Highest-A
666	NORRISTOWN MUN WASTE AUTH	NPDES	Schuylkill River	Flood Plain	5.5	891.4	Highest-A
465	WHITEMARSH TWP SEW AUTH	NPDES	Schuylkill River	Zone A	3.5	6.4	Highest-A
664	EAST NORRISTOWN/PLYMOUTH/WHITPAIN JOINT SEWER AUTHORITY	NPDES	Schuylkill River	Flood Plain	5.5	11.8	Highest-A
795	ABINGTON TWP COMM-WWTR TRTMT P	NPDES	Sandy Run	Zone A	11.3	8.6	Highest-A
821	AMBLER BORO	NPDES	Wissahickon Creek	Zone A	8.7	12.2	Highest-A
464	CONSHOHOCKEN SEW TREAT. PLT.	NPDES	Schuylkill River	Zone A	3.5	18.1	Highest-A
2473	LOWER FREDERICK TOWNSHIP TRT P	NPDES	Perkiomen Creek	Flood Plain	16.6	0.2	Highest-A
1734	BOROUGH OF NORTH WALES	NPDES	Wissahickon Creek	Flood Plain	13.2	0.2	Highest-A
2503	BERKS MONTGOMERY MUNICIPAL AUTH	NPDES	Swamp Creek	Flood Plain	23.1	4.5	Highest-A
3800	Schuylkill River-020	NP	Schuylkill River	Zone A	4.5	2.8	Highest-A
622	BRIDGEPORT BORO	NPDES	Schuylkill River	Flood Plain	5.5	0.2	Highest-A
3787	Wissahickon Creek-007	NP	Wissahickon Creek	Zone A	4.9	2.4	Highest-A
2460	SCHWENKSVILLE BOROUGH AUTH	NPDES	Perkiomen Creek	Flood Plain	16.1	0.2	Highest-A
3804	Stony Creek-024	NP	Stony Creek	Zone A	7.0	7.7	Highest-A
535	UPPER MERION TWP. AUTH-MATSUNK WPCC	NPDES	Schuylkill River	Zone B	5.0	5.2	Highest-A
3807	Trout Creek-027	NP	Trout Creek	Zone A	8.0	4.2	Highest-A
3788	Wissahickon Creek-008	NP	Wissahickon Creek	Zone A	8.1	10.8	Highest-A
2677	SPRING CITY BOROUGH SEWAGE PLANT	NPDES	Schuylkill River	Flood Plain	14.5	0.2	Highest-A
2470	BIRDSBORO BORO MUN AUTH	NPDES	Schuylkill River	Flood Plain	24.8	1.5	Highest-A

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Source ID	Source Name	Database Used	Subwatershed	Zone	Time of Travel	Relative Impact (%)	Priority
3789	Sandy Run-009	NP	Sandy Run	Zone A	8.7	3.4	Highest-A
1614	LIMERICK TWP MUN AUTH	NPDES	Schuylkill River	Flood Plain	15.0	1.7	Highest-A
792	PHOENIXVILL BORO STP	NPDES	Schuylkill River	Zone B	11.5	6.3	Highest-A
1068	PECO ENERGY CO-CROMBY GENERATING	NPDES	Schuylkill River	Flood Plain	13.5	0.2	Moderately High-B
2521	PENN RIDGE WASTE WATER TREATMENT AUTHORITY	NPDES	East Branch Perkiomen Creek	Flood Plain	25.4	9.4	Moderately High-B
2454	NORTH COVENTRY MUN AUTH STP	NPDES	Schuylkill River	Flood Plain	19.5	0.2	Moderately High-B
780	VALLEY FORGE SEWER AUTHORITY	NPDES	Schuylkill River	Zone B	10.0	12.7	Moderately High-B
2453	UPPER GWYNEDD-TOWAMENCIN MUN	NPDES	Towamencin Creek	Zone B	16.5	13.1	Moderately High-B
2747	LEESPORT BOROUGH AUTHORITY	NPDES	Schuylkill River	Flood Plain	37.1	0.2	Moderately High-B
2474	EXETER TOWNSHIP WWTR TRTMT PLT	NPDES	Schuylkill River	Flood Plain	25.7	5.8	Moderately High-B
2491	READING CITY	NPDES	Schuylkill River	Zone B	29.5	143.0	Moderately High-B
2476	ALLEGHENY E. CONF. ASSOC. 7TH DAY ADVENTISTS	NPDES	Manatawny Creek	Flood Plain	23.1	0.2	Moderately High-B
2752	120 OLD PHILADELPHI	NPDES	Schuylkill River	Flood Plain	22.8	1.7	Moderately High-B
3815	Valley Creek-035	NP	Valley Creek	Zone B	11.1	4.6	Moderately High-B
2485	BOROUGH OF SOUDERTON	NPDES	Skippack Creek	Zone B	18.5	3.4	Moderately High-B
2536	OLEY TOWNSHIP MUN AUTH	NPDES	Manatawny Creek	Flood Plain	29.8	0.2	Moderately High-B
2492	GPU GENERATION INC TITUS GENERATING STATION	NPDES	Schuylkill River	Zone B	28.6	26.7	Moderately High-B
2509	WYOMISSING VALLEY JOINT MUN AU	NPDES	Wyomissing Creek	Zone B	31.0	2.7	Moderately High-B
3934	Schuylkill River-154	NP	Schuylkill River	Zone B	15.0	3.1	Moderately High-B
3827	Skippack Creek-047	NP	Skippack Creek	Zone B	17.0	3.6	Moderately High-B
3944	Schuylkill River-164	NP	Schuylkill River	Zone B	20.5	4.5	Moderately High-B
2639	LOWER SALFORD TWP AUTH	NPDES	West Branch Skippack Creek	Flood Plain	16.5	0.2	Moderately High-B
2574	HAMBURG MUN AUTH	NPDES	Schuylkill River	Zone B	41.8	9.6	Moderately High-B
3973	Schuylkill River-193	NP	Schuylkill River	Zone B	25.2	4.8	Moderately High-B
2510	ANTIETEM VALLEY MUNICIPAL AUTHORITY	NPDES	Antietam Creek	Zone B	28.6	1.5	Moderately High-B
3838	Mill Creek-058	NP	Mill Creek	Zone B	26.1	4.4	Moderately High-B
3839	East Branch Perkiomen Creek-059	NP	East Branch Perkiomen Creek	Zone B	26.1	4.3	Moderately High-B
3948	Manatawny Creek-168	NP	Manatawny Creek	Zone B	26.8	4.8	Moderately High-B
2626	LOWER SALFORD TWP AUTH	NPDES	Indian Creek	Zone B	20.5	0.2	Moderately High-B
3840	Pleasant Spring Creek-060	NP	Pleasant Spring Creek	Zone B	27.3	8.0	Moderately High-B
3841	Morris Run-061	NP	Morris Run	Zone B	29.2	6.4	Moderately High-B
3843	East Branch Perkiomen Creek-063	NP	East Branch Perkiomen Creek	Zone B	29.8	4.3	Moderately High-B
4018	Schuylkill River-238	NP	Schuylkill River	Zone B	31.5	6.8	Moderately High-B
3985	Tulpehocken Creek-205	NP	Tulpehocken Creek	Zone B	31.5	4.5	Moderately High-B
2631	TELFORD BORO AUTHORITY	NPDES	Indian Creek	Zone B	23.6	0.2	Moderately High-B

Source ID	Source Name	Database Used	Subwatershed	Zone	Time of Travel	Relative Impact (%)	Priority
2556	MAIDENCREEK TOWNSHIP AUTHORITY	NPDES	Willow Creek	Zone B	37.6	0.2	Moderately High-B
2627	UPPER DUBLIN TWP	NPDES	Wissahickon Creek	Zone B	8.7	0.2	Moderately High-B
3989	Plum Creek-209	NP	Plum Creek	Zone B	34.6	11.0	Moderate-C
4062	Schuylkill River-282	NP	Schuylkill River	Zone B	36.1	13.3	Moderate-C
2505	BALDWIN HARDWARE MFG CORP	NPDES	Schuylkill River	Zone B	30.0	0.2	Moderate-C
4023	Willow Creek-243	NP	Willow Creek	Zone B	37.1	7.2	Moderate-C
4063	Irish Creek-283	NP	Irish Creek	Zone B	37.6	15.8	Moderate-C
4066	Pigeon Creek-286	NP	Pigeon Creek	Zone B	39.2	8.0	Moderate-C
2516	SPRING TWP MUN AUTH	NPDES	Cacoosing Creek	Zone B	35.3	1.7	Moderate-C
4065	Leshner Run-285	NP	Leshner Run	Zone B	40.2	5.4	Moderate-C
2719	GENERAL BATTERY CORP. READING SMELTER DIV.	NPDES	Bernhart Creek	Flood Plain	33.0	0.2	Moderate-C
4069	Schuylkill River-289	NP	Schuylkill River	Zone B	40.7	10.45	Moderate-C
4067	Mill Creek-287	NP	Mill Creek	Zone B	40.7	10.26	Moderate-C
2720	FLEETWOOD BORO AUTH	NPDES	Willow Creek	Zone B	40.7	0.17	Moderate-C
4110	Little Schuylkill River-330	NP	Little Schuylkill River	Zone B	45.1	5.39	Moderate-C
4075	Schuylkill River-295	NP	Schuylkill River	Zone B	47.1	8.86	Moderate-C
4074	Pine Creek-294	NP	Pine Creek	Zone B	47.6	9.21	Moderate-C
2715	BRUSH WELLMAN INC.	NPDES	Schuylkill River	Zone B	38.7	0.17	Moderate-C
509	LUKENS STEEL CO	NPDES	Schuylkill River	Zone A	4.5	1.71	Moderate-C
2723	SINKING SPRING BORO MUN AUTH	NPDES	Cacoosing Creek	Flood Plain	36.0	1.71	Moderate-C
2251	POTTSTOWN PRECISION CASTING	TRI	Schuylkill River	Flood Plain	21.4	6166	Moderate-C
2313	CABOT PERFORMANCE MATERIALS	TRI	Swamp Creek	Zone B	23.6	34067	Moderate-C
3178	MALVERN TERM	AST	Little Valley Creek	Zone B	15.4	15566041	Moderate-C
2228	HENKEL CORP.	TRI	Wissahickon Creek	Zone B	10.6	1202	Moderate-C
2191	LONZA INC.	TRI	Schuylkill River	Flood Plain	4.5	15206	Moderate-C
2177	QUAKER CHEMICAL CORP.	TRI	Schuylkill River	Zone B	3.5	3234	Moderate-C
2325	CROMPTON & KNOWLES CORP GIBRALTAR PLT	TRI	Schuylkill River	Zone B	26.2	5978	Moderate-C
2184	FREEDOM TEXTILE CHEMICALS CO.	TRI	Schuylkill River	Flood Plain	3.5	1255	Moderate-C
2248	OCCIDENTAL CHEMICAL CORP.	TRI	Schuylkill River	Flood Plain	19.0	55978	Moderate-C
2352	DANA CORP. PARISH DIVISION	TRI	Schuylkill River	Zone B	31.5	144641	Moderate-C
2185	FINNAREN & HALEY INC.	TRI	Schuylkill River	Flood Plain	3.5	2178	Moderate-C
2230	SUPERIOR TUBE CO.	TRI	Perkiomen Creek	Zone B	13.5	4992	Moderate-C
2219	HONEYWELL INC. PROCESS CONTROL DIV.	TRI	Sandy Run	Zone A	12.5	1270592	Moderate-C

The final results of the rankings are broken down into six major categories according to the PADEP's SWA Plan. These are represented by designations A through F with A representing sources of highest protection priority and gradually decreasing to F for sources of lowest protection priority. This designation process was initially designed for intakes with a limited number of sources where the whole inventory could be ranked. However, given the large number of sources and the ranking process, sources that are represented by designations D through F were screened out in the significance screening process. Therefore, the sources ranked in the document are considered potentially significant sources of contamination and will fall into categories A through C.

As shown, the sources in categories A through C may require additional ground truthing in order to provide a more accurate designation of their significance. Although not considered to be potentially significant, sources in category D may need to be evaluated as more information becomes available.

The results provide significant insight into the relative threat that various types of sources might have on the water quality at the intake. The key results are:

- All of the highest ranked sites are either NPDES sites from the PCS database or stormwater pollutant loading represented by various sub-watersheds. Twenty-four of the 30 highest ranked sites are NPDES sites.
- Stormwater or NPS loading appears to also represent a high priority. Stormwater loadings are of comparable magnitude to those from the NPDES sites in general, although they are not continuous discharges.
- TRI sites are generally ranked lower. There are no TRI sites in the top 50 sites, and all TRI sites are found in the “C” or moderate protection priority category.
- RCRA sites, with or without ASTs are generally ranked the lowest of all the types of potentially significant sites. RCRA sites did not make it into the top 95 site list.
- Results indicate that with a balanced assessment, those contaminant sources that are actually discharging to the river (NPDES permitted point sources or stormwater runoff) represent the greatest concern. Those with only the potential to release contaminants through spills or leaks (TRI, RCRA, AST) are generally given a lower priority.
- Despite the low overall rankings, the highest potential relative impacts appear to occur with the TRI and AST sites. The relative impact numbers show that, were a catastrophic spill or leak to occur at these highly ranked sites, concentrations at the intake could be potentially very high. Therefore, emergency planning activities should focus on these facilities.
- Health Impacts, as scored in the assessment, had a large influence on the resulting rankings, with those sites ranked high on potential health impacts coming out in the general ranking as important sites.
- Treatment Impacts were also important in the final rankings, with those sites scoring high on potential impact to the treatment process often tending toward a higher ranking in the overall assessment.
- The geographic distribution of significant sources showed that most of the category A sources were from nearby drainage areas of the Wissahickon Creek and Schuylkill River below Phoenixville. Approximately 75% of the potentially significant sources (categories A-C) were located in the Wissahickon Creek, Perkiomen Creek, and Schuylkill River drainage areas. Given the known influence on Queen Lane Intake water quality by the Wissahickon Creek, the sources identified in the Wissahickon Creek should be given the greatest protection priorities.

- A comparison of the types of sources indicated by the ranking process with the sources indicated by analysis of water quality data and impaired stream information (see section 3.1.5) corroborates that NPDES discharges and polluted runoff (non-point sources) from developed areas are the most important sources of influence on water quality at the PWD Queen Lane Intake.

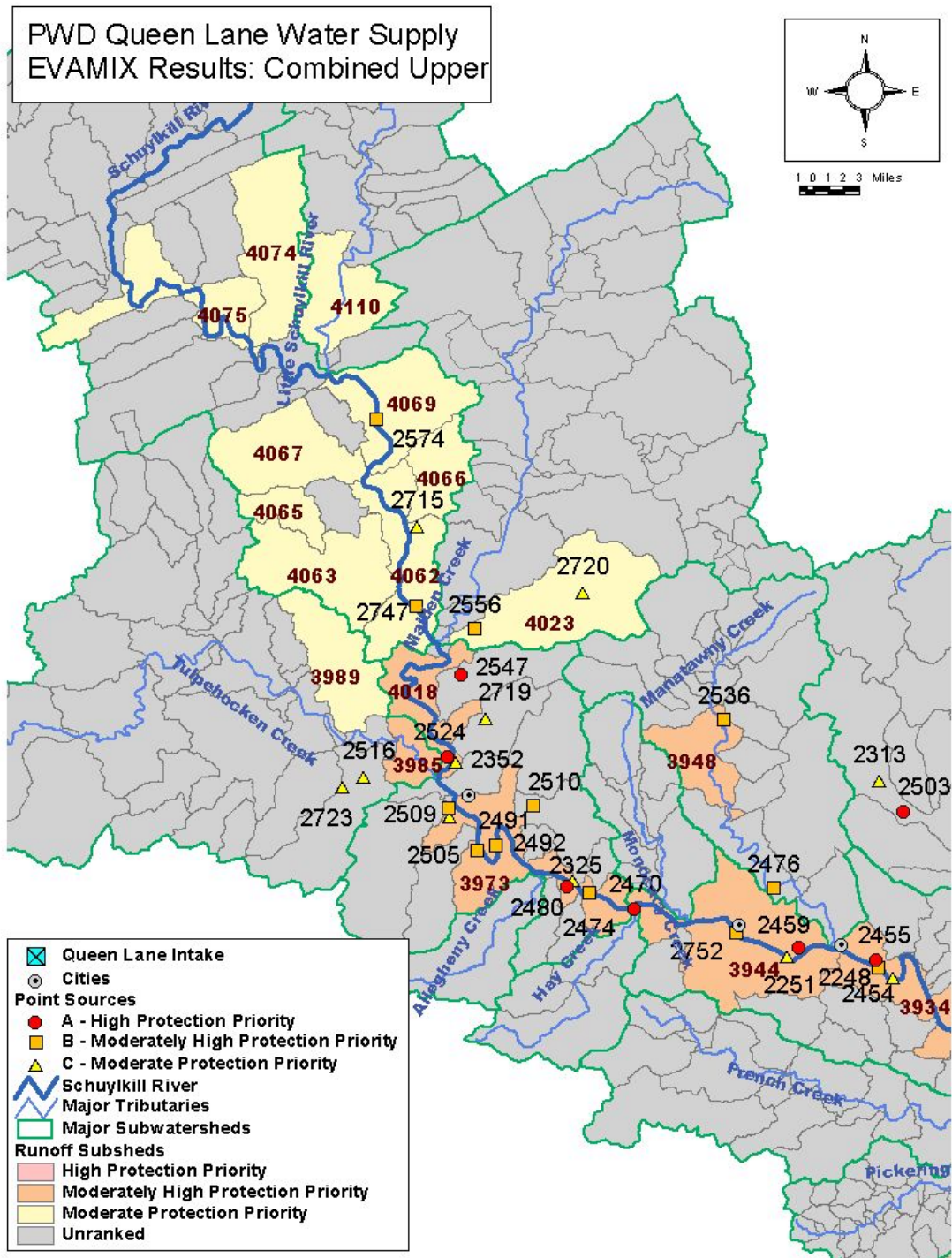
The rankings provided in Table 3.2.4-2 are based on a careful evaluation of existing data in the databases described in section 3.2.2. They are only as accurate as the data provided, and serve as a good starting point for data collection and field “ground truthing” of these sites.

Figure 3.2.4-3 is a map of the site locations for point sources and subwatersheds in the Lower Schuylkill Watershed that scored highest in the ranking process. Figure 3.2.4-4 shows the point sources and subwatersheds in the upper part of the watershed that scored the highest in the ranking process.

Figure 3.2.4-3 Priority Point Sources and Subwatersheds for PWD's Queen Lane Intake in the Lower Schuylkill River Watershed



Figure 3.2.4-4 Priority Point Sources and Subwatersheds for PWD's Queen Lane Intake in the Upper Schuylkill River Watershed



EVAMIX Ranking by Contaminant Category

The extensive screening of sites done for the combined ranking was not suitable for use in the contaminant-by-contaminant evaluation. The screening was done in part based on the types of chemicals stored, and thus could conceivably screen out numerous sites for a given contaminant simply because that contaminant is less critical than another contaminant. For those contaminant categories where the number of sites was too large, a simple threshold screening was performed based on the potential concentration of the contaminant from that source at the intake. In general, the following approach was used for selecting sites from each category for final ranking by contaminant category:

- Approximately 50 sites from the PCS database were included (all the major dischargers);
- All 11 RCRA sites were included; and
- The top ranked 20 sites each from the TRI and AST databases, and the top 30 NPS sites were included.

Ranking by contaminant category was completed using EVAMIX and six criteria (weights were provided by the Technical Advisory Group at the June, 2001 workshop):

Relative Impact at Intake (weight 40%)

Time of Travel (weight 5%)

Potential for Release/Controls (weight 20%)

Potential Release Frequency (weight 15%)

Violation Type/Frequency (weight 15%)

Location (weight 5%)

Tables 3.2.4-3 through 3.2.4 -12 provide the rankings of the primary potential sources of each contaminant group. Each table has eight columns:

Column 1: Source ID code: a unique database source code

Column 2: Source Name, the name as listed in the database

Column 3: Primary database containing information about the source used in the analysis

Column 4: Point Source subwatershed (NPS)

Column 5: Zone (either A or B)

Column 6: Estimated time of travel to the intake under high flow conditions

Column 7: Relative impact at the intake

Column 8: Relative priority groupings based on nine criteria and selected criteria weights

Salts

Table 3.2.4-3 shows the results of the ranking for salts, as represented by estimated sources of chloride. The table indicates that the major sources of chlorides are either stormwater runoff from urbanized watersheds, or potential releases of industrial salts from industrial sites as represented by sites listed in the TRI or AST database. It should be noted that neither type of source appears to provide sufficient loading to cause water quality impairments at the intake, but during winter periods, the combined runoff may have some impacts. Geographically most of the highest protection priority subwatersheds were located in Trout, Stony and Wissahickon Creeks, and along the downstream part of the Schuylkill River, as shown by Figure 3.2.4-5.

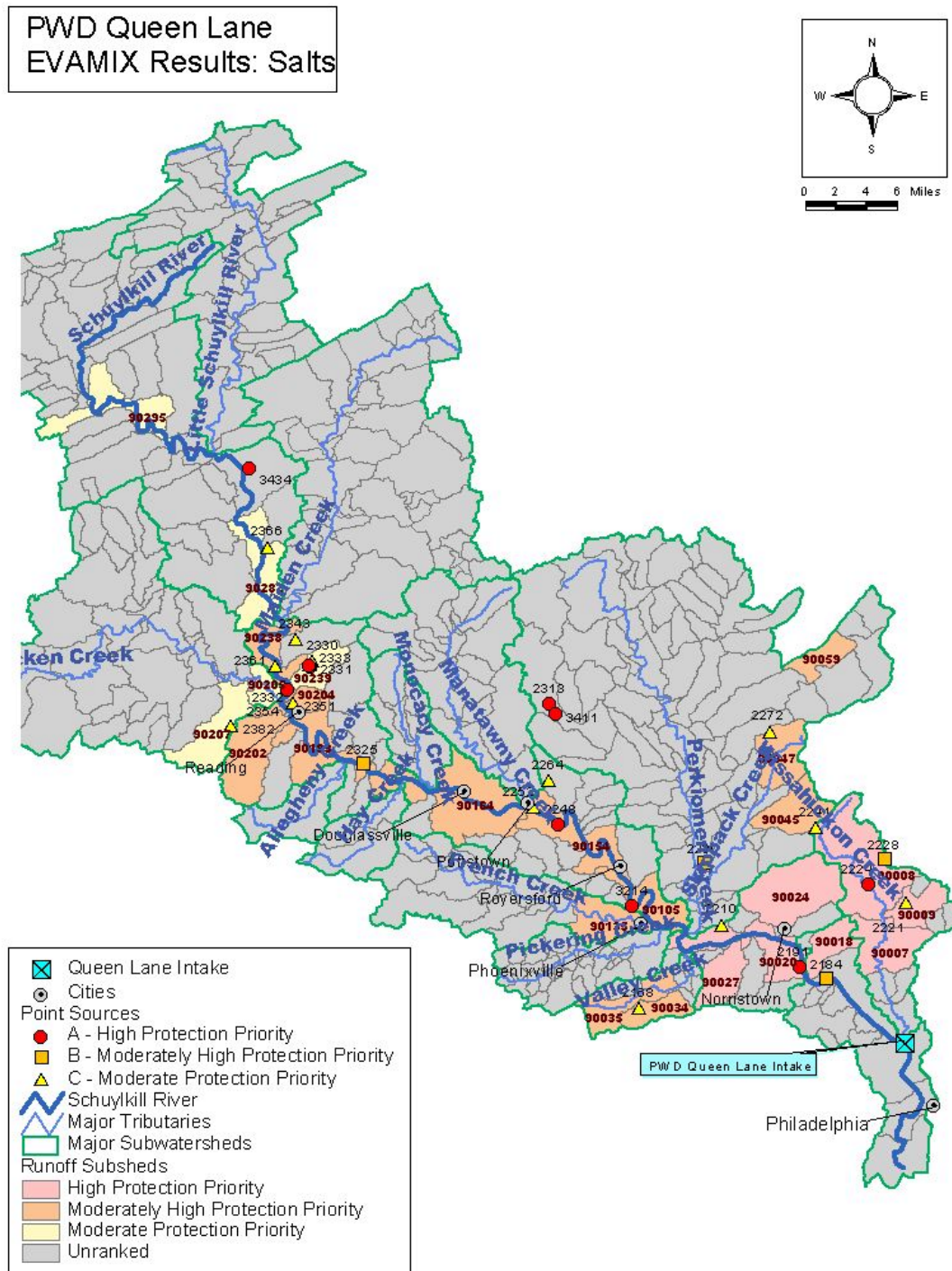
Table 3.2.4-3 Contaminant Category Ranking for Salts (Chloride)

Source ID	Source Name	Database Used	Subwatershed	Zone	Time of Travel	Relative Impact (%)	Priority
2313	CABOT PERFORMANCE MATERIALS	TRI	Swamp Creek	Zone B	23.6	4.15	Highest-A
2333	GENERAL BATTERY CORP. READING SMELTER DIV.	TRI	Bernhart Creek	Flood Plain	33.0	1.37	Highest-A
2191	LONZA INC.	TRI	Schuylkill River	Flood Plain	4.5	0.05	Highest-A
3214	PHOENIXVILLE WTP	AST	Schuylkill River	Flood Plain	13.5	1.89	Highest-A
90020	Schuylkill River-020	NP	Schuylkill River	Zone A	4.5	0.03	Highest-A
90018	Plymouth Creek-018	NP	Plymouth Creek	Zone A	4.5	0.02	Highest-A
90007	Wissahickon Creek-007	NP	Wissahickon Creek	Zone A	4.9	0.02	Highest-A
3411	BOYERTOWN WWTP	AST	Swamp Creek	Zone B	23.1	2.22	Highest-A
90024	Stony Creek-024	NP	Stony Creek	Zone A	7.0	0.02	Highest-A
90008	Wissahickon Creek-008	NP	Wissahickon Creek	Zone A	8.1	0.03	Highest-A
90027	Trout Creek-027	NP	Trout Creek	Zone A	8.0	0.02	Highest-A
2248	OCCIDENTAL CHEMICAL CORP.	TRI	Schuylkill River	Flood Plain	19.0	0.07	Highest-A
90009	Sandy Run-009	NP	Sandy Run	Zone A	8.7	0.02	Highest-A
2354	CARPENTER TECHNOLOGY CORP	TRI	Schuylkill River	Zone B	31.5	0.46	Highest-A
3434	MOYER & SON INC	AST	Schuylkill River	Zone B	42.3	2.33	Highest-A
2331	LUCENT TECHNOLOGIES	TRI	Bernhart Creek	Flood Plain	33.0	0.10	Highest-A
2224	RHONE-POULENC AG CO.	TRI	Wissahickon Creek	Flood Plain	10.0	0.48	Highest-A
2325	CROMPTON & KNOWLES CORP GIBALTAR PLT	TRI	Schuylkill River	Zone B	26.2	0.26	Moderately High-B
2228	HENKEL CORP.	TRI	Wissahickon Creek	Zone B	10.6	0.05	Moderately High-B
90105	Schuylkill River-105	NP	Schuylkill River	Zone B	10.5	0.01	Moderately High-B
90035	Valley Creek-035	NP	Valley Creek	Zone B	11.1	0.01	Moderately High-B
90034	Little Valley Creek-034	NP	Little Valley Creek	Zone B	12.2	0.01	Moderately High-B
90135	French Creek-135	NP	French Creek	Zone B	12.1	0.01	Moderately High-B
2230	SUPERIOR TUBE CO.	TRI	Perkiomen Creek	Zone B	13.5	0.02	Moderately High-B
90154	Schuylkill River-154	NP	Schuylkill River	Zone B	15.0	0.01	Moderately High-B
90045	Towamencin Creek-045	NP	Towamencin Creek	Zone B	16.0	0.01	Moderately High-B
90047	Skipack Creek-047	NP	Skipack Creek	Zone B	17.0	0.01	Moderately High-B
90164	Schuylkill River-164	NP	Schuylkill River	Zone B	20.5	0.01	Moderately High-B
90193	Schuylkill River-193	NP	Schuylkill River	Zone B	25.2	0.02	Moderately High-B
2184	FREEDOM TEXTILE CHEMICALS CO.	TRI	Schuylkill River	Flood Plain	3.5	0.14	Moderately High-B
90059	East Branch Perkiomen Creek-059	NP	East Branch Perkiomen Creek	Zone B	26.1	0.01	Moderately High-B
90204	Schuylkill River-204	NP	Schuylkill River	Zone B	31.0	0.02	Moderately High-B
90238	Schuylkill River-238	NP	Schuylkill River	Zone B	31.5	0.02	Moderately High-B
90202	Wyomissing Creek-202	NP	Wyomissing Creek	Zone B	31.0	0.01	Moderately High-B
90205	Tulpehocken Creek-205	NP	Tulpehocken Creek	Zone B	31.5	0.01	Moderate-C
90239	Bernhart Creek-239	NP	Bernhart Creek	Zone B	32.5	0.01	Moderate-C

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Source ID	Source Name	Database Used	Subwatershed	Zone	Time of Travel	Relative Impact (%)	Priority
90207	Cacoosing Creek-207	NP	Cacoosing Creek	Zone B	33.9	0.01	Moderate-C
90282	Schuylkill River-282	NP	Schuylkill River	Zone B	36.1	0.01	Moderate-C
2168	WORTHINGTON STEEL CO.	TRI	Little Valley Creek	Flood Plain	13.8	0.08	Moderate-C
2332	EXIDE CORP. READING SLI	TRI	Bernhart Creek	Flood Plain	33.0	0.30	Moderate-C
90295	Schuylkill River-295	NP	Schuylkill River	Zone B	47.1	0.01	Moderate-C
2252	POTTSTOWN PLATING WORKS INC.	TRI	Schuylkill River	Flood Plain	20.0	0.03	Moderate-C
2343	NGK METALS CORP.	TRI	Laurel Run	Flood Plain	34.1	0.07	Moderate-C
2210	GMT MICROELECTRONICS CORP	TRI	Schuylkill River	Zone B	7.5	0.01	Moderate-C
2241	MERCK & CO INC	TRI	Wissahickon Creek	Zone B	13.8	0.05	Moderate-C
2221	NOVARTIS CONSUMER HEALTH INC.	TRI	Sandy Run	Zone B	14.4	0.01	Moderate-C
2272	H. W. LONGACRE INC.	TRI	Skippack Creek	Zone B	18.0	0.05	Moderate-C
2264	STEEL PROCESSING INC. POTTSTOWN INDL. COMPLEX	TRI	Sprogles Run	Zone B	20.0	0.01	Moderate-C
2351	CROMPTON & KNOWLES COLORS INC.	TRI	Schuylkill River	Zone B	31.0	0.14	Moderate-C
2330	YUASA EXIDE INC	TRI	Bernhart Creek	Zone B	33.6	0.06	Moderate-C
2361	INDUSTRIAL METAL PLATING INC.	TRI	Schuylkill River	Zone B	32.5	0.01	Moderate-C
2382	HOFFMANN IND. INC.	TRI	Cacoosing Creek	Zone B	36.0	0.02	Moderate-C
2366	BRUSH WELLMAN INC.	TRI	Schuylkill River	Zone B	38.7	0.04	Moderate-C

Figure 3.2.4-5 Priority Point Sources and Subwatersheds for PWD's Queen Lane Intake for Salts in the Schuylkill River Watershed



Cryptosporidium

Table 3.2.4-4 shows the results of the ranking for pathogens, as represented by estimated sources of *Cryptosporidium*. The table indicates that the only sources of pathogens are either stormwater runoff from agricultural or urbanized watersheds, and permitted discharges from wastewater treatment plants. Only the NPDES sites are represented in the high protection priority category (category A). Most sources appear to be relatively minor contributors. Geographically, a larger number of sources from farther upstream into the Reading and Berks County areas were included as compared to other contaminant categories. Another potentially significant source that could not be properly inserted into this analysis are the 11 communities upstream with combined sewer overflow systems. The overflows of raw sewage during wet weather events was roughly estimated and compared to the other potentially significant sources. Based on this analysis the CSO discharges from the communities of Bridgeport and Norristown would be considered potentially significant sources of highest protection priority as well (category A). The remaining nine communities including Minersville, Tamaqua, and Greater Pottsville in Schuylkill County would be considered moderate protection priority sites (category C) since they are much further away from the intake. Figure 3.2.4-6 illustrates the priority point sources and subwatersheds for *Cryptosporidium* in the Schuylkill River Watershed.

Table 3.2.4-4 Contaminant Category Ranking for *Cryptosporidium*

Source ID	Source Name	Database Used	Subwatershed	Zone	Time of Travel	Relative Impact (%)	Priority
781	MONTGOMERY COUNTY SEW AUTH	NPDES	Perkiomen Creek	Flood Plain	10.5	0.009	Highest-A
1613	UPPER GWYNEDD TWP	NPDES	Wissahickon Creek	Flood Plain	12.5	0.009	Highest-A
465	WHITEMARSH TWP SEW AUTH	NPDES	Schuylkill River	Zone A	3.5	0.009	Highest-A
666	NORRISTOWN MUN WASTE AUTH	NPDES	Schuylkill River	Flood Plain	5.5	0.009	Highest-A
795	ABINGTON TWP COMM-WWTR TRTMT P	NPDES	Sandy Run	Zone A	11.3	0.009	Highest-A
664	EAST NORRISTOWN/PLYMOUTH/WHITPAIN JOINT SEWER AUTHORITY	NPDES	Schuylkill River	Flood Plain	5.5	0.009	Highest-A
2503	BERKS MONTGOMERY MUNICIPAL AUTH	NPDES	Swamp Creek	Flood Plain	23.1	0.009	Highest-A
821	AMBLER BORO	NPDES	Wissahickon Creek	Zone A	8.7	0.009	Highest-A
2491	READING CITY	NPDES	Schuylkill River	Zone B	29.5	0.009	Highest-A
464	CONSHOHOCKEN SEW TREAT. PLT.	NPDES	Schuylkill River	Zone A	3.5	0.009	Highest-A
2470	BIRDSBORO BORO MUN AUTH	NPDES	Schuylkill River	Flood Plain	24.8	0.009	Highest-A
2455	POTTSTOWN BORO	NPDES	Schuylkill River	Zone B	19.5	0.009	Highest-A
2547	NGK METALS CORP.	NPDES	Laurel Run	Zone B	34.1	0.009	Highest-A
2509	WYOMISSING VALLEY JOINT MUN AU	NPDES	Wyomissing Creek	Zone B	31.0	0.009	Highest-A
665	UPPER MERION MUN UTILITY AUTH	NPDES	Trout Creek	Zone A	8.0	0.009	Highest-A
535	UPPER MERION TWP. AUTH-MATSUNK WPCC	NPDES	Schuylkill River	Zone B	5.0	0.009	Highest-A
2492	GPU GENERATION INC TITUS GENERATING STATION	NPDES	Schuylkill River	Zone B	28.6	0.009	Highest-A
2574	HAMBURG MUN AUTH	NPDES	Schuylkill River	Zone B	41.8	0.009	Highest-A
2453	UPPER GWYNEDD-TOWAMENCIN MUN	NPDES	Towamencin Creek	Zone B	16.5	0.009	Highest-A
792	PHOENIXVILL BORO STP	NPDES	Schuylkill River	Zone B	11.5	0.009	Highest-A

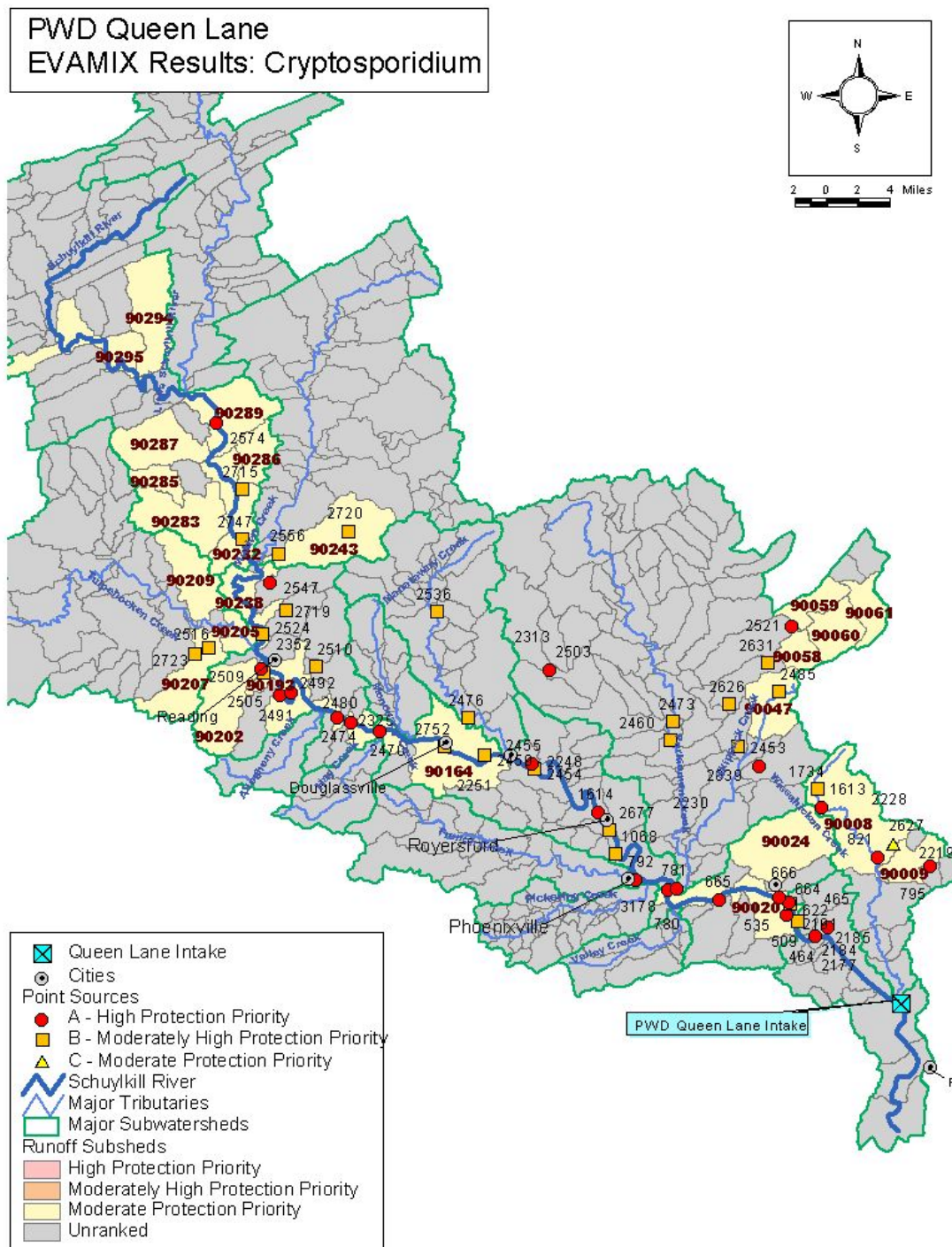
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Source ID	Source Name	Database Used	Subwatershed	Zone	Time of Travel	Relative Impact (%)	Priority
2521	PENN RIDGE WASTE WATER TREATMENT AUTHORITY	NPDES	East Branch Perkiomen Creek	Flood Plain	25.4	0.009	Highest-A
2480	CROMPTON & KNOWLES CORP GIBRALTAR PLT	NPDES	Schuylkill River	Flood Plain	26.2	0.009	Highest-A
1614	LIMERICK TWP MUN AUTH	NPDES	Schuylkill River	Flood Plain	15.0	0.009	Highest-A
2474	EXETER TOWNSHIP WWTR TRTMT PLT	NPDES	Schuylkill River	Flood Plain	25.7	0.009	Highest-A
780	VALLEY FORGE SEWER AUTHORITY	NPDES	Schuylkill River	Zone B	10.0	0.009	Highest-A
2485	BOROUGH OF SOUDERTON	NPDES	Skipack Creek	Zone B	18.5	0.009	Moderately High-B
2752	120 OLD PHILADELPHI	NPDES	Schuylkill River	Flood Plain	22.8	0.009	Moderately High-B
2510	ANTIETEM VALLEY MUNICIPAL AUTHORITY	NPDES	Antietam Creek	Zone B	28.6	0.009	Moderately High-B
2524	CARPENTER TECHNOLOGY CORP	NPDES	Schuylkill River	Zone B	31.5	0.009	Moderately High-B
2516	SPRING TWP MUN AUTH	NPDES	Cacoosing Creek	Zone B	35.3	0.009	Moderately High-B
509	LUKENS STEEL CO	NPDES	Schuylkill River	Zone A	4.5	0.009	Moderately High-B
2473	LOWER FREDERICK TOWNSHIP TRT P	NPDES	Perkiomen Creek	Flood Plain	16.6	0.001	Moderately High-B
2723	SINKING SPRING BORO MUN AUTH	NPDES	Cacoosing Creek	Flood Plain	36.0	0.009	Moderately High-B
1734	BOROUGH OF NORTH WALES	NPDES	Wissahickon Creek	Flood Plain	13.2	0.001	Moderately High-B
2747	LEESPORT BOROUGH AUTHORITY	NPDES	Schuylkill River	Flood Plain	37.1	0.001	Moderately High-B
2460	SCHWENKSVILLE BOROUGH AUTH	NPDES	Perkiomen Creek	Flood Plain	16.1	0.001	Moderately High-B
2677	SPRING CITY BOROUGH SEWAGE PLANT	NPDES	Schuylkill River	Flood Plain	14.5	0.001	Moderately High-B
622	BRIDGEPORT BORO	NPDES	Schuylkill River	Flood Plain	5.5	0.001	Moderately High-B
2454	NORTH COVENTRY MUN AUTH STP	NPDES	Schuylkill River	Flood Plain	19.5	0.001	Moderately High-B
2459	STANLEY G. FLAGG & CO. INC	NPDES	Schuylkill River	Zone B	20.9	0.001	Moderately High-B
2536	OLEY TOWNSHIP MUN AUTH	NPDES	Manatawny Creek	Flood Plain	29.8	0.001	Moderately High-B
2476	ALLEGHENY E. CONF. ASSOC. 7TH DAY ADVENTISTS	NPDES	Manatawny Creek	Flood Plain	23.1	0.001	Moderately High-B
1068	PECO ENERGY CO-CROMBY GENERATING	NPDES	Schuylkill River	Flood Plain	13.5	0.001	Moderately High-B
2556	MAIDENCREEK TOWNSHIP AUTHORITY	NPDES	Willow Creek	Zone B	37.6	0.001	Moderately High-B
2720	FLEETWOOD BORO AUTH	NPDES	Willow Creek	Zone B	40.7	0.001	Moderately High-B
2626	LOWER SALFORD TWP AUTH	NPDES	Indian Creek	Zone B	20.5	0.001	Moderately High-B
2639	LOWER SALFORD TWP AUTH	NPDES	West Branch Skipack Creek	Flood Plain	16.5	0.001	Moderately High-B
2505	BALDWIN HARDWARE MFG CORP	NPDES	Schuylkill River	Zone B	30.0	0.001	Moderately High-B
2631	TELFORD BORO AUTHORITY	NPDES	Indian Creek	Zone B	23.6	0.001	Moderately High-B
2719	GENERAL BATTERY CORP. READING SMELTER DIV.	NPDES	Bernhart Creek	Flood Plain	33.0	0.001	Moderately High-B
2715	BRUSH WELLMAN INC.	NPDES	Schuylkill River	Zone B	38.7	0.001	Moderately High-B
2627	UPPER DUBLIN TWP	NPDES	Wissahickon Creek	Zone B	8.7	0.001	Moderate-C
90008	Wissahickon Creek-008	NP	Wissahickon Creek	Zone A	8.1	0.002	Moderate-C
90024	Stony Creek-024	NP	Stony Creek	Zone A	7.0	0.002	Moderate-C
90020	Schuylkill River-020	NP	Schuylkill River	Zone A	4.5	0.001	Moderate-C
90283	Irish Creek-283	NP	Irish Creek	Zone B	37.6	0.003	Moderate-C
90282	Schuylkill River-282	NP	Schuylkill River	Zone B	36.1	0.002	Moderate-C
90009	Sandy Run-009	NP	Sandy Run	Zone A	8.7	0.001	Moderate-C
90209	Plum Creek-209	NP	Plum Creek	Zone B	34.6	0.002	Moderate-C
90289	Schuylkill River-289	NP	Schuylkill River	Zone B	40.7	0.002	Moderate-C
90060	Pleasant Spring Creek-060	NP	Pleasant Spring Creek	Zone B	27.3	0.001	Moderate-C
90238	Schuylkill River-238	NP	Schuylkill River	Zone B	31.5	0.001	Moderate-C
90287	Mill Creek-287	NP	Mill Creek	Zone B	40.7	0.002	Moderate-C

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Source ID	Source Name	Database Used	Subwatershed	Zone	Time of Travel	Relative Impact (%)	Priority
90193	Schuylkill River-193	NP	Schuylkill River	Zone B	25.2	0.001	Moderate-C
90047	Skippack Creek-047	NP	Skippack Creek	Zone B	17.0	0.001	Moderate-C
90059	East Branch Perkiomen Creek-059	NP	East Branch Perkiomen Creek	Zone B	26.1	0.001	Moderate-C
90164	Schuylkill River-164	NP	Schuylkill River	Zone B	20.5	0.001	Moderate-C
90286	Pigeon Creek-286	NP	Pigeon Creek	Zone B	39.2	0.001	Moderate-C
90061	Morris Run-061	NP	Morris Run	Zone B	29.2	0.001	Moderate-C
90243	Willow Creek-243	NP	Willow Creek	Zone B	37.1	0.001	Moderate-C
90295	Schuylkill River-295	NP	Schuylkill River	Zone B	47.1	0.001	Moderate-C
90058	Mill Creek-058	NP	Mill Creek	Zone B	26.1	0.001	Moderate-C
90294	Pine Creek-294	NP	Pine Creek	Zone B	47.6	0.001	Moderate-C
90202	Wyomissing Creek-202	NP	Wyomissing Creek	Zone B	31.0	0.001	Moderate-C
90207	Cacoosing Creek-207	NP	Cacoosing Creek	Zone B	33.9	0.001	Moderate-C
90205	Tulpehocken Creek-205	NP	Tulpehocken Creek	Zone B	31.5	0.001	Moderate-C
90285	Leshner Run-285	NP	Leshner Run	Zone B	40.2	0.001	Moderate-C

Figure 3.2.4-6 Priority Point Sources and Subwatersheds for PWD's Queen Lane Intake for *Cryptosporidium* in the Schuylkill River Watershed



Fecal Coliform

Table 3.2.4-5 shows the results of the ranking for fecal coliform. The table indicates that the only sources are either stormwater runoff from agricultural or urbanized watersheds, and permitted discharges from wastewater treatment plants. Although both sources are represented in the high priority category (category A), the results suggest that periodic loading from stormwater is orders of magnitude higher than the loading from wastewater treatment plants. The table shows that during dry weather flows, wastewater loading is insignificant at the Queen Lane Intake, but that during storm events, fecal coliform would be expected to increase by orders of magnitude. Another potentially significant source that could not be properly incorporated into this analysis are the 11 communities upstream with combined sewer overflow systems. The overflows of raw sewage during wet weather events was roughly estimated and compared to the other potentially significant sources. Based on this analysis the CSO discharges from the communities of Bridgeport and Norristown would be considered potentially significant sources of highest protection priority as well (category A). The remaining nine communities including Minersville, Tamaqua, and Greater Pottsville in Schuylkill County would be considered moderate protection priority sites (category C) since they are much further away from the Queen Lane Intake. Overall, there was a broad geographic distribution of potentially significant sources of fecal coliforms in the watershed. This may be due to the fact that die-off was not factored into the analysis. Figure 3.2.4-7 illustrates the priority point sources and subwatersheds for coliform in the Schuylkill River Watershed. The highest priority subwatersheds were in the Wissahickon and Stony Creeks, and along the lower part of the Schuylkill River.

Table 3.2.4-5 Contaminant Category Ranking for Fecal Coliform

Source ID	Source Name	Database Used	Subwatershed	Zone	Time of Travel	Relative Impact (%)	Priority
90008	Wissahickon Creek-008	NP	Wissahickon Creek	Zone A	8.1	4.70	Highest-A
90024	Stony Creek-024	NP	Stony Creek	Zone A	7.0	3.78	Highest-A
90020	Schuylkill River-020	NP	Schuylkill River	Zone A	4.5	2.83	Highest-A
781	MONTGOMERY COUNTY SEW AUTH	NPDES	Perkiomen Creek	Flood Plain	10.5	0.01	Highest-A
465	WHITEMARSH TWP SEW AUTH	NPDES	Schuylkill River	Zone A	3.5	0.01	Highest-A
1613	UPPER GWYNEDD TWP	NPDES	Wissahickon Creek	Flood Plain	12.5	0.01	Highest-A
666	NORRISTOWN MUN WASTE AUTH	NPDES	Schuylkill River	Flood Plain	5.5	0.01	Highest-A
795	ABINGTON TWP COMM-WWTR TRTMT P	NPDES	Sandy Run	Zone A	11.3	0.01	Highest-A
664	EAST NORRISTOWN/PLYMOUTH/WHITPAIN JOINT SEWER AUTHORITY	NPDES	Schuylkill River	Flood Plain	5.5	0.01	Highest-A
90007	Wissahickon Creek-007	NP	Wissahickon Creek	Zone A	4.9	2.28	Highest-A
821	AMBLER BORO	NPDES	Wissahickon Creek	Zone A	8.7	0.01	Highest-A
2473	LOWER FREDERICK TOWNSHIP TRT P	NPDES	Perkiomen Creek	Flood Plain	16.6	0.00	Highest-A
2503	BERKS MONTGOMERY MUNICIPAL AUTH	NPDES	Swamp Creek	Flood Plain	23.1	0.01	Highest-A
464	CONSHOHOCKEN SEW TREAT. PLT.	NPDES	Schuylkill River	Zone A	3.5	0.01	Highest-A
1734	BOROUGH OF NORTH	NPDES	Wissahickon	Flood Plain	13.2	0.00	Highest-A

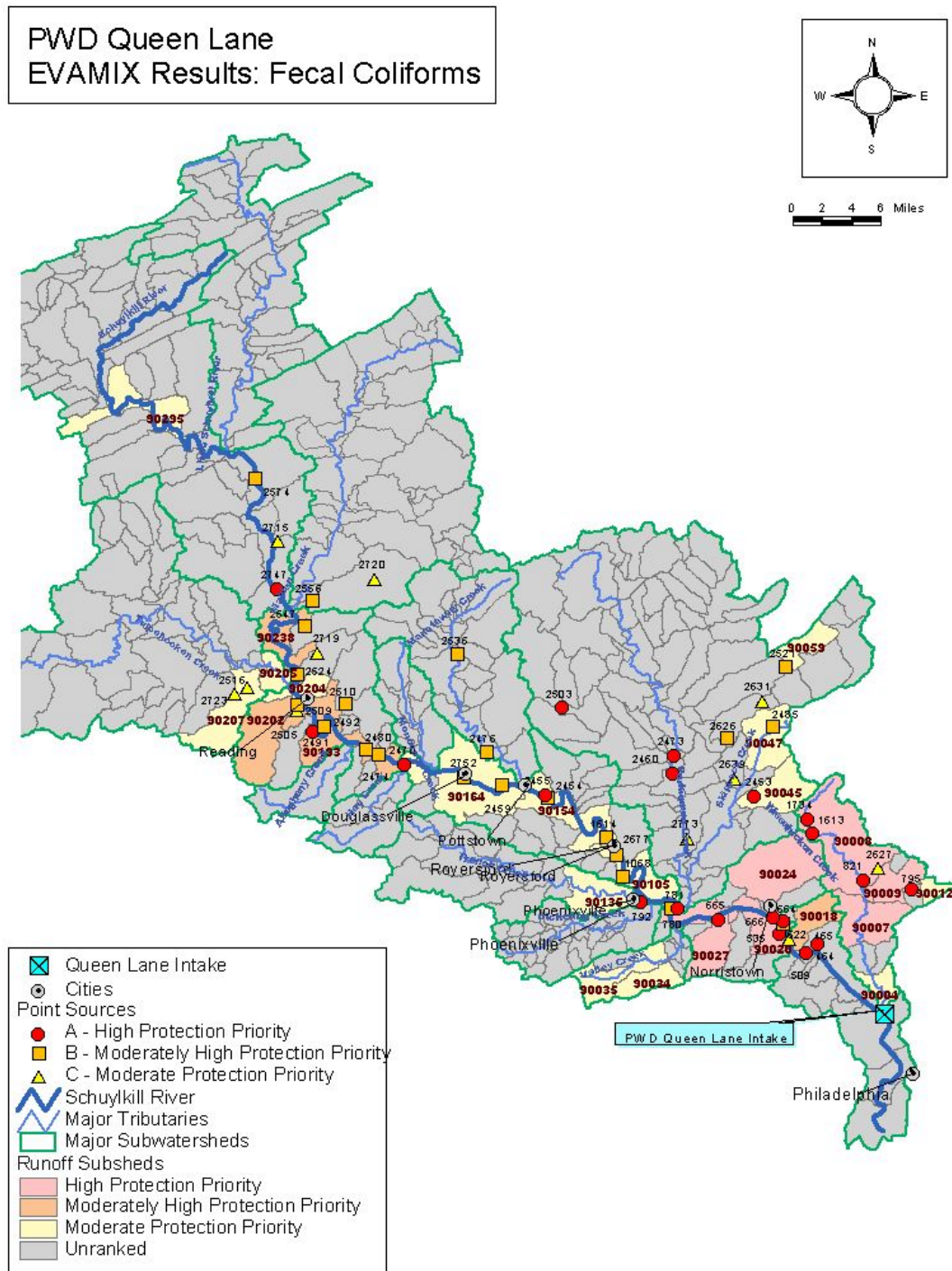
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Source ID	Source Name	Database Used	Subwatershed	Zone	Time of Travel	Relative Impact (%)	Priority
	WALES		Creek				
90009	Sandy Run-009	NP	Sandy Run	Zone A	8.7	2.15	Highest-A
2455	POTTSTOWN BORO	NPDES	Schuylkill River	Zone B	19.5	0.01	Highest-A
535	UPPER MERION TWP. AUTH-MATSUNK WPCC	NPDES	Schuylkill River	Zone B	5.0	0.01	Highest-A
2470	BIRDSBORO BORO MUN AUTH	NPDES	Schuylkill River	Flood Plain	24.8	0.01	Highest-A
90027	Trout Creek-027	NP	Trout Creek	Zone A	8.0	2.05	Highest-A
665	UPPER MERION MUN UTILITY AUTH	NPDES	Trout Creek	Zone A	8.0	0.01	Highest-A
2491	READING CITY	NPDES	Schuylkill River	Zone B	29.5	0.01	Highest-A
792	PHOENIXVILL BORO STP	NPDES	Schuylkill River	Zone B	11.5	0.01	Highest-A
2460	SCHWENKSVILLE BOROUGH AUTH	NPDES	Perkiomen Creek	Flood Plain	16.1	0.00	Highest-A
2747	LEESPORT BOROUGH AUTHORITY	NPDES	Schuylkill River	Flood Plain	37.1	0.00	Highest-A
2453	UPPER GWYNEDD-TOWAMENCIN MUN	NPDES	Towamencin Creek	Zone B	16.5	0.00	Highest-A
2677	SPRING CITY BOROUGH SEWAGE PLANT	NPDES	Schuylkill River	Flood Plain	14.5	0.00	Moderately High-B
622	BRIDGEPORT BORO	NPDES	Schuylkill River	Flood Plain	5.5	0.00	Moderately High-B
2547	NGK METALS CORP.	NPDES	Laurel Run	Zone B	34.1	0.01	Moderately High-B
2521	PENN RIDGE WASTE WATER TREATMENT AUTHORITY	NPDES	East Branch Perkiomen Creek	Flood Plain	25.4	0.01	Moderately High-B
1614	LIMERICK TWP MUN AUTH	NPDES	Schuylkill River	Flood Plain	15.0	0.01	Moderately High-B
2509	WYOMISSING VALLEY JOINT MUN AU	NPDES	Wyomissing Creek	Zone B	31.0	0.01	Moderately High-B
780	VALLEY FORGE SEWER AUTHORITY	NPDES	Schuylkill River	Zone B	10.0	0.01	Moderately High-B
90193	Schuylkill River-193	NP	Schuylkill River	Zone B	25.2	2.27	Moderately High-B
2492	GPU GENERATION INC TITUS GENERATING STATION	NPDES	Schuylkill River	Zone B	28.6	0.01	Moderately High-B
2480	CROMPTON & KNOWLES CORP GIBALTAR PLT	NPDES	Schuylkill River	Flood Plain	26.2	0.01	Moderately High-B
2485	BOROUGH OF SOUDERTON	NPDES	Skippack Creek	Zone B	18.5	0.01	Moderately High-B
2454	NORTH COVENTRY MUN AUTH STP	NPDES	Schuylkill River	Flood Plain	19.5	0.00	Moderately High-B
2474	EXETER TOWNSHIP WWTR TRTMT PLT	NPDES	Schuylkill River	Flood Plain	25.7	0.01	Moderately High-B
2574	HAMBURG MUN AUTH	NPDES	Schuylkill River	Zone B	41.8	0.01	Moderately High-B
2459	STANLEY G. FLAGG & CO. INC	NPDES	Schuylkill River	Zone B	20.9	0.00	Moderately High-B
90018	Plymouth Creek-018	NP	Plymouth Creek	Zone A	4.5	1.73	Moderately High-B
90238	Schuylkill River-238	NP	Schuylkill River	Zone B	31.5	2.22	Moderately High-B
1068	PECO ENERGY CO-CROMBY GENERATING	NPDES	Schuylkill River	Flood Plain	13.5	0.00	Moderately High-B
2476	ALLEGHENY E. CONF. ASSOC. 7TH DAY ADVENTISTS	NPDES	Manatawny Creek	Flood Plain	23.1	0.00	Moderately High-B
2536	OLEY TOWNSHIP MUN AUTH	NPDES	Manatawny Creek	Flood Plain	29.8	0.00	Moderately High-B
2752	120 OLD PHILADELPHI	NPDES	Schuylkill River	Flood Plain	22.8	0.01	Moderately High-B
2510	ANTIETEM VALLEY MUNICIPAL AUTHORITY	NPDES	Antietam Creek	Zone B	28.6	0.01	Moderately High-B
2556	MAIDENCREEK TOWNSHIP AUTHORITY	NPDES	Willow Creek	Zone B	37.6	0.00	Moderately High-B
2524	CARPENTER TECHNOLOGY CORP	NPDES	Schuylkill River	Zone B	31.5	0.01	Moderately High-B
90202	Wyomissing Creek-202	NP	Wyomissing Creek	Zone B	31.0	1.95	Moderately High-B
2626	LOWER SALFORD TWP AUTH	NPDES	Indian Creek	Zone B	20.5	0.00	Moderately High-B
2639	LOWER SALFORD TWP AUTH	NPDES	West Branch Skippack Creek	Flood Plain	16.5	0.00	Moderate-C

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Source ID	Source Name	Database Used	Subwatershed	Zone	Time of Travel	Relative Impact (%)	Priority
90204	Schuylkill River-204	NP	Schuylkill River	Zone B	31.0	1.92	Moderate-C
90059	East Branch Perkiomen Creek-059	NP	East Branch Perkiomen Creek	Zone B	26.1	1.83	Moderate-C
2631	TELFORD BORO AUTHORITY	NPDES	Indian Creek	Zone B	23.6	0.00	Moderate-C
2720	FLEETWOOD BORO AUTH	NPDES	Willow Creek	Zone B	40.7	0.00	Moderate-C
90045	Towamencin Creek-045	NP	Towamencin Creek	Zone B	16.0	1.63	Moderate-C
2505	BALDWIN HARDWARE MFG CORP	NPDES	Schuylkill River	Zone B	30.0	0.00	Moderate-C
2516	SPRING TWP MUN AUTH	NPDES	Cacoosing Creek	Zone B	35.3	0.01	Moderate-C
90012	Sandy Run-012	NP	Sandy Run	Zone A	11.9	1.39	Moderate-C
2627	UPPER DUBLIN TWP	NPDES	Wissahickon Creek	Zone B	8.7	0.00	Moderate-C
2719	GENERAL BATTERY CORP. READING SMELTER DIV.	NPDES	Bernhart Creek	Flood Plain	33.0	0.00	Moderate-C
90154	Schuylkill River-154	NP	Schuylkill River	Zone B	15.0	1.48	Moderate-C
90004	Wissahickon Creek-004	NP	Wissahickon Creek	Zone A	1.1	1.13	Moderate-C
2715	BRUSH WELLMAN INC.	NPDES	Schuylkill River	Zone B	38.7	0.00	Moderate-C
90035	Valley Creek-035	NP	Valley Creek	Zone B	11.1	1.38	Moderate-C
90105	Schuylkill River-105	NP	Schuylkill River	Zone B	10.5	1.33	Moderate-C
90034	Little Valley Creek-034	NP	Little Valley Creek	Zone B	12.2	1.35	Moderate-C
90164	Schuylkill River-164	NP	Schuylkill River	Zone B	20.5	1.32	Moderate-C
90047	Skippack Creek-047	NP	Skippack Creek	Zone B	17.0	1.26	Moderate-C
90135	French Creek-135	NP	French Creek	Zone B	12.1	1.17	Moderate-C
90205	Tulpehocken Creek-205	NP	Tulpehocken Creek	Zone B	31.5	1.30	Moderate-C
90207	Cacoosing Creek-207	NP	Cacoosing Creek	Zone B	33.9	1.26	Moderate-C
90295	Schuylkill River-295	NP	Schuylkill River	Zone B	47.1	1.27	Moderate-C
509	LUKENS STEEL CO	NPDES	Schuylkill River	Zone A	4.5	0.01	Moderate-C
2773	GRATERFORD STATE CORRECTIONAL INSTITUTE	NPDES	Perkiomen Creek	Zone B	13.5	0.00	Moderate-C
2723	SINKING SPRING BORO MUN AUTH	NPDES	Cacoosing Creek	Flood Plain	36.0	0.01	Moderate-C

Figure 3.2.4-7 Priority Point Sources and Subwatersheds for PWD's Queen Lane Intake for Fecal Coliform in the Schuylkill River Watershed



Metals

Table 3.2.4-6 provides the results of the heavy metal source ranking. Results generally show that NPDES permitted discharges are the primary sources. Some TRI sites with significant storage or use of metals are also rated as high protection priority sources, primarily because a catastrophic leak or spill would result in extremely high concentrations. Non-point sources from urbanized watersheds are generally a medium priority. Most of the TRI, RCRA and AST sites fall into the moderate protection priority category (category C). However, it is important to note that acid mine drainage could not be included in this analysis and may be a more significant source than any of the other source categories (see section 3.1.5.4). Most sites were located in the watershed below Pottstown. However, a few sites were in the Reading and Upper Schuylkill areas. Figures 3.2.4-8 and 3.2.4-9 identify the priority point sources and subwatersheds for metals in the lower and upper parts of the Schuylkill River Watershed.

Table 3.2.4-6 Contaminant Category Ranking for Metals

Source ID	Source Name	Database Used	Subwatershed	Zone	Time of Travel	Relative Impact (%)	Priority
2339	ELECTRIC COIL SERVICE INC.	TRI	Laurel Run	Flood Plain	34.1	1692328.8	Highest-A
2333	GENERAL BATTERY CORP. READING SMELTER DIV.	TRI	Bernhart Creek	Flood Plain	33.0	488073.1	Highest-A
465	WHITEMARSH TWP SEW AUTH	NPDES	Schuylkill River	Zone A	3.5	1.5	Highest-A
666	NORRISTOWN MUN WASTE AUTH	NPDES	Schuylkill River	Flood Plain	5.5	1.5	Highest-A
664	EAST NORRISTOWN/PLYMOUTH/WHITPAIN JOINT SEWER AUTHORITY	NPDES	Schuylkill River	Flood Plain	5.5	3.5	Highest-A
781	MONTGOMERY COUNTY SEW AUTH	NPDES	Perkiomen Creek	Flood Plain	10.5	1.5	Highest-A
464	CONSHOHOCKEN SEW TREAT. PLT.	NPDES	Schuylkill River	Zone A	3.5	1.5	Highest-A
1613	UPPER GWYNEDD TWP	NPDES	Wissahickon Creek	Flood Plain	12.5	9.9	Highest-A
821	AMBLER BORO	NPDES	Wissahickon Creek	Zone A	8.7	7.7	Highest-A
795	ABINGTON TWP COMM-WWTR TRTMT P	NPDES	Sandy Run	Zone A	11.3	2.7	Highest-A
535	UPPER MERION TWP. AUTH-MATSUNK WPCC	NPDES	Schuylkill River	Zone B	5.0	1.5	Highest-A
622	BRIDGEPORT BORO	NPDES	Schuylkill River	Flood Plain	5.5	0.1	Highest-A
665	UPPER MERION MUN UTILITY AUTH	NPDES	Trout Creek	Zone A	8.0	4.6	Highest-A
1734	BOROUGH OF NORTH WALES	NPDES	Wissahickon Creek	Flood Plain	13.2	0.1	Highest-A
2473	LOWER FREDERICK TOWNSHIP TRT P	NPDES	Perkiomen Creek	Flood Plain	16.6	0.1	Highest-A
792	PHOENIXVILL BORO STP	NPDES	Schuylkill River	Zone B	11.5	1.5	Highest-A
780	VALLEY FORGE SEWER AUTHORITY	NPDES	Schuylkill River	Zone B	10.0	1.5	Highest-A
2677	SPRING CITY BOROUGH SEWAGE PLANT	NPDES	Schuylkill River	Flood Plain	14.5	0.1	Highest-A
2460	SCHWENKSVILLE BOROUGH AUTH	NPDES	Perkiomen Creek	Flood Plain	16.1	0.1	Highest-A
1614	LIMERICK TWP MUN AUTH	NPDES	Schuylkill River	Flood Plain	15.0	1.5	Highest-A
2453	UPPER GWYNEDD-TOWAMENCIN MUN	NPDES	Towamencin Creek	Zone B	16.5	4.3	Highest-A
2503	BERKS MONTGOMERY MUNICIPAL AUTH	NPDES	Swamp Creek	Flood Plain	23.1	1.5	Highest-A
1068	PECO ENERGY CO-	NPDES	Schuylkill River	Flood Plain	13.5	0.1	Highest-A

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Source ID	Source Name	Database Used	Subwatershed	Zone	Time of Travel	Relative Impact (%)	Priority
	CROMBY GENERATING						
2455	POTTSTOWN BORO	NPDES	Schuylkill River	Zone B	19.5	29.4	Highest-A
2470	BIRDSBORO BORO MUN AUTH	NPDES	Schuylkill River	Flood Plain	24.8	1.5	Highest-A
2485	BOROUGH OF SOUDERTON	NPDES	Skippack Creek	Zone B	18.5	0.7	Highest-A
2454	NORTH COVENTRY MUN AUTH STP	NPDES	Schuylkill River	Flood Plain	19.5	0.1	Highest-A
2459	STANLEY G. FLAGG & CO. INC	NPDES	Schuylkill River	Zone B	20.9	0.1	Highest-A
2627	UPPER DUBLIN TWP	NPDES	Wissahickon Creek	Zone B	8.7	0.1	Highest-A
2521	PENN RIDGE WASTE WATER TREATMENT AUTHORITY	NPDES	East Branch Perkiomen Creek	Flood Plain	25.4	5.3	Highest-A
2476	ALLEGHENY E. CONF. ASSOC. 7TH DAY ADVENTISTS	NPDES	Manatawny Creek	Flood Plain	23.1	0.1	Moderately High-B
2752	120 OLD PHILADELPHI	NPDES	Schuylkill River	Flood Plain	22.8	1.5	Moderately High-B
2480	CROMPTON & KNOWLES CORP GIBALTAR PLT	NPDES	Schuylkill River	Flood Plain	26.2	4.0	Moderately High-B
2491	READING CITY	NPDES	Schuylkill River	Zone B	29.5	1.5	Moderately High-B
2474	EXETER TOWNSHIP WWTR TRTMT PLT	NPDES	Schuylkill River	Flood Plain	25.7	1.5	Moderately High-B
2639	LOWER SALFORD TWP AUTH	NPDES	West Branch Skippack Creek	Flood Plain	16.5	0.1	Moderately High-B
2492	GPU GENERATION INC TITUS GENERATING STATION	NPDES	Schuylkill River	Zone B	28.6	26.7	Moderately High-B
2626	LOWER SALFORD TWP AUTH	NPDES	Indian Creek	Zone B	20.5	0.1	Moderately High-B
2509	WYOMISSING VALLEY JOINT MUN AU	NPDES	Wyomissing Creek	Zone B	31.0	1.5	Moderately High-B
2536	OLEY TOWNSHIP MUN AUTH	NPDES	Manatawny Creek	Flood Plain	29.8	0.1	Moderately High-B
2547	NGK METALS CORP.	NPDES	Laurel Run	Zone B	34.1	7.5	Moderately High-B
2747	LEESPORT BOROUGH AUTHORITY	NPDES	Schuylkill River	Flood Plain	37.1	0.1	Moderately High-B
2510	ANTIETAM VALLEY MUNICIPAL AUTHORITY	NPDES	Antietam Creek	Zone B	28.6	1.5	Moderately High-B
2631	TELFORD BORO AUTHORITY	NPDES	Indian Creek	Zone B	23.6	0.1	Moderately High-B
2524	CARPENTER TECHNOLOGY CORP	NPDES	Schuylkill River	Zone B	31.5	15.5	Moderately High-B
2231	ANCHOR GLASS CONTAINER CORP.	TRI	Schuylkill River	Zone B	15.0	112878.3	Moderately High-B
90004	Wissahickon Creek-004	NP	Wissahickon Creek	Zone A	1.1	0.4	Moderately High-B
2505	BALDWIN HARDWARE MFG CORP	NPDES	Schuylkill River	Zone B	30.0	0.1	Moderately High-B
509	LUKENS STEEL CO	NPDES	Schuylkill River	Zone A	4.5	1.5	Moderately High-B
2200	CHEMALLOY CO. INC.	TRI	Schuylkill River	Zone A	5.0	35154.3	Moderately High-B
2574	HAMBURG MUN AUTH	NPDES	Schuylkill River	Zone B	41.8	1.5	Moderately High-B
2556	MAIDENCREEK TOWNSHIP AUTHORITY	NPDES	Willow Creek	Zone B	37.6	0.1	Moderately High-B
90020	Schuylkill River-020	NP	Schuylkill River	Zone A	4.5	1.0	Moderately High-B
90018	Plymouth Creek-018	NP	Plymouth Creek	Zone A	4.5	0.6	Moderately High-B
90007	Wissahickon Creek-007	NP	Wissahickon Creek	Zone A	4.9	0.9	Moderately High-B
2516	SPRING TWP MUN AUTH	NPDES	Cacoosing Creek	Zone B	35.3	1.5	Moderately High-B
2719	GENERAL BATTERY CORP. READING SMELTER DIV.	NPDES	Bernhart Creek	Flood Plain	33.0	0.1	Moderately High-B
90024	Stony Creek-024	NP	Stony Creek	Zone A	7.0	1.2	Moderately High-B
756	PENN MED TECHNOLOGY	RCRA	Gulph Creek	Flood Plain	4.5	0.0	Moderately High-B
2193	BETHLEHEM STEEL CORP. - LUKENS PLATE CONSHOHOCKEN DIV.	TRI	Plymouth Creek	Zone A	5.0	10338.6	Moderately High-B
90027	Trout Creek-027	NP	Trout Creek	Zone A	8.0	0.7	Moderately High-B
90008	Wissahickon Creek-008	NP	Wissahickon Creek	Zone A	8.1	1.6	Moderate-C
90009	Sandy Run-009	NP	Sandy Run	Zone A	8.7	0.7	Moderate-C
2720	FLEETWOOD BORO AUTH	NPDES	Willow Creek	Zone B	40.7	0.1	Moderate-C
2215	YARWAY CORP.	TRI	Wissahickon Creek	Zone B	9.4	38677.4	Moderate-C

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Source ID	Source Name	Database Used	Subwatershed	Zone	Time of Travel	Relative Impact (%)	Priority
2354	CARPENTER TECHNOLOGY CORP	TRI	Schuylkill River	Zone B	31.50721741	123314.4	Moderate-C
2352	DANA CORP. PARISH DIVISION	TRI	Schuylkill River	Zone B	31.5	144641.1	Moderate-C
2715	BRUSH WELLMAN INC.	NPDES	Schuylkill River	Zone B	38.7	0.0	Moderate-C
90012	Sandy Run-012	NP	Sandy Run	Zone A	11.9	0.4	Moderate-C
1187	SPRING CITY FOUNDRY	RCRA	Schuylkill River	Flood Plain	14.5	0.0	Moderate-C
2190	PHILADELPHIA GEAR CORP.	TRI	Crow Creek	Zone A	9.0	6106.5	Moderate-C
2773	GRATERFORD STATE CORRECTIONAL INSTITUTE	NPDES	Perkiomen Creek	Zone B	13.5	0.1	Moderate-C
2225	HANDY & HARMAN TUBE CO INC	TRI	Stony Creek	Zone B	8.5	6642.4	Moderate-C
2230	SUPERIOR TUBE CO.	TRI	Perkiomen Creek	Zone B	13.5	3469.3	Moderate-C
3353	NORRISTOWN FILTRATION PLT	AST	Schuylkill River	Zone A	6.0	9265.5	Moderate-C
2420	RAHNS SPECIALITY METALS	TRI	Perkiomen Creek	Zone B	14.0	3723.1	Moderate-C
2161	DAMASCUS - BISHOP TUBE CO. INC.	TRI	Little Valley Creek	Zone B	14.4	4273.1	Moderate-C
2240	PRECISION TUBE CO. INC	TRI	Wissahickon Creek	Zone B	14.4	3568.0	Moderate-C
2251	POTTSTOWN PRECISION CASTING	TRI	Schuylkill River	Flood Plain	21.4	6166.3	Moderate-C
3321	COLORCON INC	AST	Wissahickon Creek	Zone B	13.8	40150.5	Moderate-C
2376	HEYCO METALS INC.	TRI	Schuylkill River	Flood Plain	33.6	58103.3	Moderate-C
2256	HAMMOND LEAD PRODUCTS	TRI	Schuylkill River	Zone B	21.4	15654.0	Moderate-C
2332	EXIDE CORP. READING SLI	TRI	Bernhart Creek	Flood Plain	33.0	35434.3	Moderate-C
2353	BALDWIN HARDWARE MFG CORP	TRI	Schuylkill River	Zone B	30.0	11803	Moderate-C
2343	NGK METALS CORP.	TRI	Laurel Run	Flood Plain	34.1	20466	Moderate-C
3411	BOYERTOWN WWTP	AST	Swamp Creek	Zone B	23.1	37062	Moderate-C
2330	YUASA EXIDE INC	TRI	Bernhart Creek	Zone B	33.6	5486	Moderate-C
2356	CAMBRIDGE-LEE INDS. READING TUBE DIV.	TRI	Schuylkill River	Zone B	35.6	15795	Moderate-C
2366	BRUSH WELLMAN INC.	TRI	Schuylkill River	Zone B	38.7	17224	Moderate-C
2328	CAN CORP. OF AMERICA INC.	TRI	Willow Creek	Zone B	38.1	3761	Moderate-C
3679	GLIDDEN CO THE	AST	Bernhart Creek	Zone B	32.5	18531	Moderate-C
2375	PENNSYLVANIA STEEL FNDY. & MACHINE CO.	TRI	Schuylkill River	Zone B	42.3	7429	Moderate-C

Figure 3.2.4-8 Priority Point Sources and Subwatersheds for PWD's Queen Lane Intake for Metals in the Lower Schuylkill River Watershed

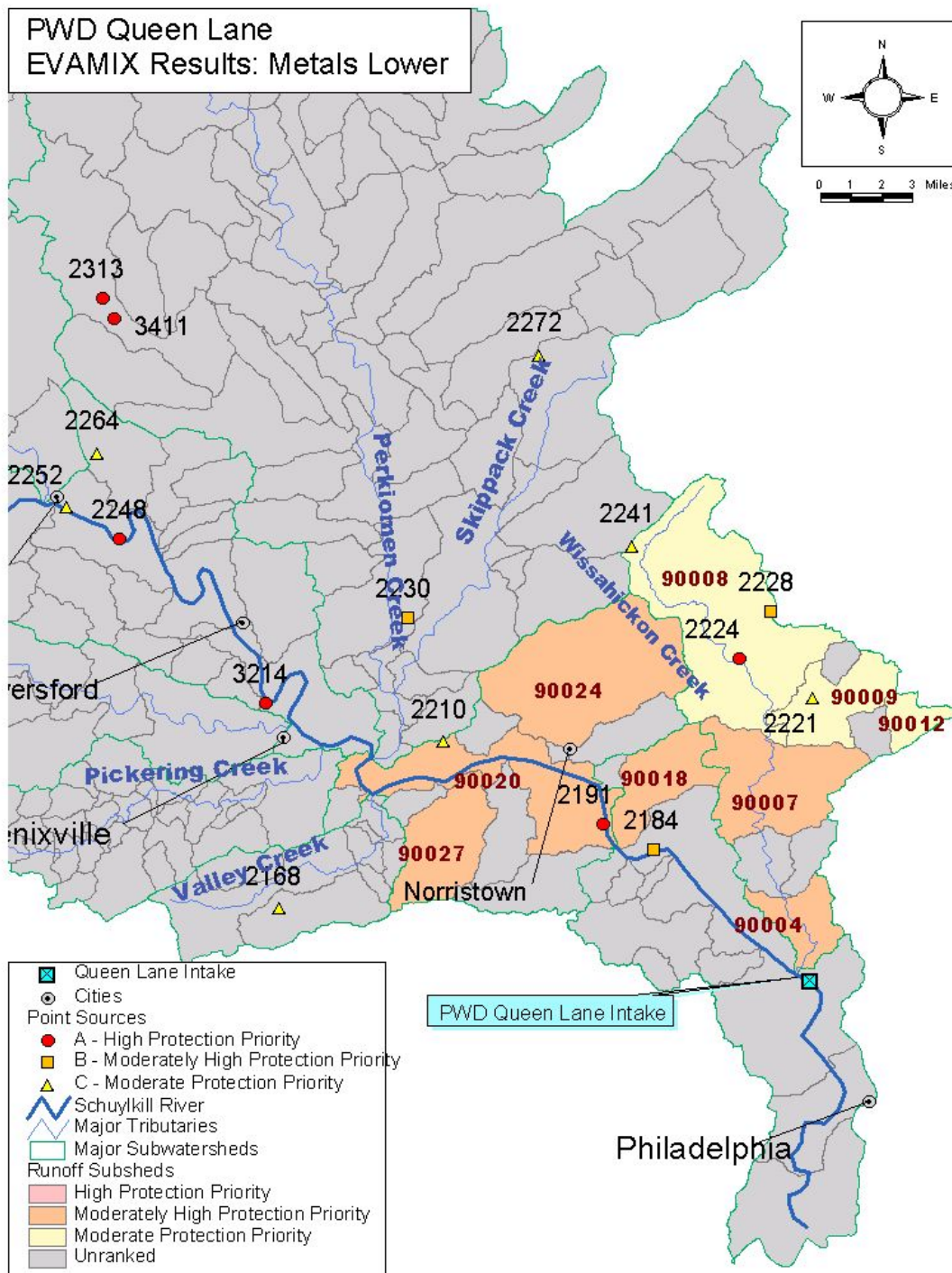
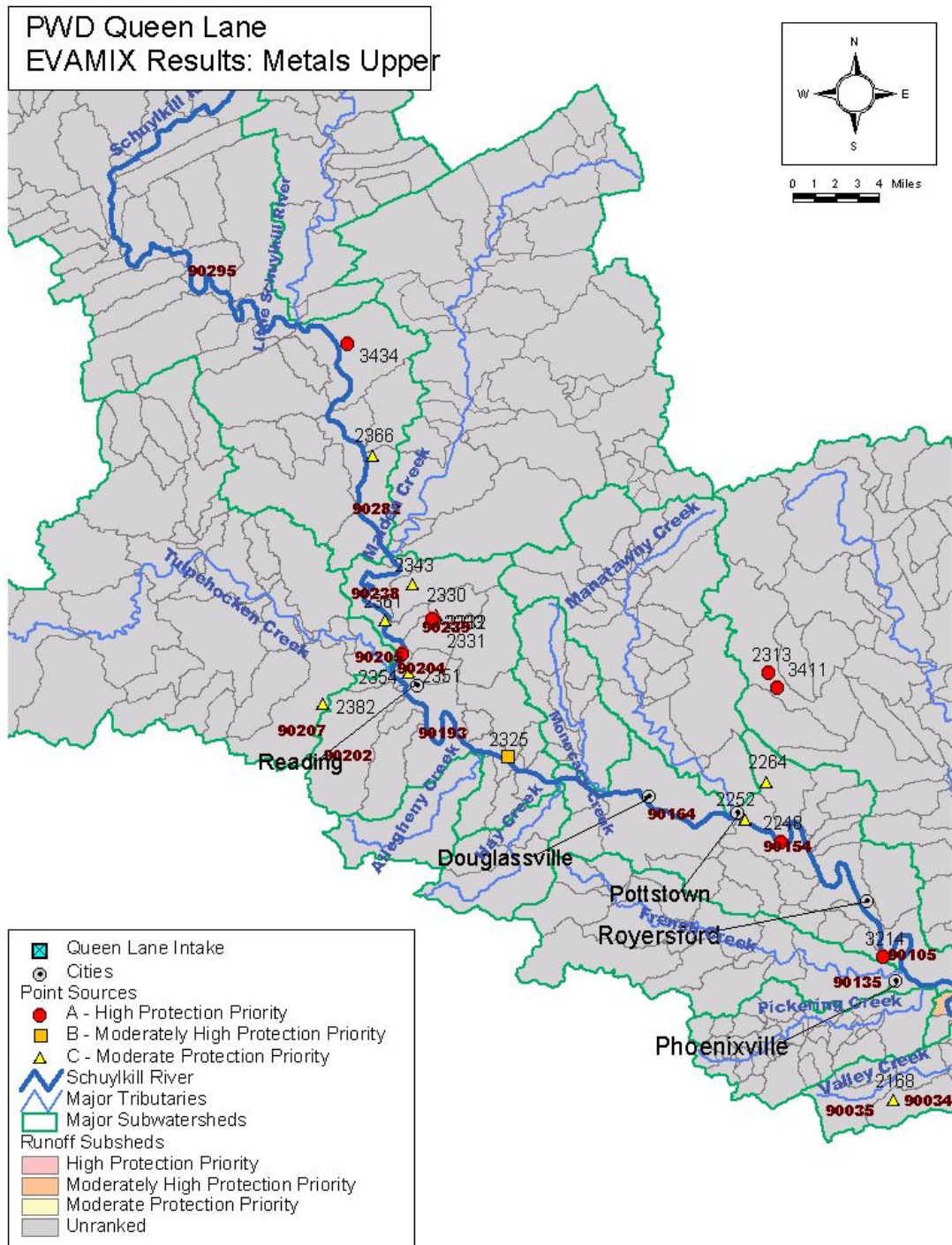


Figure 3.2.4-9 Priority Point Sources and Subwatersheds for PWD’s Queen Lane Intake for Metals in the Upper Schuylkill River Watershed



Nitrates

Table 3.2.4-7 shows the ranking of sites for nitrate loading. The high category (category A) is dominated by NPDES dischargers, primarily wastewater treatment plants. Most of the loading from these sites appears to be relatively low, and is not likely to cause a cumulative impact that would cause an exceedance of the nitrate standard at the intake. Moderately high priority sites (category B) are a mixture of NPDES sites and non-point runoff from storm water. Only twelve of the 87 potentially significant sources were located within the five-hour time of travel (zone A). Therefore, efforts to reduce nitrate impacts will be necessary watershed wide. Figures 3.2.4-10 and 3.2.4-11 illustrate the priority point sources and subwatersheds for nitrates in the Lower and Upper Schuylkill River watersheds. Moderately high priority subwatersheds are located in Wissahickon Creek and the downstream part of the Schuylkill River.

Table 3.2.4-7 Contaminant Category Ranking for Nitrates

Source ID	Source Name	Database Used	Subwatershed	Zone	Time of Travel	Relative Impact (%)	Priority
2230	SUPERIOR TUBE CO.	TRI	Perkiomen Creek	Zone B	13.5	636.59	Highest-A
2491	READING CITY	NPDES	Schuylkill River	Zone B	29.5	130.18	Highest-A
465	WHITEMARSH TWP SEW AUTH	NPDES	Schuylkill River	Zone A	3.5	1.64	Highest-A
666	NORRISTOWN MUN WASTE AUTH	NPDES	Schuylkill River	Flood Plain	5.5	5.46	Highest-A
664	EAST NORRISTOWN/PLYMOUTH/WHITPAIN JOINT SEWER AUTHORITY	NPDES	Schuylkill River	Flood Plain	5.5	2.49	Highest-A
781	MONTGOMERY COUNTY SEW AUTH	NPDES	Perkiomen Creek	Flood Plain	10.5	3.13	Highest-A
464	CONSHOHOCKEN SEW TREAT. PLT.	NPDES	Schuylkill River	Zone A	3.5	0.79	Highest-A
795	ABINGTON TWP COMM-WWTR TRTMT P	NPDES	Sandy Run	Zone A	11.3	2.64	Highest-A
1613	UPPER GWYNEDD TWP	NPDES	Wissahickon Creek	Flood Plain	12.5	0.33	Highest-A
821	AMBLER BORO	NPDES	Wissahickon Creek	Zone A	8.7	0.49	Highest-A
535	UPPER MERION TWP. AUTH-MATSUNK WPCC	NPDES	Schuylkill River	Zone B	5.0	0.97	Highest-A
665	UPPER MERION MUN UTILITY AUTH	NPDES	Trout Creek	Zone A	8.0	3.90	Highest-A
622	BRIDGEPORT BORO	NPDES	Schuylkill River	Flood Plain	5.5	0.01	Highest-A
1734	BOROUGH OF NORTH WALES	NPDES	Wissahickon Creek	Flood Plain	13.2	0.01	Highest-A
792	PHOENIXVILL BORO STP	NPDES	Schuylkill River	Zone B	11.5	2.14	Highest-A
780	VALLEY FORGE SEWER AUTHORITY	NPDES	Schuylkill River	Zone B	10.0	2.97	Highest-A
2473	LOWER FREDERICK TOWNSHIP TRT P	NPDES	Perkiomen Creek	Flood Plain	16.6	0.01	Highest-A
2677	SPRING CITY BOROUGH SEWAGE PLANT	NPDES	Schuylkill River	Flood Plain	14.5	0.01	Highest-A
2460	SCHWENKSVILLE BOROUGH AUTH	NPDES	Perkiomen Creek	Flood Plain	16.1	0.01	Highest-A
2453	UPPER GWYNEDD-TOWAMENCIN MUN	NPDES	Towamencin Creek	Zone B	16.5	1.25	Highest-A
1614	LIMERICK TWP MUN AUTH	NPDES	Schuylkill River	Flood Plain	15.0	0.10	Highest-A
2455	POTTSTOWN BORO	NPDES	Schuylkill River	Zone B	19.5	1.44	Highest-A

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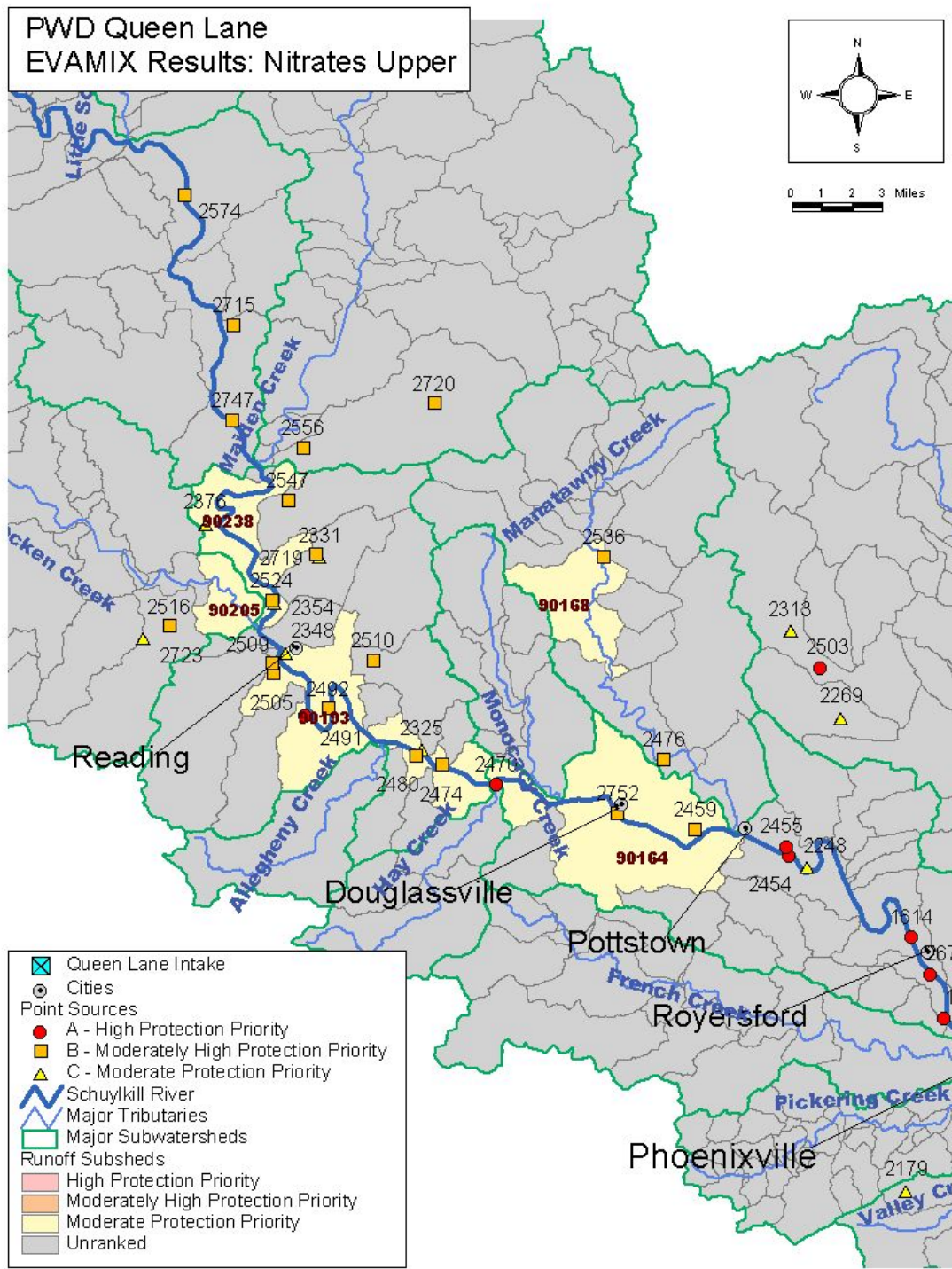
Source ID	Source Name	Database Used	Subwatershed	Zone	Time of Travel	Relative Impact (%)	Priority
2503	BERKS MONTGOMERY MUNICIPAL AUTH	NPDES	Swamp Creek	Flood Plain	23.1	1.26	Highest-A
1068	PECO ENERGY CO-CROMBY GENERATING	NPDES	Schuylkill River	Flood Plain	13.5	0.01	Highest-A
2521	PENN RIDGE WASTE WATER TREATMENT AUTHORITY	NPDES	East Branch Perkiomen Creek	Flood Plain	25.4	8.96	Highest-A
2470	BIRDSBORO BORO MUN AUTH	NPDES	Schuylkill River	Flood Plain	24.8	1.48	Highest-A
2485	BOROUGH OF SOUDERTON	NPDES	Skippack Creek	Zone B	18.5	0.26	Highest-A
2454	NORTH COVENTRY MUN AUTH STP	NPDES	Schuylkill River	Flood Plain	19.5	0.01	Highest-A
2627	UPPER DUBLIN TWP	NPDES	Wissahickon Creek	Zone B	8.7	0.01	Highest-A
2459	STANLEY G. FLAGG & CO. INC	NPDES	Schuylkill River	Zone B	20.9	0.01	Moderately High-B
2476	ALLEGHENY E. CONF. ASSOC. 7TH DAY ADVENTISTS	NPDES	Manatawny Creek	Flood Plain	23.1	0.01	Moderately High-B
2474	EXETER TOWNSHIP WWTR TRTMT PLT	NPDES	Schuylkill River	Flood Plain	25.7	2.05	Moderately High-B
2752	120 OLD PHILADELPHI	NPDES	Schuylkill River	Flood Plain	22.8	0.13	Moderately High-B
2639	LOWER SALFORD TWP AUTH	NPDES	West Branch Skippack Creek	Flood Plain	16.5	0.01	Moderately High-B
2480	CROMPTON & KNOWLES CORP GIBALTAR PLT	NPDES	Schuylkill River	Flood Plain	26.2	0.12	Moderately High-B
2492	GPU GENERATION INC TITUS GENERATING STATION	NPDES	Schuylkill River	Zone B	28.6	0.11	Moderately High-B
2509	WYOMISSING VALLEY JOINT MUN AU	NPDES	Wyomissing Creek	Zone B	31.0	2.35	Moderately High-B
2626	LOWER SALFORD TWP AUTH	NPDES	Indian Creek	Zone B	20.5	0.01	Moderately High-B
2189	METLAB CO	TRI	Cresheim Creek	Zone B	4.3	42.46	Moderately High-B
2536	OLEY TOWNSHIP MUN AUTH	NPDES	Manatawny Creek	Flood Plain	29.8	0.01	Moderately High-B
2547	NGK METALS CORP.	NPDES	Laurel Run	Zone B	34.1	0.11	Moderately High-B
2510	ANTIETAM VALLEY MUNICIPAL AUTHORITY	NPDES	Antietam Creek	Zone B	28.6	0.27	Moderately High-B
2631	TELFORD BORO AUTHORITY	NPDES	Indian Creek	Zone B	23.6	0.01	Moderately High-B
2747	LEESPORT BOROUGH AUTHORITY	NPDES	Schuylkill River	Flood Plain	37.1	0.01	Moderately High-B
2524	CARPENTER TECHNOLOGY CORP	NPDES	Schuylkill River	Zone B	31.5	0.11	Moderately High-B
2505	BALDWIN HARDWARE MFG CORP	NPDES	Schuylkill River	Zone B	30.0	0.01	Moderately High-B
509	LUKENS STEEL CO	NPDES	Schuylkill River	Zone A	4.5	0.11	Moderately High-B
2574	HAMBURG MUN AUTH	NPDES	Schuylkill River	Zone B	41.8	0.11	Moderately High-B
2556	MAIDENCREEK TOWNSHIP AUTHORITY	NPDES	Willow Creek	Zone B	37.6	0.01	Moderately High-B
2516	SPRING TWP MUN AUTH	NPDES	Cacoosing Creek	Zone B	35.3	0.97	Moderately High-B
90020	Schuylkill River-020	NP	Schuylkill River	Zone A	4.5	0.06	Moderately High-B
2719	GENERAL BATTERY CORP. READING SMELTER DIV.	NPDES	Bernhart Creek	Flood Plain	33.0	0.01	Moderately High-B
90007	Wissahickon Creek-007	NP	Wissahickon Creek	Zone A	4.9	0.05	Moderately High-B
90024	Stony Creek-024	NP	Stony Creek	Zone A	7.0	0.09	Moderately High-B
2720	FLEETWOOD BORO AUTH	NPDES	Willow Creek	Zone B	40.7	0.01	Moderately High-B
90008	Wissahickon Creek-008	NP	Wissahickon Creek	Zone A	8.1	0.12	Moderately High-B
90009	Sandy Run-009	NP	Sandy Run	Zone A	8.7	0.05	Moderately High-B
2715	BRUSH WELLMAN INC.	NPDES	Schuylkill River	Zone B	38.7	0.01	Moderately High-B

Source ID	Source Name	Database Used	Subwatershed	Zone	Time of Travel	Relative Impact (%)	Priority
2773	GRATERFORD STATE CORRECTIONAL INSTITUTE	NPDES	Perkiomen Creek	Zone B	13.5	0.01	Moderate-C
2183	JOHNSON MATTHEY CSDNA	TRI	Trout Creek	Zone A	9.5	0.14	Moderate-C
2192	CHEF FRANCISCO OF PA	TRI	Crow Creek	Zone B	8.5	0.18	Moderate-C
2234	UNIFORM TUBES INC.	TRI	Perkiomen Creek	Zone B	14.0	0.13	Moderate-C
2248	OCCIDENTAL CHEMICAL CORP.	TRI	Schuylkill River	Flood Plain	19.0	0.41	Moderate-C
2313	CABOT PERFORMANCE MATERIALS	TRI	Swamp Creek	Zone B	23.6	19.00	Moderate-C
90047	Skippack Creek-047	NP	Skippack Creek	Zone B	17.0	0.04	Moderate-C
2179	ALEX C. FERGUSON INC.	TRI	Valley Creek	Zone B	13.8	0.21	Moderate-C
2221	NOVARTIS CONSUMER HEALTH INC.	TRI	Sandy Run	Zone B	14.4	0.15	Moderate-C
90164	Schuylkill River-164	NP	Schuylkill River	Zone B	20.5	0.05	Moderate-C
2422	ROSENBERGERS DAIRIES INC.	TRI	Skippack Creek	Zone B	17.5	0.25	Moderate-C
2272	H. W. LONGACRE INC.	TRI	Skippack Creek	Zone B	18.0	0.25	Moderate-C
2273	WAMPLER-LONGACRE INC.	TRI	Skippack Creek	Zone B	18.0	0.25	Moderate-C
2415	MOYER PACKING CO.	TRI	Skippack Creek	Zone B	18.0	0.25	Moderate-C
90193	Schuylkill River-193	NP	Schuylkill River	Zone B	25.2	0.06	Moderate-C
2325	CROMPTON & KNOWLES CORP GIBRALTAR PLT	TRI	Schuylkill River	Zone B	26.2	0.51	Moderate-C
90059	East Branch Perkiomen Creek-059	NP	East Branch Perkiomen Creek	Zone B	26.1	0.05	Moderate-C
90058	Mill Creek-058	NP	Mill Creek	Zone B	26.1	0.04	Moderate-C
2723	SINKING SPRING BORO MUN AUTH	NPDES	Cacoosing Creek	Flood Plain	36.0	0.11	Moderate-C
2269	MRS. SMITH'S INC.	TRI	Minister Creek	Zone B	22.0	0.17	Moderate-C
90168	Manatawny Creek-168	NP	Manatawny Creek	Zone B	26.8	0.05	Moderate-C
90060	Pleasant Spring Creek-060	NP	Pleasant Spring Creek	Zone B	27.3	0.07	Moderate-C
2331	LUCENT TECHNOLOGIES	TRI	Bernhart Creek	Flood Plain	33.0	0.14	Moderate-C
90061	Morris Run-061	NP	Morris Run	Zone B	29.2	0.05	Moderate-C
2354	CARPENTER TECHNOLOGY CORP	TRI	Schuylkill River	Zone B	31.5	3.61	Moderate-C
2348	GARDEN STATE TANNING - READING	TRI	Schuylkill River	Flood Plain	30.0	0.25	Moderate-C
90238	Schuylkill River-238	NP	Schuylkill River	Zone B	31.5	0.07	Moderate-C
90205	Tulpehocken Creek-205	NP	Tulpehocken Creek	Zone B	31.5	0.05	Moderate-C
2376	HEYCO METALS INC.	TRI	Schuylkill River	Flood Plain	33.6	1.40	Moderate-C

Figure 3.2.4-10 Priority Point Sources and Subwatersheds for PWD's Queen Lane Intake for Nitrates in the Lower Schuylkill River Watershed



Figure 3.2.4-11 Priority Point Sources and Subwatersheds for PWD’s Queen Lane Intake for Nitrates in the Upper Schuylkill River Watershed



Petroleum Hydrocarbons

There were a limited number of significant sources of petroleum hydrocarbons, as shown in Table 3.2.4-8. Only aboveground storage tanks containing fuel, or stormwater runoff were identified as significant potential sources of petroleum hydrocarbon loading. Most of the high priority sites are either fuel storage facilities (with a low probability of release but potentially very high concentrations), or stormwater runoff with lower concentrations but frequent occurrence. All of the potentially significant sources of AST identified were in the Zone B or 5 to 25-hour time of travel range. Several non-point source runoff subwatersheds in the Wissahickon Creek and Lower Schuylkill River were identified as potentially significant sources of high protection priority. Figure 3.2.4-12 identifies the priority point sources and subwatersheds for petroleum hydrocarbons in the Schuylkill River Watershed. Much of the downstream portion of the Schuylkill (downstream of Pottstown) and the tributaries are high priority subwatersheds.

Table 3.2.4-8 Contaminant Category Ranking for Petroleum Hydrocarbons

Source ID	Source Name	Database Used	Subwatershed	Zone	Time of Travel	Relative Impact (%)	Priority
3702	BERKS FUEL STORAGE CO INC	AST	Laurel Run	Zone B	33.6	741240.0	Highest-A
3241	PLOTTS OIL BULK PLT	AST	Stony Run	Zone B	15.0	312247.4	Highest-A
90020	Schuylkill River-020	NP	Schuylkill River	Zone A	4.5	2.7	Highest-A
90018	Plymouth Creek-018	NP	Plymouth Creek	Zone A	4.5	1.6	Highest-A
90007	Wissahickon Creek-007	NP	Wissahickon Creek	Zone A	4.9	1.5	Highest-A
90024	Stony Creek-024	NP	Stony Creek	Zone A	7.0	2.5	Highest-A
90027	Trout Creek-027	NP	Trout Creek	Zone A	8.0	1.8	Highest-A
90008	Wissahickon Creek-008	NP	Wissahickon Creek	Zone A	8.1	3.2	Highest-A
90009	Sandy Run-009	NP	Sandy Run	Zone A	8.7	1.8	Highest-A
90105	Schuylkill River-105	NP	Schuylkill River	Zone B	10.5	1.2	Highest-A
90035	Valley Creek-035	NP	Valley Creek	Zone B	11.1	1.1	Highest-A
90135	French Creek-135	NP	French Creek	Zone B	12.1	1.0	Highest-A
90034	Little Valley Creek-034	NP	Little Valley Creek	Zone B	12.2	1.3	Highest-A
90154	Schuylkill River-154	NP	Schuylkill River	Zone B	15.0	1.3	Highest-A
90045	Towamencin Creek-045	NP	Towamencin Creek	Zone B	16.0	1.1	Highest-A
90047	Skipack Creek-047	NP	Skipack Creek	Zone B	17.0	1.1	Highest-A
90164	Schuylkill River-164	NP	Schuylkill River	Zone B	20.5	1.2	Moderately High-B
90193	Schuylkill River-193	NP	Schuylkill River	Zone B	25.2	2.1	Moderately High-B
90059	East Branch Perkiomen Creek-059	NP	East Branch Perkiomen Creek	Zone B	26.1	1.1	Moderately High-B
3759	COLUMBIA PETRO	AST	Laurel Run	Zone B	33.6	234977.3	Moderately High-B
3305	REIT FUEL OIL CO BLUE BELL	AST	Stony Creek	Zone B	10.0	185310.0	Moderately High-B
90202	Wyomissing Creek-202	NP	Wyomissing Creek	Zone B	31.0	1.3	Moderately High-B
90204	Schuylkill River-204	NP	Schuylkill River	Zone B	31.0	1.6	Moderately High-B
90238	Schuylkill River-238	NP	Schuylkill River	Zone B	31.5	2.1	Moderately High-B
90205	Tulpehocken Creek-205	NP	Tulpehocken Creek	Zone B	31.5	1.3	Moderately High-B
90239	Bernhart Creek-239	NP	Bernhart Creek	Zone B	32.5	1.1	Moderately High-B
3436	OEHLERT Bros. Fuel Oil	AST	Mingo Creek	Zone B	15.5	185310.0	Moderately High-B
90207	Cacoosing Creek-207	NP	Cacoosing Creek	Zone B	33.9	1.0	Moderately High-B
90282	Schuylkill River-282	NP	Schuylkill River	Zone B	36.1	0.9	Moderately High-B
3173	FARM AND HOME OIL CO. INC.	AST	Mill Creek	Zone B	26.7	185310.0	Moderately High-B
90295	Schuylkill River-295	NP	Schuylkill River	Zone B	47.1	0.9	Moderately High-B
3434	MOYER & SON INC	AST	Schuylkill River	Zone B	42.3	188135.2	Moderately High-B
3437	ROBERT MARSHALL INC	AST	Skipack Creek	Zone B	15.5	85242.6	Moderate-C

Source ID	Source Name	Database Used	Subwatershed	Zone	Time of Travel	Relative Impact (%)	Priority
3301	FARM & HOME OIL CO	AST	Manatawny Creek	Zone B	21.4	92655.0	Moderate-C
3733	COLUMBIA PETRO CORP	AST	Schuylkill River	Zone B	21.9	92655.0	Moderate-C
3433	JAY GRESS INC	AST	Plymouth Creek	Zone B	5.5	55593.0	Moderate-C
3213	HESTON S SWARTLEY TRANS CO INC	AST	East Branch Perkiomen Creek	Zone B	26.1	92655.0	Moderate-C
3362	LONZA INC.	AST	Schuylkill River	Zone A	3.0	9265.5	Moderate-C
3344	QUAKER CHEMICAL CORP.	AST	Schuylkill River	Zone A	3.5	9265.5	Moderate-C
3739	SANTILLI OIL CO INC	AST	Pigeon Creek	Flood Plain	39.2	69120.6	Moderate-C
3721	GOSHERTS QUALITY FUELS	AST	Schuylkill River	Flood Plain	31.5	46327.5	Moderate-C
3387	DE WALKER & SON INC	AST	Wissahickon Creek	Zone B	14.4	46327.5	Moderate-C
3254	OCCIDENTAL CHEMICAL CORP.	AST	Sprogles Run	Zone B	19.0	42621.3	Moderate-C
3386	EDWARD J SWEENEY & SONS	AST	Schuylkill River	Zone B	19.5	29279.0	Moderate-C
3169	M & S OIL	AST	East Branch Perkiomen Creek	Zone B	26.7	18531.0	Moderate-C
3385	WALTER F SCHWAB CO	AST	Manatawny Creek	Zone B	21.4	4632.8	Moderate-C
3405	WH KNEAS LUMBER CO	AST	East Branch Perkiomen Creek	Zone B	26.1	4632.8	Moderate-C
3661	KOCH MATERIALS CO.	AST	Laurel Run	Zone B	33.6	18531.0	Moderate-C
3679	GLIDDEN CO THE	AST	Bernhart Creek	Zone B	32.5	4632.8	Moderate-C
3714	ES SAVAGE INC	AST	Schuylkill River	Zone B	42.3	9265.5	Moderate-C

Figure 3.2.4-12 Priority Point Sources and Subwatersheds for PWD’s Queen Lane Intake for Petroleum Hydrocarbons in Schuylkill River Watershed



Phosphorus

Table 3.2.4-9 shows the ranking of sites for phosphorus loading. Like nitrates, the high protection priority category (category A) is dominated by NPDES dischargers, primarily wastewater treatment plants. Most of the loading from these sites appears to be relatively low, and is not likely to cause a cumulative impact that would cause significant water quality impairment at the intake. There are a few very large industrial sites that are also included in the high category, primarily due to the high potential concentrations should a spill occur. Moderately high priority sites are a mixture of NPDES sites and TRI sites. The NPS subwatersheds fell into category C. A large majority of the potentially significant sources were located in the drainage areas along the main stem Schuylkill River. Figures 3.2.4-13 and 3.2.4-14 illustrate the priority point sources and subwatersheds (moderate priority only) for phosphorous in the Lower and Upper Schuylkill River watersheds.

Table 3.2.4-9 Contaminant Category Ranking for Phosphorus

Source ID	Source Name	Database Used	Subwatershed	Zone	Time of Travel	Relative Impact (%)	Priority
3679	GLIDDEN CO THE	AST	Bernhart Creek	Zone B	32.5	2316.38	Highest-A
2434	RICHARDSAPEX INC.	TRI	Schuylkill River	Zone A	1.0	892.00	Highest-A
465	WHITEMARSH TWP SEW AUTH	NPDES	Schuylkill River	Zone A	3.5	0.93	Highest-A
666	NORRISTOWN MUN WASTE AUTH	NPDES	Schuylkill River	Flood Plain	5.5	0.93	Highest-A
781	MONTGOMERY COUNTY SEW AUTH	NPDES	Perkiomen Creek	Flood Plain	10.5	0.93	Highest-A
664	EAST NORRISTOWN/PLYMOUTH/WHITPAIN JOINT SEWER AUTHORITY	NPDES	Schuylkill River	Flood Plain	5.5	0.93	Highest-A
464	CONSHOHOCKEN SEW TREAT. PLT.	NPDES	Schuylkill River	Zone A	3.5	0.93	Highest-A
1613	UPPER GWYNEDD TWP	NPDES	Wissahickon Creek	Flood Plain	12.5	0.93	Highest-A
795	ABINGTON TWP COMM-WWTR TRTMT P	NPDES	Sandy Run	Zone A	11.3	0.93	Highest-A
821	AMBLER BORO	NPDES	Wissahickon Creek	Zone A	8.7	0.93	Highest-A
535	UPPER MERION TWP. AUTH-MATSUNK WPCC	NPDES	Schuylkill River	Zone B	5.0	0.93	Highest-A
665	UPPER MERION MUN UTILITY AUTH	NPDES	Trout Creek	Zone A	8.0	0.93	Highest-A
622	BRIDGEPORT BORO	NPDES	Schuylkill River	Flood Plain	5.5	0.16	Highest-A
1734	BOROUGH OF NORTH WALES	NPDES	Wissahickon Creek	Flood Plain	13.2	0.15	Highest-A
2473	LOWER FREDERICK TOWNSHIP TRT P	NPDES	Perkiomen Creek	Flood Plain	16.6	0.15	Highest-A
792	PHOENIXVILL BORO STP	NPDES	Schuylkill River	Zone B	11.5	0.93	Highest-A
780	VALLEY FORGE SEWER AUTHORITY	NPDES	Schuylkill River	Zone B	10.0	0.93	Highest-A
2453	UPPER GWYNEDD-TOWAMENCIN MUN	NPDES	Towamencin Creek	Zone B	16.5	13.15	Highest-A
2677	SPRING CITY BOROUGH SEWAGE PLANT	NPDES	Schuylkill River	Flood Plain	14.5	0.15	Highest-A
2460	SCHWENKSVILLE BOROUGH AUTH	NPDES	Perkiomen Creek	Flood Plain	16.1	0.15	Highest-A
2503	BERKS MONTGOMERY MUNICIPAL AUTH	NPDES	Swamp Creek	Flood Plain	23.1	4.20	Highest-A
1614	LIMERICK TWP MUN AUTH	NPDES	Schuylkill River	Flood Plain	15.0	0.93	Highest-A
2455	POTTSTOWN BORO	NPDES	Schuylkill River	Zone B	19.5	0.93	Highest-A

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Source ID	Source Name	Database Used	Subwatershed	Zone	Time of Travel	Relative Impact (%)	Priority
1068	PECO ENERGY CO-CROMBY GENERATING	NPDES	Schuylkill River	Flood Plain	13.5	0.15	Highest-A
2470	BIRDSBORO BORO MUN AUTH	NPDES	Schuylkill River	Flood Plain	24.8	0.93	Highest-A
2485	BOROUGH OF SOUDERTON	NPDES	Skipack Creek	Zone B	18.5	3.44	Highest-A
2454	NORTH COVENTRY MUN AUTH STP	NPDES	Schuylkill River	Flood Plain	19.5	0.15	Highest-A
2459	STANLEY G. FLAGG & CO. INC	NPDES	Schuylkill River	Zone B	20.9	0.15	Highest-A
2521	PENN RIDGE WASTE WATER TREATMENT AUTHORITY	NPDES	East Branch Perkiomen Creek	Flood Plain	25.4	5.70	Highest-A
2491	READING CITY	NPDES	Schuylkill River	Zone B	29.5	0.93	Moderately High-B
2627	UPPER DUBLIN TWP	NPDES	Wissahickon Creek	Zone B	8.7	0.15	Moderately High-B
2476	ALLEGHENY E. CONF. ASSOC. 7TH DAY ADVENTISTS	NPDES	Manatawny Creek	Flood Plain	23.1	0.15	Moderately High-B
2480	CROMPTON & KNOWLES CORP GIBALTAR PLT	NPDES	Schuylkill River	Flood Plain	26.2	0.93	Moderately High-B
2752	120 OLD PHILADELPHI	NPDES	Schuylkill River	Flood Plain	22.8	0.93	Moderately High-B
2474	EXETER TOWNSHIP WWTR TRTMT PLT	NPDES	Schuylkill River	Flood Plain	25.7	0.93	Moderately High-B
2492	GPU GENERATION INC TITUS GENERATING STATION	NPDES	Schuylkill River	Zone B	28.6	0.93	Moderately High-B
2639	LOWER SALFORD TWP AUTH	NPDES	West Branch Skipack Creek	Flood Plain	16.5	0.15	Moderately High-B
2509	WYOMISSING VALLEY JOINT MUN AU	NPDES	Wyomissing Creek	Zone B	31.0	0.93	Moderately High-B
2626	LOWER SALFORD TWP AUTH	NPDES	Indian Creek	Zone B	20.5	0.15	Moderately High-B
2547	NGK METALS CORP.	NPDES	Laurel Run	Zone B	34.1	0.93	Moderately High-B
2536	OLEY TOWNSHIP MUN AUTH	NPDES	Manatawny Creek	Flood Plain	29.8	0.15	Moderately High-B
2747	LEESPORT BOROUGH AUTHORITY	NPDES	Schuylkill River	Flood Plain	37.1	0.15	Moderately High-B
2510	ANTIETEM VALLEY MUNICIPAL AUTHORITY	NPDES	Antietam Creek	Zone B	28.6	0.93	Moderately High-B
2631	TELFORD BORO AUTHORITY	NPDES	Indian Creek	Zone B	23.6	0.15	Moderately High-B
2225	HANDY & HARMAN TUBE CO INC	TRI	Stony Creek	Zone B	8.5	176.28	Moderately High-B
2524	CARPENTER TECHNOLOGY CORP	NPDES	Schuylkill River	Zone B	31.5	0.93	Moderately High-B
2574	HAMBURG MUN AUTH	NPDES	Schuylkill River	Zone B	41.8	0.93	Moderately High-B
2505	BALDWIN HARDWARE MFG CORP	NPDES	Schuylkill River	Zone B	30.0	0.15	Moderately High-B
2556	MAIDENCREEK TOWNSHIP AUTHORITY	NPDES	Willow Creek	Zone B	37.6	0.15	Moderately High-B
509	LUKENS STEEL CO	NPDES	Schuylkill River	Zone A	4.5	0.93	Moderately High-B
2516	SPRING TWP MUN AUTH	NPDES	Cacoosing Creek	Zone B	35.3	0.93	Moderately High-B
2719	GENERAL BATTERY CORP. READING SMELTER DIV.	NPDES	Bernhart Creek	Flood Plain	33.0	0.15	Moderately High-B
2184	FREEDOM TEXTILE CHEMICALS CO.	TRI	Schuylkill River	Flood Plain	3.5	40.19	Moderately High-B
2191	LONZA INC.	TRI	Schuylkill River	Flood Plain	4.5	3.53	Moderately High-B
2720	FLEETWOOD BORO AUTH	NPDES	Willow Creek	Zone B	40.7	0.15	Moderately High-B
2158	NAMICO INC.	TRI	Schuylkill River	Flood Plain	1.0	7.58	Moderately High-B
2171	SIMPSON PAPER CO.	TRI	Schuylkill River	Flood Plain	2.5	14.10	Moderately High-B
90020	Schuylkill River-020	NP	Schuylkill River	Zone A	4.5	0.65	Moderate-C
2715	BRUSH WELLMAN INC.	NPDES	Schuylkill River	Zone B	38.7	0.15	Moderate-C
90024	Stony Creek-024	NP	Stony Creek	Zone A	7.0	1.25	Moderate-C
90008	Wissahickon Creek-008	NP	Wissahickon Creek	Zone A	8.1	1.56	Moderate-C
2199	RESCO PRODS. INC.	TRI	Schuylkill River	Zone A	5.0	11.54	Moderate-C
2228	HENKEL CORP.	TRI	Wissahickon	Zone B	10.6	35.26	Moderate-C

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Source ID	Source Name	Database Used	Subwatershed	Zone	Time of Travel	Relative Impact (%)	Priority
2177	QUAKER CHEMICAL CORP.	TRI	Creek				
2773	GRATERFORD STATE	NPDES	Schuylkill River	Zone B	3.5	4.87	Moderate-C
	CORRECTIONAL INSTITUTE		Perkiomen	Zone B	13.5	0.15	Moderate-C
2218	LEHIGH VALLEY DAIRIES INC.	TRI	Creek				
			Sandy Run	Flood Plain	12.5	21.15	Moderate-C
2179	ALEX C. FERGUSON INC.	TRI	Valley Creek	Zone B	13.8	17.63	Moderate-C
90047	Skippack Creek-047	NP	Skippack Creek	Zone B	17.0	0.62	Moderate-C
2241	MERCK & CO INC	TRI	Wissahickon	Zone B	13.8	3.70	Moderate-C
			Creek				
2244	SERMATECH INTL. INC.	TRI	Mingo Creek	Zone B	16.5	14.46	Moderate-C
2249	TUSCAN LEHIGH DAIRIES L.P.	TRI	Towamencin	Zone B	18.5	3.53	Moderate-C
			Creek				
2325	CROMPTON & KNOWLES CORP GIBALTAR PLT	TRI	Schuylkill River	Zone B	26.2	15.87	Moderate-C
90193	Schuylkill River-193	NP	Schuylkill River	Zone B	25.2	0.63	Moderate-C
2723	SINKING SPRING BORO MUN AUTH	NPDES	Cacoosing	Flood Plain	36.0	0.93	Moderate-C
			Creek				
90059	East Branch Perkiomen Creek-059	NP	East Branch Perkiomen	Zone B	26.1	0.71	Moderate-C
			Creek				
90058	Mill Creek-058	NP	Mill Creek	Zone B	26.1	0.67	Moderate-C
90168	Manatawny Creek-168	NP	Manatawny	Zone B	26.8	0.77	Moderate-C
			Creek				
2331	LUCENT TECHNOLOGIES	TRI	Bernhart Creek	Flood Plain	33.0	6.70	Moderate-C
90060	Pleasant Spring Creek-060	NP	Pleasant Spring	Zone B	27.3	1.12	Moderate-C
			Creek				
90061	Morris Run-061	NP	Morris Run	Zone B	29.2	0.83	Moderate-C
2324	ATOFINA CHEMICALS INC.	TRI	Schuylkill River	Zone B	25.7	2.64	Moderate-C
90238	Schuylkill River-238	NP	Schuylkill River	Zone B	31.5	0.88	Moderate-C
90207	Cacoosing Creek-207	NP	Cacoosing	Zone B	33.9	0.70	Moderate-C
			Creek				
90209	Plum Creek-209	NP	Plum Creek	Zone B	34.6	1.27	Moderate-C
2395	EAGLE CHEMICAL CO.	TRI	Schuylkill River	Zone B	33.0	21.15	Moderate-C
90282	Schuylkill River-282	NP	Schuylkill River	Zone B	36.1	1.77	Moderate-C

Figure 3.2.4-13 Priority Point Sources and Subwatersheds for PWD’s Queen Lane Intake for Phosphorus in the Lower Schuylkill River Watershed

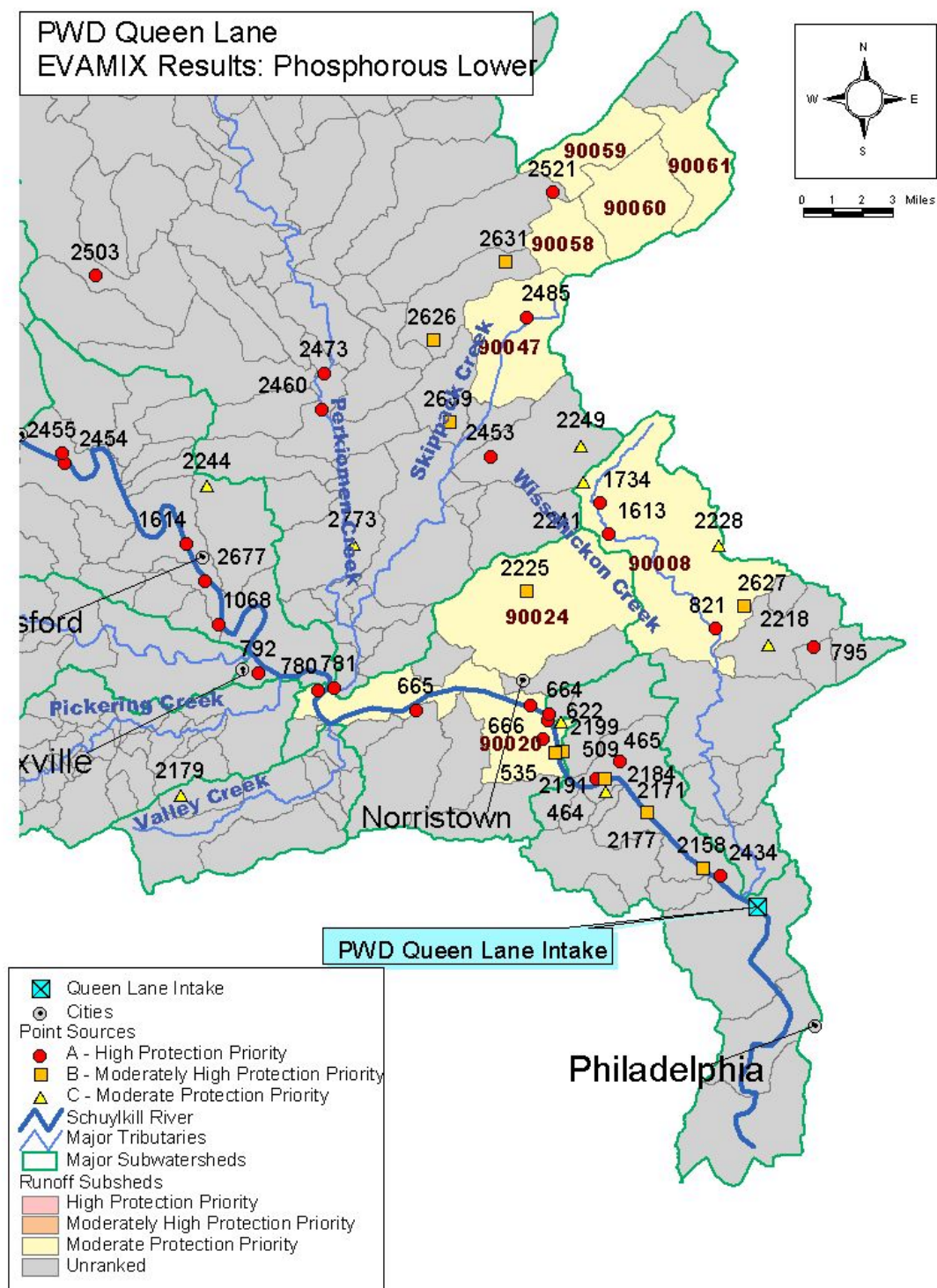
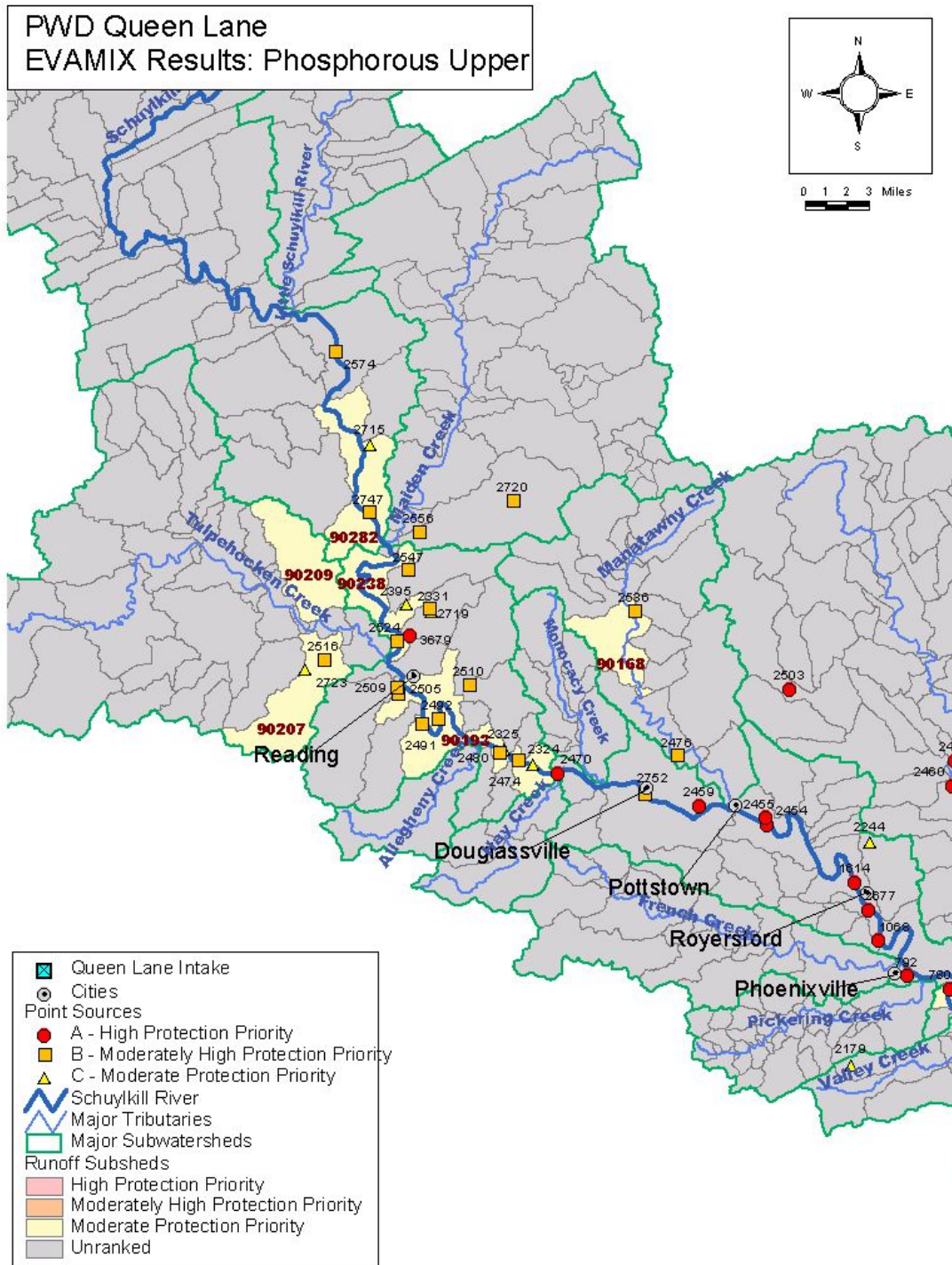


Figure 3.2.4-14 Priority Point Sources and Subwatersheds for PWD’s Queen Lane Intake for Phosphorus in the Upper Schuylkill River Watershed



Disinfection By-Product Precursors (Total Organic Carbon)

Table 3.2.4-10 provides the results of the ranking of potential sources of TOC. In this case, all of the high protection priority sites (category A) are NPDES discharges from wastewater treatment plants. With the exception of some of the largest treatment plants, the results suggest that stormwater runoff is also a potential source of TOC with loads similar to the smaller NPDES sites. TRI and AST sites were mostly screened out, with only a few found in the moderate priority category (category C). Figures 3.2.4-15 and 3.2.4-16 illustrate the priority point sources and subwatersheds for total organic carbon in the Lower and Upper Schuylkill River watersheds. Moderately high priority subwatersheds are mainly located in the Wissahickon Creek area.

**Table 3.2.4-10 Contaminant Category Ranking for Total Organic Carbon
(Disinfection By-product Surrogate)**

Source ID	Source Name	Database Used	Subwatershed	Zone	Time of Travel	Relative Impact (%)	Priority
2491	READING CITY	NPDES	Schuylkill River	Zone B	29.5	143.04	Highest-A
464	CONSHOHOCKEN SEW TREAT. PLT.	NPDES	Schuylkill River	Zone A	3.5	18.07	Highest-A
781	MONTGOMERY COUNTY SEW AUTH	NPDES	Perkiomen Creek	Flood Plain	10.5	14.97	Highest-A
2455	POTTSTOWN BORO	NPDES	Schuylkill River	Zone B	19.5	20.80	Highest-A
664	EAST NORRISTOWN/PLYMOUTH/WHITPAIN JOINT SEWER AUTHORITY	NPDES	Schuylkill River	Flood Plain	5.5	10.43	Highest-A
465	WHITEMARSH TWP SEW AUTH	NPDES	Schuylkill River	Zone A	3.5	6.42	Highest-A
666	NORRISTOWN MUN WASTE AUTH	NPDES	Schuylkill River	Flood Plain	5.5	6.98	Highest-A
780	VALLEY FORGE SEWER AUTHORITY	NPDES	Schuylkill River	Zone B	10.0	12.69	Highest-A
795	ABINGTON TWP COMM-WWTR TRTMT P	NPDES	Sandy Run	Zone A	11.3	8.63	Highest-A
665	UPPER MERION MUN UTILITY AUTH	NPDES	Trout Creek	Zone A	8.0	9.59	Highest-A
821	AMBLER BORO	NPDES	Wissahickon Creek	Zone A	8.7	6.20	Highest-A
1613	UPPER GWYNEDD TWP	NPDES	Wissahickon Creek	Flood Plain	12.5	3.52	Highest-A
535	UPPER MERION TWP. AUTH-MATSUNK WPCC	NPDES	Schuylkill River	Zone B	5.0	5.16	Highest-A
792	PHOENIXVILL BORO STP	NPDES	Schuylkill River	Zone B	11.5	6.28	Highest-A
2521	PENN RIDGE WASTE WATER TREATMENT AUTHORITY	NPDES	East Branch Perkiomen Creek	Flood Plain	25.4	9.36	Highest-A
2503	BERKS MONTGOMERY MUNICIPAL AUTH	NPDES	Swamp Creek	Flood Plain	23.1	4.45	Highest-A
622	BRIDGEPORT BORO	NPDES	Schuylkill River	Flood Plain	5.5	0.17	Highest-A
1734	BOROUGH OF NORTH WALES	NPDES	Wissahickon Creek	Flood Plain	13.2	0.17	Highest-A
2473	LOWER FREDERICK TOWNSHIP TRT P	NPDES	Perkiomen Creek	Flood Plain	16.6	0.17	Highest-A
2474	EXETER TOWNSHIP WWTR TRTMT PLT	NPDES	Schuylkill River	Flood Plain	25.7	5.78	Highest-A
1614	LIMERICK TWP MUN AUTH	NPDES	Schuylkill River	Flood Plain	15.0	1.71	Highest-A
2453	UPPER GWYNEDD-TOWAMENCIN MUN	NPDES	Towamencin Creek	Zone B	16.5	1.71	Highest-A
2574	HAMBURG MUN AUTH	NPDES	Schuylkill River	Zone B	41.8	9.58	Highest-A
2677	SPRING CITY BOROUGH SEWAGE PLANT	NPDES	Schuylkill River	Flood Plain	14.5	0.17	Highest-A
2460	SCHWENKSVILLE	NPDES	Perkiomen Creek	Flood Plain	16.1	0.17	Highest-A

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Source ID	Source Name	Database Used	Subwatershed	Zone	Time of Travel	Relative Impact (%)	Priority
	BOROUGH AUTH						
1068	PECO ENERGY CO-CROMBY GENERATING	NPDES	Schuylkill River	Flood Plain	13.5	0.17	Highest-A
2470	BIRDSBORO BORO MUN AUTH	NPDES	Schuylkill River	Flood Plain	24.8	0.71	Highest-A
2485	BOROUGH OF SOUDERTON	NPDES	Skippack Creek	Zone B	18.5	0.41	Highest-A
2454	NORTH COVENTRY MUN AUTH STP	NPDES	Schuylkill River	Flood Plain	19.5	0.17	Highest-A
2752	120 OLD PHILADELPHI	NPDES	Schuylkill River	Flood Plain	22.8	1.71	Highest-A
2492	GPU GENERATION INC TITUS GENERATING STATION	NPDES	Schuylkill River	Zone B	28.6	1.71	Moderately High-B
2459	STANLEY G. FLAGG & CO. INC	NPDES	Schuylkill River	Zone B	20.9	0.17	Moderately High-B
2509	WYOMISSING VALLEY JOINT MUN AU	NPDES	Wyomissing Creek	Zone B	31.0	1.71	Moderately High-B
2480	CROMPTON & KNOWLES CORP GIBRALTAR PLT	NPDES	Schuylkill River	Flood Plain	26.2	0.53	Moderately High-B
2476	ALLEGHENY E. CONF. ASSOC. 7TH DAY ADVENTISTS	NPDES	Manatawny Creek	Flood Plain	23.1	0.17	Moderately High-B
2547	NGK METALS CORP.	NPDES	Laurel Run	Zone B	34.1	1.71	Moderately High-B
2627	UPPER DUBLIN TWP	NPDES	Wissahickon Creek	Zone B	8.7	0.17	Moderately High-B
2639	LOWER SALFORD TWP AUTH	NPDES	West Branch Skippack Creek	Flood Plain	16.5	0.17	Moderately High-B
2626	LOWER SALFORD TWP AUTH	NPDES	Indian Creek	Zone B	20.5	0.17	Moderately High-B
2747	LEESPORT BOROUGH AUTHORITY	NPDES	Schuylkill River	Flood Plain	37.1	0.17	Moderately High-B
2510	ANTIETEM VALLEY MUNICIPAL AUTHORITY	NPDES	Antietam Creek	Zone B	28.6	1.15	Moderately High-B
2536	OLEY TOWNSHIP MUN AUTH	NPDES	Manatawny Creek	Flood Plain	29.8	0.17	Moderately High-B
2524	CARPENTER TECHNOLOGY CORP	NPDES	Schuylkill River	Zone B	31.5	1.71	Moderately High-B
2631	TELFORD BORO AUTHORITY	NPDES	Indian Creek	Zone B	23.6	0.17	Moderately High-B
2505	BALDWIN HARDWARE MFG CORP	NPDES	Schuylkill River	Zone B	30.0	0.17	Moderately High-B
2516	SPRING TWP MUN AUTH	NPDES	Cacoosing Creek	Zone B	35.3	1.71	Moderately High-B
2556	MAIDENCREEK TOWNSHIP AUTHORITY	NPDES	Willow Creek	Zone B	37.6	0.17	Moderately High-B
509	LUKENS STEEL CO	NPDES	Schuylkill River	Zone A	4.5	1.71	Moderately High-B
2719	GENERAL BATTERY CORP. READING SMELTER DIV.	NPDES	Bernhart Creek	Flood Plain	33.0	0.17	Moderately High-B
2720	FLEETWOOD BORO AUTH	NPDES	Willow Creek	Zone B	40.7	0.17	Moderately High-B
2715	BRUSH WELLMAN INC.	NPDES	Schuylkill River	Zone B	38.7	0.17	Moderately High-B
90020	Schuylkill River-020	NP	Schuylkill River	Zone A	4.5	1.27	Moderately High-B
90018	Plymouth Creek-018	NP	Plymouth Creek	Zone A	4.5	0.74	Moderately High-B
90007	Wissahickon Creek-007	NP	Wissahickon Creek	Zone A	4.9	0.90	Moderately High-B
90008	Wissahickon Creek-008	NP	Wissahickon Creek	Zone A	8.1	2.10	Moderately High-B
90024	Stony Creek-024	NP	Stony Creek	Zone A	7.0	1.52	Moderately High-B
3158	CROMBY GENERATING STATION	AST	Schuylkill River	Flood Plain	13.5	10.30	Moderately High-B
90027	Trout Creek-027	NP	Trout Creek	Zone A	8.0	0.88	Moderately High-B
90009	Sandy Run-009	NP	Sandy Run	Zone A	8.7	0.94	Moderately High-B
2171	SIMPSON PAPER CO.	TRI	Schuylkill River	Flood Plain	2.5	0.10	Moderately High-B
2773	GRATERFORD STATE CORRECTIONAL INSTITUTE	NPDES	Perkiomen Creek	Zone B	13.5	0.17	Moderate-C
90035	Valley Creek-035	NP	Valley Creek	Zone B	11.1	0.75	Moderate-C
90154	Schuylkill River-154	NP	Schuylkill River	Zone B	15.0	0.69	Moderate-C
90164	Schuylkill River-164	NP	Schuylkill River	Zone B	20.5	0.73	Moderate-C
2723	SINKING SPRING BORO MUN AUTH	NPDES	Cacoosing Creek	Flood Plain	36.0	1.71	Moderate-C
2229	AJAX/ACORN STAMPING & MFG INC.	TRI	Perkiomen Creek	Zone B	13.5	0.24	Moderate-C
2251	POTTSTOWN PRECISION CASTING	TRI	Schuylkill River	Flood Plain	21.4	0.87	Moderate-C

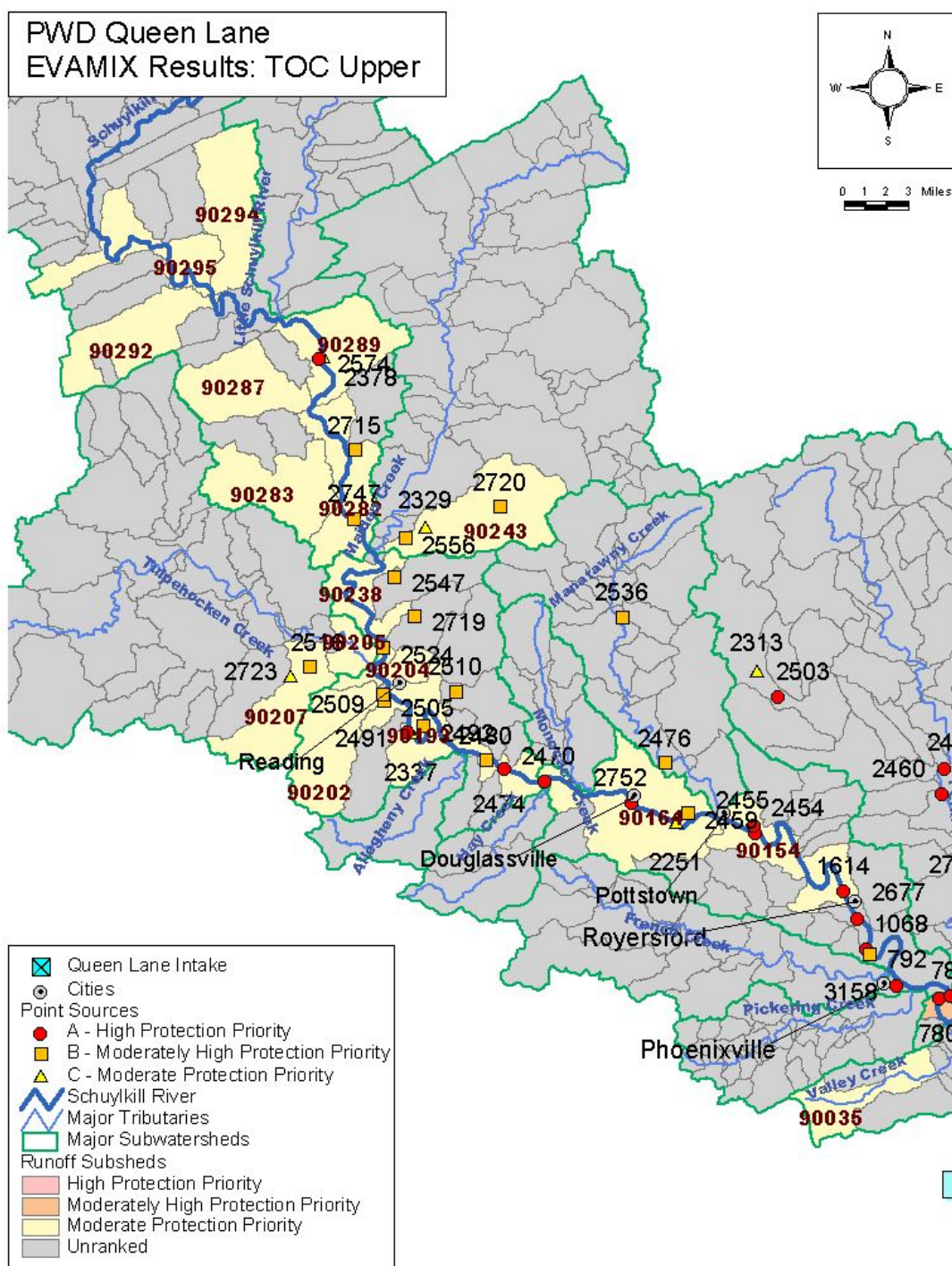
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Source ID	Source Name	Database Used	Subwatershed	Zone	Time of Travel	Relative Impact (%)	Priority
2236	COLORCON INC	TRI	Wissahickon Creek	Zone B	13.8	0.20	Moderate-C
2241	MERCK & CO INC	TRI	Wissahickon Creek	Zone B	13.8	0.02	Moderate-C
90193	Schuylkill River-193	NP	Schuylkill River	Zone B	25.2	1.10	Moderate-C
2313	CABOT PERFORMANCE MATERIALS	TRI	Swamp Creek	Zone B	23.6	0.24	Moderate-C
2268	MOYER PACKING CO.	TRI	Skippack Creek	Zone B	18.0	0.47	Moderate-C
2267	HATFIELD QUALITY MEATS INC.	TRI	Skippack Creek	Zone B	17.5	0.13	Moderate-C
90059	East Branch Perkiomen Creek-059	NP	East Branch Perkiomen Creek	Zone B	26.1	0.78	Moderate-C
2249	TUSCAN LEHIGH DAIRIES L.P.	TRI	Towamencin Creek	Zone B	18.5	0.00	Moderate-C
2337	CITY OF READING WASTEWATER TREATMENT PLANT	TRI	Schuylkill River	Flood Plain	29.1	0.94	Moderate-C
90238	Schuylkill River-238	NP	Schuylkill River	Zone B	31.5	1.14	Moderate-C
90202	Wyomissing Creek-202	NP	Wyomissing Creek	Zone B	31.0	0.80	Moderate-C
90204	Schuylkill River-204	NP	Schuylkill River	Zone B	31.0	0.77	Moderate-C
90205	Tulpehocken Creek-205	NP	Tulpehocken Creek	Zone B	31.5	0.67	Moderate-C
90207	Cacoosing Creek-207	NP	Cacoosing Creek	Zone B	33.9	0.69	Moderate-C
90282	Schuylkill River-282	NP	Schuylkill River	Zone B	36.1	1.04	Moderate-C
90243	Willow Creek-243	NP	Willow Creek	Zone B	37.1	0.83	Moderate-C
90283	Irish Creek-283	NP	Irish Creek	Zone B	37.6	0.79	Moderate-C
90289	Schuylkill River-289	NP	Schuylkill River	Zone B	40.7	1.02	Moderate-C
90287	Mill Creek-287	NP	Mill Creek	Zone B	40.7	0.69	Moderate-C
90295	Schuylkill River-295	NP	Schuylkill River	Zone B	47.1	1.08	Moderate-C
2329	GIORGIO FOODS INC.	TRI	Willow Creek	Zone B	38.1	0.003	Moderate-C
90292	Bear Creek-292	NP	Bear Creek	Zone B	47.2	0.77	Moderate-C
90294	Pine Creek-294	NP	Pine Creek	Zone B	47.6	0.91	Moderate-C
2378	MID ATLANTIC CANNERS ASSOC.	TRI	Schuylkill River	Zone B	41.8	0.00	Moderate-C

Figure 3.2.4-15 Priority Point Sources and Subwatersheds for PWD’s Queen Lane Intake for TOC in the Lower Schuylkill River Watershed



Figure 3.2.4-16 Priority Point Sources and Subwatersheds for PWD’s Queen Lane Intake for TOC in the Upper Schuylkill River Watershed



Turbidity (Total Suspended Solids)

Turbidity was analyzed using TSS as a surrogate. Table 3.2.4-11 provides the results of the final ranking of sites. Only NPDES discharges were identified as highest priority sources of TSS. The stormwater runoff (NPS sites) tend to show higher loading with less frequency. The NPDES sites generally have lower rates of TSS loading, however, at a more constant discharge. Loading rates from both sources appear high enough to cause concern for cumulative impacts at the intake. Figure 3.2.4-17 identifies the priority point sources and subwatersheds for total suspended solids in the Schuylkill River Watershed. Only one subwatershed, in the Wissahickon Creek area, is a moderately high priority.

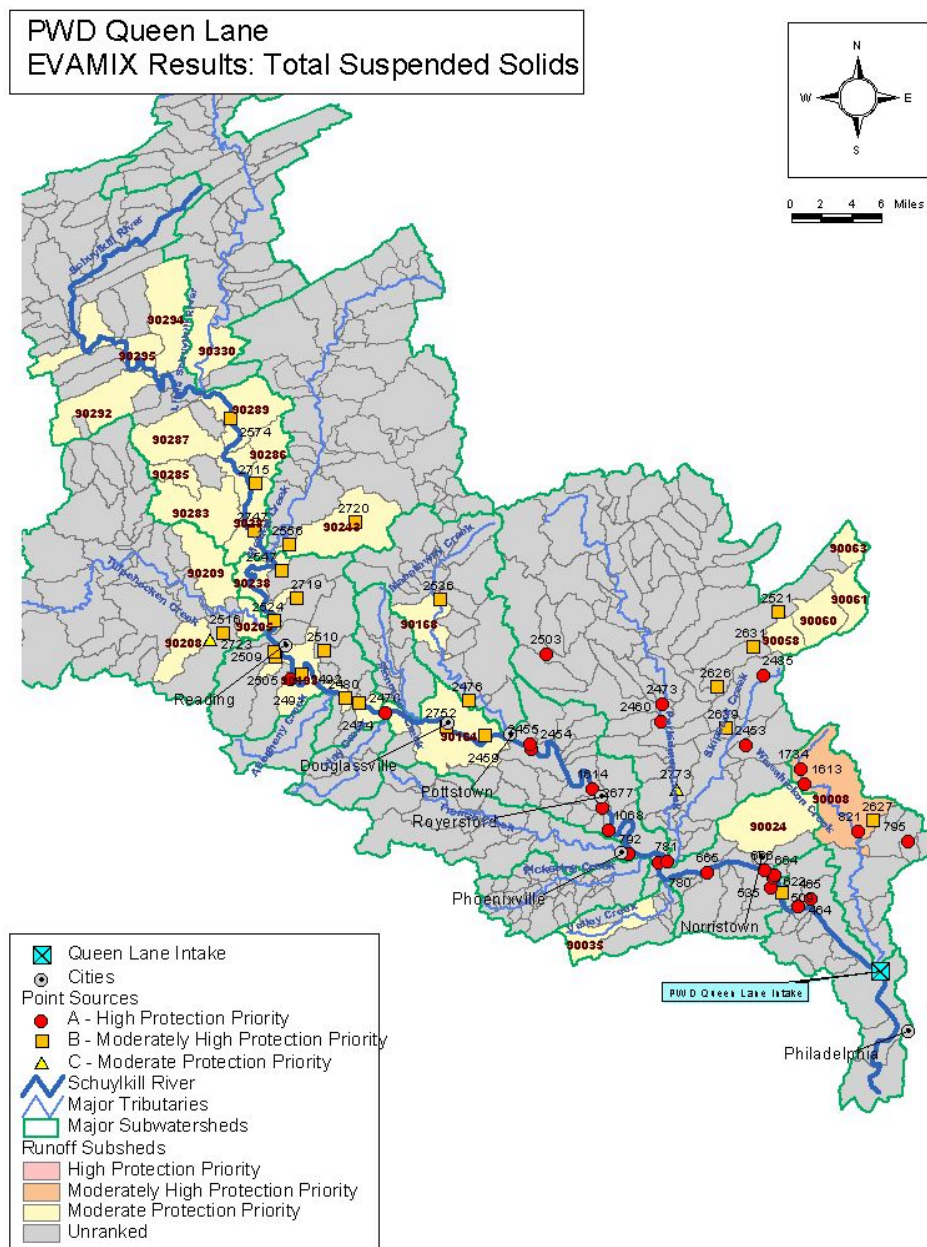
Table 3.2.4-11 Contaminant Category Ranking for Total Suspended Solids (TSS)

Source ID	Source Name	Database Used	Subwatershed	Zone	Time of Travel	Relative Impact (%)	Priority
666	NORRISTOWN MUN WASTE AUTH	NPDES	Schuylkill River	Flood Plain	5.5	891.44	Highest-A
781	MONTGOMERY COUNTY SEW AUTH	NPDES	Perkiomen Creek	Flood Plain	10.5	16.00	Highest-A
465	WHITEMARSH TWP SEW AUTH	NPDES	Schuylkill River	Zone A	3.5	1.67	Highest-A
664	EAST NORRISTOWN/PLYMOUTH/WHITPAIN JOINT SEWER AUTHORITY	NPDES	Schuylkill River	Flood Plain	5.5	11.78	Highest-A
464	CONSHOHOCKEN SEW TREAT. PLT.	NPDES	Schuylkill River	Zone A	3.5	9.19	Highest-A
821	AMBLER BORO	NPDES	Wissahickon Creek	Zone A	8.7	12.22	Highest-A
1613	UPPER GWYNEDD TWP	NPDES	Wissahickon Creek	Flood Plain	12.5	7.53	Highest-A
2491	READING CITY	NPDES	Schuylkill River	Zone B	29.5	61.48	Highest-A
795	ABINGTON TWP COMM-WWTR TRTMT P	NPDES	Sandy Run	Zone A	11.3	6.08	Highest-A
535	UPPER MERION TWP. AUTH-MATSUNK WPCC	NPDES	Schuylkill River	Zone B	5.0	2.22	Highest-A
2455	POTTSTOWN BORO	NPDES	Schuylkill River	Zone B	19.5	25.32	Highest-A
665	UPPER MERION MUN UTILITY AUTH	NPDES	Trout Creek	Zone A	8.0	2.32	Highest-A
780	VALLEY FORGE SEWER AUTHORITY	NPDES	Schuylkill River	Zone B	10.0	11.12	Highest-A
1734	BOROUGH OF NORTH WALES	NPDES	Wissahickon Creek	Flood Plain	13.2	0.03	Highest-A
622	BRIDGEPORT BORO	NPDES	Schuylkill River	Flood Plain	5.5	0.03	Highest-A
2473	LOWER FREDERICK TOWNSHIP TRT P	NPDES	Perkiomen Creek	Flood Plain	16.6	0.03	Highest-A
792	PHOENIXVILL BORO STP	NPDES	Schuylkill River	Zone B	11.5	1.16	Highest-A
2503	BERKS MONTGOMERY MUNICIPAL AUTH	NPDES	Swamp Creek	Flood Plain	23.1	1.02	Highest-A
2453	UPPER GWYNEDD-TOWAMENCIN MUN	NPDES	Towamencin Creek	Zone B	16.5	1.55	Highest-A
2460	SCHWENKSVILLE BOROUGH AUTH	NPDES	Perkiomen Creek	Flood Plain	16.1	0.03	Highest-A
2677	SPRING CITY BOROUGH SEWAGE PLANT	NPDES	Schuylkill River	Flood Plain	14.5	0.03	Highest-A
1614	LIMERICK TWP MUN AUTH	NPDES	Schuylkill River	Flood Plain	15.0	0.52	Highest-A
1068	PECO ENERGY CO-CROMBY GENERATING	NPDES	Schuylkill River	Flood Plain	13.5	0.03	Highest-A
2470	BIRDSBORO BORO MUN AUTH	NPDES	Schuylkill River	Flood Plain	24.8	1.19	Highest-A
2485	BOROUGH OF SOUDERTON	NPDES	Skippack Creek	Zone B	18.5	1.14	Highest-A
2454	NORTH COVENTRY MUN AUTH STP	NPDES	Schuylkill River	Flood Plain	19.5	0.03	Highest-A
2521	PENN RIDGE WASTE WATER TREATMENT AUTHORITY	NPDES	East Branch Perkiomen Creek	Flood Plain	25.4	2.75	Moderately High-B
2459	STANLEY G. FLAGG & CO.	NPDES	Schuylkill River	Zone B	20.9	0.03	Moderately High-B

Source ID	Source Name	Database Used	Subwatershed	Zone	Time of Travel	Relative Impact (%)	Priority
2474	INC EXETER TOWNSHIP WWTR TRTMT PLT	NPDES	Schuylkill River	Flood Plain	25.7	4.00	Moderately High-B
2627	UPPER DUBLIN TWP	NPDES	Wissahickon Creek	Zone B	8.7	0.03	Moderately High-B
2492	GPU GENERATION INC TITUS GENERATING STATION	NPDES	Schuylkill River	Zone B	28.6	1.98	Moderately High-B
2476	ALLEGHENY E. CONF. ASSOC. 7TH DAY ADVENTISTS	NPDES	Manatawny Creek	Flood Plain	23.1	0.03	Moderately High-B
2480	CROMPTON & KNOWLES CORP GIBALTAR PLT	NPDES	Schuylkill River	Flood Plain	26.2	0.06	Moderately High-B
2752	120 OLD PHILADELPHI	NPDES	Schuylkill River	Flood Plain	22.8	0.98	Moderately High-B
2509	WYOMISSING VALLEY JOINT MUN AU	NPDES	Wyomissing Creek	Zone B	31.0	2.69	Moderately High-B
2639	LOWER SALFORD TWP AUTH	NPDES	West Branch Skippack Creek	Flood Plain	16.5	0.03	Moderately High-B
2547	NGK METALS CORP.	NPDES	Laurel Run	Zone B	34.1	0.14	Moderately High-B
2626	LOWER SALFORD TWP AUTH	NPDES	Indian Creek	Zone B	20.5	0.03	Moderately High-B
2747	LEESPORT BOROUGH AUTHORITY	NPDES	Schuylkill River	Flood Plain	37.1	0.03	Moderately High-B
2536	OLEY TOWNSHIP MUN AUTH	NPDES	Manatawny Creek	Flood Plain	29.8	0.03	Moderately High-B
2510	ANTIETAM VALLEY MUNICIPAL AUTHORITY	NPDES	Antietam Creek	Zone B	28.6	0.26	Moderately High-B
2631	TELFORD BORO AUTHORITY	NPDES	Indian Creek	Zone B	23.6	0.03	Moderately High-B
2524	CARPENTER TECHNOLOGY CORP	NPDES	Schuylkill River	Zone B	31.5	0.14	Moderately High-B
2574	HAMBURG MUN AUTH	NPDES	Schuylkill River	Zone B	41.8	2.50	Moderately High-B
2505	BALDWIN HARDWARE MFG CORP	NPDES	Schuylkill River	Zone B	30.0	0.03	Moderately High-B
2556	MAIDENCREEK TOWNSHIP AUTHORITY	NPDES	Willow Creek	Zone B	37.6	0.03	Moderately High-B
509	LUKENS STEEL CO	NPDES	Schuylkill River	Zone A	4.5	0.54	Moderately High-B
2516	SPRING TWP MUN AUTH	NPDES	Cacoosing Creek	Zone B	35.3	0.35	Moderately High-B
2719	GENERAL BATTERY CORP. READING SMELTER DIV.	NPDES	Bernhart Creek	Flood Plain	33.0	0.03	Moderately High-B
2720	FLEETWOOD BORO AUTH	NPDES	Willow Creek	Zone B	40.7	0.06	Moderately High-B
2715	BRUSH WELLMAN INC.	NPDES	Schuylkill River	Zone B	38.7	0.03	Moderately High-B
90008	Wissahickon Creek-008	NP	Wissahickon Creek	Zone A	8.1	10.80	Moderately High-B
90024	Stony Creek-024	NP	Stony Creek	Zone A	7.0	7.69	Moderate-C
2773	GRATERFORD STATE CORRECTIONAL INSTITUTE	NPDES	Perkiomen Creek	Zone B	13.5	0.03	Moderate-C
90035	Valley Creek-035	NP	Valley Creek	Zone B	11.1	4.64	Moderate-C
90164	Schuylkill River-164	NP	Schuylkill River	Zone B	20.5	4.46	Moderate-C
2723	SINKING SPRING BORO MUN AUTH	NPDES	Cacoosing Creek	Flood Plain	36.0	0.51	Moderate-C
90193	Schuylkill River-193	NP	Schuylkill River	Zone B	25.2	4.77	Moderate-C
90060	Pleasant Spring Creek-060	NP	Pleasant Spring Creek	Zone B	27.3	8.03	Moderate-C
90058	Mill Creek-058	NP	Mill Creek	Zone B	26.1	4.38	Moderate-C
90168	Manatawny Creek-168	NP	Manatawny Creek	Zone B	26.8	4.82	Moderate-C
90061	Morris Run-061	NP	Morris Run	Zone B	29.2	6.40	Moderate-C
90063	East Branch Perkiomen Creek-063	NP	East Branch Perkiomen Creek	Zone B	29.8	4.28	Moderate-C
90238	Schuylkill River-238	NP	Schuylkill River	Zone B	31.5	6.76	Moderate-C
90205	Tulpehocken Creek-205	NP	Tulpehocken Creek	Zone B	31.5	4.47	Moderate-C
90209	Plum Creek-209	NP	Plum Creek	Zone B	34.6	11.02	Moderate-C
90282	Schuylkill River-282	NP	Schuylkill River	Zone B	36.1	13.34	Moderate-C
90283	Irish Creek-283	NP	Irish Creek	Zone B	37.6	15.75	Moderate-C
90243	Willow Creek-243	NP	Willow Creek	Zone B	37.1	7.23	Moderate-C
90208	Little Cacoosing Creek-208	NP	Little Cacoosing Creek	Zone B	36.7	4.62	Moderate-C
90286	Pigeon Creek-286	NP	Pigeon Creek	Zone B	39.2	7.96	Moderate-C
90289	Schuylkill River-289	NP	Schuylkill River	Zone B	40.7	10.45	Moderate-C

Source ID	Source Name	Database Used	Subwatershed	Zone	Time of Travel	Relative Impact (%)	Priority
90287	Mill Creek-287	NP	Mill Creek	Zone B	40.7	10.26	Moderate-C
90285	Leshner Run-285	NP	Leshner Run	Zone B	40.2	5.36	Moderate-C
90330	Little Schuylkill River-330	NP	Little Schuylkill River	Zone B	45.1	5.39	Moderate-C
90295	Schuylkill River-295	NP	Schuylkill River	Zone B	47.1	8.86	Moderate-C
90294	Pine Creek-294	NP	Pine Creek	Zone B	47.6	9.21	Moderate-C
90292	Bear Creek-292	NP	Bear Creek	Zone B	47.2	4.86	Moderate-C

Figure 3.2.4-17 Priority Point Sources and Subwatersheds for PWD’s Queen Lane Intake for Total Suspended Solids in the Schuylkill River Watershed



VOCs

Table 3.2.4-12 shows the results of the ranking of VOC sites. In this case, the only significant potential sources of VOCs are storage tanks (ASTs), industrial sites from the TRI database, RCRA sites, or wastewater treatment plants. The high priority category is a mixture of AST, TRI, and NPDES sites. The medium and low priority categories are primarily AST and RCRA sites. The NPDES sites appear to load VOCs at a very low rate, and are not likely to cause water quality impairment at the intake. The AST, and TRI sites would require a spill to cause water quality impairment, but resulting concentrations would be very high. RCRA sites were difficult to assess for potential loading. Figure 3.2.4-18 identifies the priority point sources and subwatersheds for VOCs in the Schuylkill River Watershed.

Table 3.2.4-12 Contaminant Category Ranking for VOCs

Source ID	Source Name	Database Used	Subwatershed	Zone	Time of Travel	Relative Impact (%)	Priority
3759	COLUMBIA PETRO	AST	Laurel Run	Zone B	33.6	18869025	Highest-A
3178	MALVERN TERM	AST	Little Valley Creek	Zone B	14.4	15566041	Highest-A
1613	UPPER GWYNEDD TWP	NPDES	Wissahickon Creek	Flood Plain	12.5	1.13	Highest-A
665	UPPER MERION MUN UTILITY AUTH	NPDES	Trout Creek	Zone A	8.0	1.11	Highest-A
2455	POTTSTOWN BORO	NPDES	Schuylkill River	Zone B	19.5	26.27	Highest-A
2480	CROMPTON & KNOWLES CORP GIBRALTAR PLT	NPDES	Schuylkill River	Flood Plain	26.2	2.79	Highest-A
2459	STANLEY G. FLAGG & CO. INC	NPDES	Schuylkill River	Zone B	20.9	0.67	Highest-A
3262	COOPERS CREEK CHEMICAL CORP.	AST	Schuylkill River	Zone A	3.0	4169475	Highest-A
2547	NGK METALS CORP.	NPDES	Laurel Run	Zone B	34.1	0.00	Highest-A
2524	CARPENTER TECHNOLOGY CORP	NPDES	Schuylkill River	Zone B	31.5	4.14	Highest-A
2219	HONEYWELL INC. PROCESS CONTROL DIV.	TRI	Sandy Run	Zone A	12.5	1270592	Highest-A
2410	ASHLAND CHEMICAL CO DIV ASHLAND OIL INC	TRI	Schuylkill River	Flood Plain	4.0	46200	Highest-A
2191	LONZA INC.	TRI	Schuylkill River	Flood Plain	4.5	15206	Highest-A
2185	FINNAREN & HALEY INC.	TRI	Schuylkill River	Flood Plain	3.5	2179	Highest-A
2181	COOPERS CREEK CHEMICAL CORP.	TRI	Gulph Creek	Zone A	4.5	64484	Highest-A
2201	SPRAY PRODS. CORP.	TRI	Plymouth Creek	Zone A	5.5	2077	Highest-A
2248	OCCIDENTAL CHEMICAL CORP.	TRI	Schuylkill River	Flood Plain	19.0	55978	Highest-A
2224	RHONE-POULENC AG CO.	TRI	Wissahickon Creek	Flood Plain	10.0	4654	Highest-A
2427	STEVENSON, W. N. CO.	TRI	Schuylkill River	Zone B	1.0	6143	Highest-A
2177	QUAKER CHEMICAL CORP.	TRI	Schuylkill River	Zone B	3.5	3234	Highest-A
2230	SUPERIOR TUBE CO.	TRI	Perkiomen Creek	Zone B	13.5	4992	Highest-A
3173	FARM AND HOME OIL CO. INC.	AST	Mill Creek	Zone B	26.7	3706200	Highest-A
2407	MOBIL OIL MALVERN TERMINAL	TRI	Little Valley Creek	Zone B	14.4	258926	Highest-A
2408	SUNOCO INC. (R&M) MALVERN TERMINAL	TRI	Little Valley Creek	Zone B	14.4	174141	Highest-A
2405	CROMBY GENERATING STATION	TRI	Schuylkill River	Zone B	13.5	50770	Moderately High-B

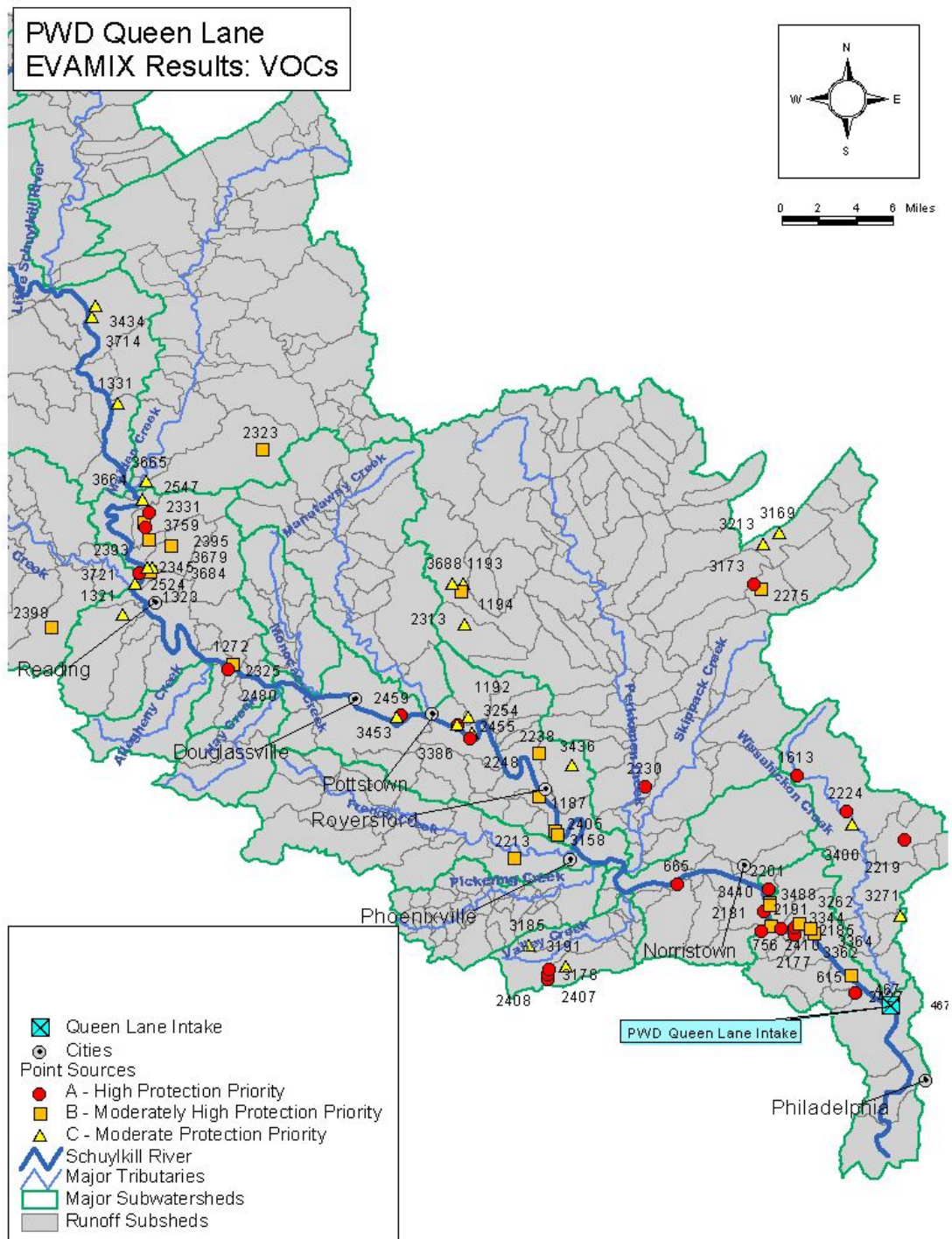
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Source ID	Source Name	Database Used	Subwatershed	Zone	Time of Travel	Relative Impact (%)	Priority
2313	CABOT PERFORMANCE MATERIALS	TRI	Swamp Creek	Zone B	23.6	34067	Moderately High-B
2213	PIERCE & STEVENS CHEMICAL CORP	TRI	French Creek	Zone B	14.4	2822	Moderately High-B
2331	LUCENT TECHNOLOGIES	TRI	Bernhart Creek	Flood Plain	33.0	1392	Moderately High-B
2238	STANLEY TOOLS ROYERSFORD PLANT	TRI	Schuylkill River	Zone B	15.5	1416	Moderately High-B
2325	CROMPTON & KNOWLES CORP GIBRALTAR PLT	TRI	Schuylkill River	Zone B	26.2	5978	Moderately High-B
756	PENN MED TECHNOLOGY	RCRA	Gulph Creek	Flood Plain	4.5	0.00	Moderately High-B
2345	GLIDDEN CO THE	TRI	Bernhart Creek	Zone B	32.5	33436	Moderately High-B
467	EVER READY CLEANERS	RCRA	Schuylkill River	Flood Plain	0.0	0.00	Moderately High-B
2275	FRES-CO SYSTEM USA INC.	TRI	Mill Creek	Zone B	26.7	3304	Moderately High-B
1187	SPRING CITY FOUNDRY	RCRA	Schuylkill River	Flood Plain	14.5	0.00	Moderately High-B
615	CONTAINER CORP OF AMERICA	RCRA	Schuylkill River	Flood Plain	1.5	0.00	Moderately High-B
2393	CARLOS R. LEFFLER INC. TUCKERTON FACILITY	TRI	Laurel Run	Zone B	33.6	177694	Moderately High-B
2395	EAGLE CHEMICAL CO.	TRI	Schuylkill River	Zone B	33.0	1523	Moderately High-B
2398	SUNOCO INC. (R&M) MONTELLO TERMINAL	TRI	Cacoosing Creek	Zone B	37.4	128448	Moderately High-B
3362	LONZA INC.	AST	Schuylkill River	Zone A	3.0	370620	Moderately High-B
3364	SCHUYLKILL PRINTING PLANT	AST	Schuylkill River	Zone A	3.0	277965	Moderately High-B
2323	GARDEN STATE TANNING - FLEETWOOD	TRI	Willow Creek	Zone B	41.2	2509	Moderately High-B
3344	QUAKER CHEMICAL CORP.	AST	Schuylkill River	Zone A	3.5	277965	Moderately High-B
3488	MONTGOMERY CHEM	AST	Plymouth Creek	Zone A	5.0	315027	Moderately High-B
3440	MONTGOMERY CNTY RESOURCE RECOVERY FAC	AST	Plymouth Creek	Zone A	5.0	277965	Moderately High-B
3158	CROMBY GENERATING STATION	AST	Schuylkill River	Flood Plain	13.5	444744	Moderately High-B
3400	ROTELLE INC	AST	Wissahickon Creek	Zone A	9.4	281671	Moderate-C
3271	METLAB CO	AST	Cresheim Creek	Zone B	4.3	325868	Moderate-C
3185	HCI EAST FALLS CORP	AST	Valley Creek	Zone B	13.8	555930	Moderate-C
3191	WORTHINGTON STEEL CO.	AST	Little Valley Creek	Zone B	13.8	296496	Moderate-C
3436	OEHLERT Bros. Fuel Oil	AST	Mingo Creek	Zone B	15.5	370620	Moderate-C
3386	EDWARD J SWEENEY & SONS	AST	Schuylkill River	Zone B	19.5	555930	Moderate-C
3254	OCCIDENTAL CHEMICAL CORP.	AST	Sprogles Run	Zone B	19.0	370620	Moderate-C
3721	GOSHERTS QUALITY FUELS	AST	Schuylkill River	Flood Plain	31.5	370620	Moderate-C
3453	PAM OIL INC	AST	Schuylkill River	Zone B	21.4	315824	Moderate-C
3688	BOYERTOWN OIL CO INC	AST	Swamp Creek	Zone B	24.2	277965	Moderate-C
3213	HESTON S SWARTLEY TRANS CO INC	AST	East Branch Perkiomen Creek	Zone B	26.1	370620	Moderate-C
3169	M & S OIL	AST	East Branch Perkiomen Creek	Zone B	26.7	370620	Moderate-C
1194	BOYERTOWN SANITARY DISPOSAL CO	RCRA	Minister Creek	Flood Plain	23.1	0.35	Moderate-C
1193	CABOT PERFORMANCE MATERIALS	RCRA	Swamp Creek	Flood Plain	24.2	2.78	Moderate-C

*PWD Source Water Assessment Report
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Source ID	Source Name	Database Used	Subwatershed	Zone	Time of Travel	Relative Impact (%)	Priority
3684	CARPENTER TECHNOLOGY CORP	AST	Bernhart Creek	Zone B	32.5	370620	Moderate-C
3679	GLIDDEN CO THE	AST	Bernhart Creek	Zone B	32.5	333558	Moderate-C
1192	OCCIDENTAL CHEMICAL CORP.	RCRA	Schuylkill River	Zone B	19.0	5.84	Moderate-C
3665	TEXTILE CHEM EK1	AST	Willow Creek	Zone B	37.1	555930	Moderate-C
3664	TEXTILE CHEMICAL CO INC	AST	Schuylkill River	Zone B	35.1	370620	Moderate-C
1321	BALDWIN HARDWARE MFG CORP	RCRA	Wyomissing Creek	Flood Plain	31.4	0.24	Moderate-C
3434	MOYER & SON INC	AST	Schuylkill River	Zone B	42.3	555930	Moderate-C
1272	CROMPTON & KNOWLES CORP GIBRALTAR PLT	RCRA	Schuylkill River	Zone B	26.2	76.16	Moderate-C
3714	ES SAVAGE INC	AST	Schuylkill River	Zone B	42.3	370620	Moderate-C
1323	CARPENTER TECHNOLOGY CORP	RCRA	Bernhart Creek	Zone B	32.5	19.55	Moderate-C
1331	BRUSH WELLMAN INC.	RCRA	Schuylkill River	Zone B	38.7	62.71	Moderate-C

Figure 3.2.4-18 Priority Point Sources and Subwatersheds for PWD’s Belmont Intake for VOCs in the Schuylkill River Watershed



3.2.4.3 Narrative Results

Potentially Significant CERCLA Sources

Twenty-two of the 378 CERCLA sites in the watershed are on the National Priority List (NPL) for clean up by the USEPA. Approximately 274 of those CERCLA sites fall within the Zone A and B (5 to 25-hour times of travel) from the Belmont Intake during extreme high flow conditions. Only 27 of those 274 sites are within the Zone A (5-hour time of travel) from the Queen Lane Intake. Of those 27 sites in Zone A, 6 are within the floodplain. Overall, 18 sites are within the floodplain of Zone A and B from the Queen Lane Intake. It is very difficult to quantify the types and extent of pollution at a CERCLA site as well as their ability to migrate and impact a surface water supply. Therefore, a simple screening process was developed to determine which CERCLA sites may be a potentially significant source of contamination to the water supply. Sites that were considered significant needed to meet one or several of the following characteristics:

- The site is a National Priority List Site and considered contaminated and to be of concern by the USEPA;
- The site is within Zone A of the intake;
- The site is within the floodplain;
- The site is not currently being cleaned up by USEPA; or
- The site was identified by stakeholders as contaminated and of concern to the local community.

The priority ranking of the sites used the following criteria:

- A site met multiple criteria from above;
- A site was closer to the intake than another;
- A site had a higher surface water migration score than another site or overall migration score according to rankings provided at www.scorecard.org.

Using these criteria, 22 NPL sites were identified within the watershed. Two of the NPL sites reside within the floodplain, 18 fall within the Zone A and B of the Queen Lane intake. NPL sites are considered to be significant due to their history of contamination and local environmental impacts that require cleanup by the USEPA. As shown in Table 3.2.4-13, Montgomery, Chester, Berks, and Bucks counties are the top four counties in Pennsylvania when ranked by the number of NPL sites within them. Table 3.2.4-14 is a summary list of the most frequently detected chemicals at NPL sites in several counties within the Schuylkill River Watershed. As shown, the most common contaminants at these sites are volatile organic compounds and metal compounds.

Table 3.2.4-13 County Rankings in PA for Number of NPL Sites

Rank	County	Number of Superfund Sites
1	MONTGOMERY	16
2	CHESTER	12
3	BERKS	8
4	BUCKS	7
5	ADAMS	4
	ALLEGHENY	4
	LANCASTER	4
	LEHIGH	4
	MERCER	4
	MONROE	4
	YORK	4
6	DELAWARE	3
	SCHUYLKILL	3

Source www.scorecard.org

Table 3.2.4-14 Most Frequently Detected Chemicals at NPL Sites in Various Counties Draining Into the Schuylkill River Watershed

Contaminant	County
TCE	Berks
Diethanolamine	Berks
1,1-Trichlorethane	Bucks
Zinc	Bucks
Trichlorethylene	Chester
Nickel Compounds	Chester
Vinyl Chloride	Lehigh
Copper	Lehigh
TCE	Montgomery
Copper	Montgomery
Methyl Isobutyl Ketone	Philadelphia
Nickel Compounds	Philadelphia
Mercury	Schuylkill
Barium Compounds	Schuylkill

Source www.scorecard.org

In addition to NPL sites there were another 18 CERCLA sites in the floodplain upstream of the intake. These sites and the other CERCLA sites identified by stakeholders as potentially significant sources of concern were examined for significance.

The final ranking of the NPL sites is provided in Table 3.2.4-15. The rankings identified 18 NPL sites and 3 additional CERCLA sites that are considered to be potentially significant sources of contamination. Three of the sites were located within the Zone A (5-hour) travel time to the Queen Lane Intake. All remaining sites are located in Zone B (<25-hour). The sites of protection priority C are sites that have been cleaned up, contained, or are being utilized by businesses again and should represent little threat to the environment.

As mentioned earlier, there is no way to adequately quantify all of these sites for proper comparison in the overall EVAMIX prioritization rankings. However, based on the limited information available it appears that the CERCLA sites would potentially rank very low compared to other potentially significant sources in the watershed from the combined ranking.

Table 3.2.4-15 Potentially Significant CERCLA Sources for the Queen Lane WTP Intake

Rank	Zone	Site Name	Chemicals	Floodplain	NPL Status
A	A	TYSONS DUMP	VOCs		NPL
A	B	DOUGLASVILLE DISPOSAL SITE	VOCs, metals	YES	NPL
A	B	MOYERS LANDFILL	VOCs, metals		NPL
A	B	BERKS LANDFILL	VOCs, metals		NPL
A	B	OCCIDENTAL CHEMICAL CORP.	VOCs	YES	NPL
A	B	FOOTE MINERAL CO	VOCs, metals		NPL
B	B	RECTICON/ALLIED STEEL CORP	VOCs		NPL
B	B	BROWN'S BATTERY BREAKING	metals	YES	NPL
B	B	NORTH PENN – AREA 1	VOCs		NPL
B	B	NORTH PENN – AREA 7	VOCs		NPL
B	B	MALVERN TCE	VOCs		NPL
B	B	SALFORD QUARRY	VOCs, metals		Proposed
B	B	CRATER RESOURCES/KEYSTONE COKE/ALAN WOOD	VOCs, metals		NPL
B	A	MIQUON LANDFILL	Herbicides/Pesticides, metals		NOT ON NPL
B	A	POTTSTOWN INDUSTRIES COMPLEX	Unknown		NOT ON NPL
B	B	PHOENIXVILLE PIPE & TUBE LP STEEL CORP	Unknown		NOT ON NPL
C	B	HENDERSON RD SUPERFUND SITE	VOCs, metals		NPL
C	B	STANLEY KESSLER	VOCs		NPL
C	B	KIMBERTON SITE	VOCs, metals		NPL
C	B	COMMODORE SEMICONDUCTOR GROUP	VOCs		NPL
C	B	NORTH PENN – AREA 12	VOCs		NPL

Spills and Accidents

As mentioned in previous sections, the Schuylkill River is a major transportation corridor for railroads and trucking. In addition, there are several major petroleum pipelines located within the watershed. The volumes of chemicals transported by these means are quite significant. A tanker truck can normally hold about 5,000 gallons of a chemical. A railroad tanker car can normally hold about 14,000 gallons of a chemical. A pipeline, if it breaks and spills contaminants for an hour or more can spill between 1,000 to 10,000 gallons of a chemical, depending on its size.

Assuming that there was an accident and the entire or even partial contents of these sources were spilled into the river, estimates show that the impacts on downstream local water supplies could be severe even up to 100 miles downriver. Assuming the pipeline, railroad tanker car, or a tanker truck spilled benzene even ten miles upriver, only ten gallons of benzene would need to make it to the river during a normal flow day for concentrations in the river to potentially cause significant impacts on water quality. This would either require the plant to stop withdrawing water or special treatment of the water with carbon.

Under more extreme conditions, up to 100 gallons of benzene would need to be spilled for a similar impact. These estimates do not take into account the loss of benzene due to holding in pockets in the river or binding to sediments and other material as it flows downstream. Therefore, higher concentrations of 1,000 gallons of benzene spilled from an accident would most likely have a severe impact on water quality at the intake even if it was spilled during a rain event 100 miles upriver.

In terms of their overall priority compared to the other sources provided in the combined ranking, spills and accidents can have one of the greatest relative impacts on water quality and require some moderate level of protection priority. An early warning system on the Schuylkill River such as present on the Ohio River would help to prevent such severe impacts in the event of a spill.

Radionuclides

The presence of the Limerick Nuclear Generating Station upriver requires monitoring for the presence of radionuclides in the finished drinking water. To date, special monitoring has only detected Gross Beta radionuclides at levels far below the regulated limits in the finished water from Schuylkill River sources. No other types of radionuclides have been detected.

Regardless of the lack of observed impact from these sources, they were still identified. There were only two sources of radionuclides identified in the Schuylkill River Watershed. They are the Limerick Nuclear Generating Station and the Unitech Laundry Facility. The Limerick NGS does not directly discharge any waters into the Schuylkill River from its process and radionuclides are only considered to potentially enter the river through airborne deposition. The Unitech Laundry located in Royersford, cleans the uniforms from the operations at the Limerick NGS. It currently discharges its wastewater to the local sewage treatment plant but may be treating and discharging its process water to the river directly. This was mainly the result of issues associated with

radionuclides in the bio-solids from the local sewage treatment plant that were to be used for land application.

Given that current water quality data does not suggest any radionuclide issues with these sources and the current controls and monitoring in place to protect against them, these sources would be considered a medium protection priority and would tend to fair lower than other sources identified in the combined ranking.

3.2.5 Qualitative Loading Analysis

Key Points

- Quantitative contaminant loading analyses are difficult to implement, as it is not possible to accurately characterize all of the factors affecting potential contaminant releases and transport.
- Qualitative contaminant loading analyses can provide useful order-of-magnitude assessments that will help to identify potentially significant major loads.
- Non-point sources associated with stormwater runoff were identified as significant sources of salts, *Cryptosporidium*, fecal coliform, nitrates, petroleum hydrocarbons, phosphorus, disinfection by-products, and total suspended solids.

3.2.5.1 Method

Performing a quantitative pollutant loading analysis requires a substantial investment in data collection. For example, for sites that actually discharge wastewater to the river on a continuous or intermittent basis, accurate data on discharge rates and concentrations of contaminants in the discharge water are required. For sites that store chemicals, accurate data on the amount and type of chemical stored are required, and a series of assumptions must be made about the probability of leaks or spills occurring. The analysis must also account for natural sources of certain contaminants and a calibrated non-point source or runoff-loading model is needed to add stormwater-related loadings to the calculations. For this reason, a quantitative contaminant loading analysis goes well beyond the scope of this study, and the data collected are not sufficiently accurate to allow a quantitative analysis to be performed.

Despite the limitations that the data impose, a more qualitative analysis of contaminant loading is still valuable, and can provide important insight into the relative magnitude of the impacts that the major contaminant sources might have on the water quality within the watershed. The approach to performing the analysis is summarized by the following steps.

Step 1: Loading Estimates

- For sites that have continuous or intermittent discharges, estimates of annual contaminant loading for each contaminant category are calculated by multiplying median discharge concentration times average annual discharge rate.
- For sites that simply store or use chemicals onsite, there is no logical way to estimate point loading because contaminants are only released through spills or leaks. An extreme estimate of potential loading can be made by assuming stored chemicals in the largest tank onsite are released through a catastrophic tank failure and are all spilled to the surface water.
- For non-point source pollutant loading, estimates for each contaminant category were provided by the SWMM model results on an annual basis.

Step 2: Loading Magnitude Comparisons

The loading estimates produced in step one are of widely varying accuracy. The SWMM model stormwater loads may be generally accurate, however, they are based on Event Mean Concentrations that may or may not be representative of local conditions within the watershed. The loading estimates for point source dischargers range from accurate for dischargers who regularly monitor their discharges and report results (usually the larger sources), to highly speculative where data had to be filled in for both concentration and discharge rate (many of the smaller dischargers). The loading estimates for sites that store or use chemicals are not based on data, and represent a speculation on potential leaking or spilling that probably overestimates loading by a considerable margin.

Despite the disparity in accuracy, the total annual loads can be contrasted with each other, and general conclusions about the magnitude of each type of source drawn. These estimates will also be compared to estimates of contaminant loads from natural or more regional sources (e.g. acid mine drainage) where information or data are available. The intent is not to calculate actual estimates of loading rate, but to better understand which sources are most likely to be major sources, and which appear to be minor sources.

Step 3: Reality Check

Because of the highly speculative nature of the loading estimates, annual average contaminant loads can be summed, and divided by annual average flow rates in the river to estimate an in stream concentration. The calculated concentration can be compared to in stream sampling data and conclusions drawn about the degree of overestimation or underestimation that the loading estimates appear to represent.

3.2.5.2 Results

Only a general, qualitative analysis of contaminant loading can be made with the sketchy data available for this analysis. A cumulative loading analysis goes well beyond the scope of this analysis and is not attempted here. The qualitative loading analysis is based on the loading estimates produced by the database in support of the evaluation of sites, and only provides an indication of the relative importance of each potential source.

Loading Estimates

Using the database, order of magnitude estimates of loads from each type of source can be made. These are discussed here in a general sense for the sites in the major databases.

Each source is rated according to the relative impact that the source might have on ambient river concentrations.

- *Low:* if the sites do not appear to contribute enough load to even register as a portion of the ambient concentration. Generally, each of these sites if discharging or spilling to the river, would only change the concentration at the intake by less than one percent.

- *Medium*: if the sites could be contributing a low percentage of the actual ambient concentrations. Generally, each of these sites, if discharging or spilling to the river, would change the concentration at the intake from 1 to 25%.
- *High*: if the sites could or are one of the major contributors of this contaminant. Generally, each of these sites, if discharging or spilling to the river, would change concentrations at the intake by more than 25%.

A distinction is made between sources that are contributing and those that could, but only if spills or leaks occur.

Table 3.2.5-1 provides a summary of the estimated combined contributions by the various source types under either normal or abnormal (such as the primary storage tank spilling all its contents) conditions. The table also provides comments on whether the indicated, cumulative sources appear to drive or influence water quality when compared to water quality data. “Yes” indicates that current water quality data corroborates the indicated source contributions. “Partial” indicates that current water quality data only partially corroborates the source contributions. “No” indicates that no real correspondence exists between the source contributions and water quality data.

Table 3.2.5-1 Qualitative Combined Contributions to River Water Quality

Contaminant	NPDES (dischargers)	NPS (runoff)	TRI (toxic facilities)	AST (storage tanks)	Matches with Reality?
Salts	Low	Low	Low-Medium*	Medium*	Yes
<i>Cryptosporidium</i>	Low	Low	Low	Low	Partial
Fecal coliforms	Low	Medium	Low	Low	Yes
Nitrate	Medium-High	Low	Medium-High*	Low	Yes
Metals	Medium	Medium	High*	High*	Partial
Phosphorus	Low-Medium	Medium	Medium	High*	Yes
Petroleum Hydrocarbons	Low	Medium	Low	High*	No
Disinfection-by-Products	Medium-High	Medium	Low	Low	Partial
Turbidity	Medium-High	Medium	Low	Low	Partial
Volatile Organic Compounds	Low-Medium	Low	High*	High*	Yes

* Abnormal and highly unlikely situation would require the simultaneous release of contaminants from all facilities or storage tanks.

As shown, estimates for salts, fecal coliforms, nitrate, phosphorus, and volatile organic compounds appear to match well with current water quality data observations. However, the estimate for petroleum hydrocarbons does not match. Petroleum hydrocarbons are rarely, if ever, measured at the intake. Some categories, such as metals, only show partial matches. Source contributions for metals, such as lead and copper, do generally match water quality. However, source contributions do not correlate with iron and manganese intake levels, which are greatly influenced by acid

mine drainage. Therefore, the qualitative loading analysis, which is based on conservative assumptions, only provides some very general indications about the impacts of various sources. This analysis requires further refinement as part of a true cumulative analysis for a TMDL in order to provide more accurate predictions.

Salts

NPDES (permitted dischargers): Low

Permanent discharges, but at very low concentrations.

NPS (stormwater runoff loading): Low

Stormwater runoff can be a source of salts during the winter, but does not appear to be a significant concern.

TRI (generators/handlers): Low - Medium

Sites could contribute minor amounts, but only do so through spill or leaks.

AST (aboveground tanks): Medium (potential only)

Not a significant source unless a spill occurs.

Comparison of the loading results to actual seasonal trends in water quality data (section 2.1.5) shows that the results of both analyses indicate that NPS (stormwater) runoff is the main source of salts in the watershed. The qualitative loading results further indicate that the cumulative impact of these sources especially from developed areas may be significant. In addition, long-term trends appear to suggest that the cumulative impacts are significant and the source of the increasing concentrations in the river.

Cryptosporidium

NPDES (permitted dischargers): Low

These are one of only two sources, however, the loading rate is relatively low, and does not result in significant concentrations in the ambient water under normal circumstances.

NPS (stormwater runoff loading): Low

Stormwater runoff can be a source of *Cryptosporidium* from certain land uses, and is probably responsible for almost all the background levels found in the river.

TRI (generators/handlers): Low

Not a source

AST (aboveground tanks): Low

Not a source.

Comparison of the qualitative loading data with actual water quality data from research studies conducted by PWD, suggest that the elevated concentrations observed during storm events are most likely due to storm water runoff from developed areas and pasture lands. However, during non-rainfall periods, it appears that NPDES discharges in particular from wastewater treatment plants are the main source of daily concentrations observed in the Schuylkill River. Therefore, efforts to reduce mean daily concentrations of *Cryptosporidium* in the river should focus on reducing the impacts from wastewater discharge, while efforts to reduce peak concentrations should focus on mitigating stormwater runoff from pastures and developed areas.

Fecal Coliform

NPDES (permitted dischargers): Low

These sites are one of only two sources, however, the loading rate is relatively low, and does not result in significant concentrations in the ambient water under normal circumstances.

NPS (stormwater runoff loading): Medium

Stormwater runoff is a major source and is probably responsible for almost all the background levels found in the river. This is usually seen in the extreme variability of fecal counts responding to rainfall events.

TRI (generators/handlers): Low

Not a source

AST (aboveground tanks): Low

Not a source.

Comparison of the qualitative loading data with actual water quality data suggests that the elevated concentrations observed during storm events are most likely due to stormwater runoff from developed areas and pasture lands. However, during non-rainfall periods, it appears that coliforms can originate from a number of sources including wastewater discharges, leaking septic tanks, leaking sewers, “wildcat” or illegal sewage discharges, geese, and livestock.

Metals

NPDES (permitted dischargers): Medium

NPDES discharges may account for some of the metal concentration found at the intake. The amounts, cumulatively, could represent a low but significant percent of total metal loading for certain metals.

NPS (stormwater runoff loading): Medium

Stormwater runoff can be a significant source of metals during storm events, with runoff often contributing copper, zinc, cadmium, and other metals at relatively low concentrations to the water.

TRI (generators/handlers): High (potential only)

Sites could contribute major amounts of metal to the river, but only do so through spill or leaks. The amounts stored, if spilled, could cause order of magnitude exceedances of the drinking water standards at the intake for short periods of time.

AST (aboveground tanks): High (potential only)

Sites could contribute major amounts of metal to the river, but only do so through spill or leaks. The amounts stored, if spilled, could cause order of magnitude exceedances of the drinking water standards at the intake for short periods of time.

Though the qualitative analysis suggests that TRI and AST sites have the potential for the greatest cumulative impacts, it would require numerous simultaneous catastrophes in the watershed for this to occur. Based on analysis of long-term trends, it appears that concentrations of metals are increasing in the river. Also water quality data suggests most metals increase during storm events. The only metal that does not always increase during rain events is Manganese. In section 1.4.6.1, it was shown that concentrations measured from acid mine drainage discharges can actually be responsible for everyday concentrations of Iron and Manganese observed in the Schuylkill River. Also, spatial analyses in section 3.1.5 also observed a decrease in metals concentrations with distance downriver. Therefore, though it is estimated qualitatively that NPDES discharges appear to have a medium impact on metal concentrations in the river, it is more likely that stormwater runoff and acid mine drainage are the driving factors cumulatively influencing water quality trends in the river.

Nitrates

NPDES (permitted dischargers): Medium - High

Permitted discharges of wastewater contribute a steady load of nitrates to the river, but do not result in concentrations that approach the drinking water standard.

NPS (stormwater runoff loading): Low

Stormwater runoff can be a source of nitrate, especially runoff from agricultural lands, however, in general, loading is not significant.

TRI (generators/handlers): Medium – High (potential only)

Generally not a source, although a few sites appear to have the potential to be a temporary source of high concentrations if a spill were to occur.

AST (aboveground tanks): Low

Not a significant source.

Analysis of observed nitrate concentrations in sections 3.1.5 and 1.5 show that nitrate and ammonia concentrations are decreasing in the river. Also, seasonal fluctuations in nitrate concentrations appear to be dominated by biological activity in the river. However, analysis of impairment data in section 3.1.5.4 suggests that nutrients are one of the top three leading causes of impairments in the lower half of the Schuylkill River Watershed. Upon further examination, these impairments may be more related to phosphorus than nitrate. Overall, the combined information suggests that improvements by wastewater discharge and reduced agricultural runoff have benefited the watershed, but the cumulative impacts of nitrate from both point and non-point sources combined may still play a significant role in determining stream health.

Petroleum Hydrocarbons

NPDES (permitted dischargers): Low

Not a significant source.

NPS (stormwater runoff loading): Medium

Stormwater runoff is a source of petroleum hydrocarbons during storm events, particularly from urban areas. Measurable concentrations at the intake are possible as a result of stormwater runoff.

TRI (generators/handlers): Low

Not a source.

AST (aboveground tanks): High (potential only)

This is only a source if spilled or leaked. The amounts stored at many sites, however, mean that a spill could have significant impact, with very high concentrations occurring following a spill.

As observed, petroleum hydrocarbons from non-point source runoff and above ground storage tanks were considered to have the greatest potential qualitative impacts. Petroleum hydrocarbon impacts are typically observed from spills caused by accidents or releases. The impacts of hydrocarbons from storm water runoff have not been observed in either water quality data or stream impairment descriptions to date.

Therefore, the observed cumulative impact of various sources on hydrocarbons is low, but the observed impact from an individual source during an accident can be significant.

Phosphorus

NPDES (permitted dischargers): Low - Medium

Wastewater discharges are a source of phosphorus, but at amounts that are not likely to have a large effect on ambient concentrations at the intake.

NPS (stormwater runoff loading): Medium

Stormwater runoff can be a major source of phosphorus in runoff from residential and agricultural areas. Concentrations may occasionally be high, causing a measurable impact at the intake.

TRI (generators/handlers): Medium (potential only)

Some sites could contribute significant amounts, but only do so through spill or leaks.

AST (aboveground tanks): High (potential only)

Generally not a source unless a major spill occurs.

Analysis of observed orthophosphate concentrations in sections 3.1.5 and 1.5 show that orthophosphate concentrations are increasing in the river. Seasonally, orthophosphate concentrations also appear their greatest during spring when runoff and rainfall occurs. In addition, analysis of impairment data in section 3.1.5.4 suggests that nutrients are one of the top three leading causes of impairments in the lower half of the Schuylkill River Watershed. Upon further examination, these impairments may be more related to phosphorus than nitrate. Overall, the combined information suggests that the cumulative release of phosphorus from non-point sources may be the most significant contribution for control.

Disinfection By-Product (Total Organic Carbon)

NPDES (permitted dischargers): Medium - High

Wastewater discharges are one of the major sources of TOC, and can be having a measurable impact on concentrations at the intake.

NPS (stormwater runoff loading): Medium

Stormwater runoff is a major source of TOC during storm events, and contribution can come for a variety of land uses, including parkland and wooded areas.

TRI (generators/handlers): Low

Sites could contribute minor amounts, but only do so through spill or leaks.

AST (aboveground tanks): Low

Not a significant source.

Total organic carbon can come from many sources including agriculture, decaying leaves and algae, and sewage discharge. However, the nature of the organic matter from those sources can be significantly different and have significantly different impacts on the formation of disinfection-by-products when they react with chlorine. Water quality data in section 1.4 suggests that TOC has increased in the river over the past decade. Since the population in the watershed has not changed significantly in the past decade, it is doubtful that NPDES discharges are the influencing cumulative source related to this increase. However, during this period, developed land throughout the watershed has increased. These observations suggest that the combined impact from the many non-point sources in the watershed may be driving the increasing concentrations observed in the river.

Turbidity (Total Suspended Solids)

NPDES (permitted dischargers): Medium - High

Wastewater discharges are a major source of TSS, and probably have a measurable impact at the intake.

NPS (stormwater runoff loading): Medium

Stormwater runoff is the major source of TSS during storm events, and can cause large increases in concentration for periods of time during and after a storm. The heaviest loading comes from disturbed construction sites and agricultural areas.

TRI (generators/handlers): Low

Not a source.

AST (aboveground tanks): Low

Not a source.

Though the qualitative analysis suggests that NPDES discharges can be a controlling source of turbidity, water quality data suggests otherwise. In fact, data shows that non-point source runoff tends to control turbidity due to its increased values during the wetter seasons. NPDES discharges may contribute to the daily non-rain event turbidity levels, but water quality data to date does not clearly suggest any impact on turbidity from dry weather discharges.

VOCs

NPDES (permitted dischargers): Low - Medium

Generally not a significant source of VOCs, however can contribute to loads depending on mix of industry.

NPS (stormwater runoff loading): Low

Not a significant source.

TRI (generators/handlers): High (potential only)

Sites could contribute significant amounts, but only through spill or leaks. A spill would result in orders of magnitude increase above drinking water standards.

AST (aboveground tanks): High (potential only)

Sites could contribute significant amounts, but only through spill or leaks. A spill would result in orders of magnitude increase above drinking water standards.

As observed, volatile organic compounds toxic release facilities and aboveground storage tanks were considered to have the greatest potential qualitative impacts. Analysis of the limited VOC data does not suggest any impacts from particular point sources or facilities. Past experiences tend to suggest that individual sources, such as accidents and spills that release benzene or toluene, are most likely to impact the water supply. Therefore, the observed cumulative impact and likelihood from various sources of VOCs is low, but the observed impact from an individual source during an accident can be significant.

3.2.6 Watershed Protection and Restoration Activities

Key Points

- **Restoration activities within the Lower Schuylkill River Watershed and the Wissahickon Creek Watershed are within Zone A of the Philadelphia Water Department's Queen Lane Intake.**
- **The Lower Schuylkill River Watershed was awarded \$5,837,791 in grant funding over the past seven years.**
- **Over 50% of the grants funded restoration projects within the watershed.**
- **The Wissahickon Creek Watershed was awarded \$1,124,625 in grants over the past seven years.**
- **Nearly 40% of the Wissahickon Creek grant funds are being used to fund urban stormwater best management demonstration projects.**

In order to gain an understanding of the current levels of environmental stewardship and awareness within watersheds, a compilation of grants and restoration projects was completed. State, Federal and private grant sources identified the levels of funding that they provided through various programs to respective watersheds from 1995 to 2001.

These programs include the Pennsylvania Department of Environmental Protection's (PA-DEP) 319 Non-point Source Program and the Growing Greener Program, the Pennsylvania Department of Conservation and Natural Resource's (PA-DCNR) Rivers Conservation Plan Program, and Pennsylvania's Coastal Zone Management Program. Also included were Pennsylvania's Natural Resource and Conservation Service's (NRCS) Conservation Reserve Program (CRP), Wetlands Reserve Program (WRP), Watershed Protection and Flood Prevention Act (PL-566) Program, and the Environmental Quality Incentives Program (EQIP). In addition, private sources of funding were also compiled, including the William Penn Foundation, the Pew Charitable Trusts and The Pennsylvania League of Women's Voters. Additional sources of funding included federal funds via the Army Corps of Engineers (USACOE), the United States Environmental Protection Agency (EPA), the United States Fish and Wildlife Service (FWS), and the National Science Foundation (NSF).

Restoration activities within the Lower Schuylkill River Watershed and the Wissahickon Creek Watershed are within the Zone A limit of PWD's Queen Lane Intake. The Lower Schuylkill ranked first out of 17 subwatersheds for total dollars spent with \$5,837,791, which corresponds to \$83,913.68/ square mile. The Wissahickon Creek Watershed ranked fifth out of 17 subheds with a total of \$1,124,625, which corresponds to \$17,674.44/ square mile.

Figure 3.2.6-1 summarizes the distribution of grant dollars for the lower Schuylkill River Watershed by project type. Over 50% of the grant funds were allocated for restoration projects in the watershed.

Figure 3.2.6-1 Distribution of Lower Schuylkill River Watershed Grants by Project Type

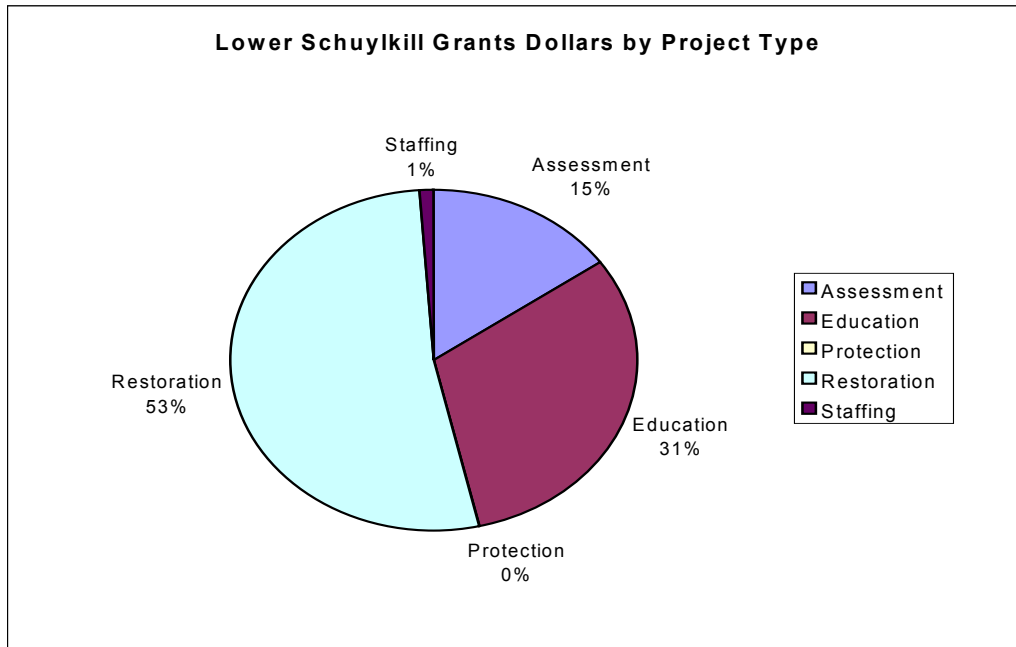


Table 3.2.6-1 lists the grants received within the Lower Schuylkill River Watershed from 1995-2001. The largest project funded was the Fairmount Water Works, receiving approximately 33% of the total funding for the watershed. The Fairmount Water Works will serve as the educational center for the region in terms of water resources and the connection between anthropogenic activities and environmental sustainability.

Table 3.2.6-1 Projects Receiving Grants in the Lower Schuylkill River Watershed from 1995-2001

Grant	Awardee	Project Description	Source	Year
\$30,000	Philadelphia Urban Resource Partnership	Hire a director	PA DEP 319	1995
\$50,000	Philadelphia Water Department	Waterworks exhibits	PA CZM	1995
\$30,000	Philadelphia Urban Resource Partnership	Hire a director	PA DEP 319	1996
\$3,600	Friends of the Manayunk Canal	Towpath map	DELEP	1997
\$21,238	Fairmount Park Commission	Footbridge, observation deck	PA CZM	1998
\$11,600	Pennsylvania Environmental Council	Environmental education	PA CZM	1998
\$7,389	Schuylkill River Keeper	Riparian planting		1998
\$27,500	Lower Merion Conservancy	Headquarters renovation	WPF	1999

Grant	Awardee	Project Description	Source	Year
\$2,956	Manayunk Development Corporation	Environmental education	PA LoWV	1999
\$7,200	Montgomery County Lands Trust	Land preservation	WPF	1999
\$3,000	Philadelphia Water Department	Riparian buffer restoration	PA LoWV	1999
\$3,000	Philadelphia Water Department	Riparian planting	DELEP	1999
\$66,000	Schuylkill River Development Council	Bridge restoration	WPF	1999
\$144,540	Schuylkill River Development Council	Riparian parkland	WPF	1999
\$2,200	Manayunk Development Corporation	Towpath tour	DELEP	1999
\$55,300	Villanova University	Wetland restoration; urban bmps	PA DEP 319	1999
\$150,000	Bryn Mawr College	Stormwater wetland	PA GG	2000
\$25,300	Fairmount Park Commission	Lake restoration	PA GG	2000
\$20,000	Friends of the Manayunk Canal	Restoration Plan	PA GG	2000
\$1,100,000	Fund for the Fairmount Water Works	Restoration and education	WPF	2000
\$56,415	Manayunk Development Corporation	NPS pollution education	PA GG	2000
\$2,906	Manayunk Development Corporation	Environmental education	PA LoWV	2000
\$750,000	Philadelphia Water Department	Fairmount Water Works	PA GG	2000
\$3,000	Philadelphia Water Department	Riparian buffer restoration	PA LoWV	2000
\$200,000	Philadelphia Water Department	Stormwater bmps at a school	PA GG	2000
\$11,000	Riverbend Environmental Education Center	Watershed models; education	PA GG	2000
\$2,910	John Bartram Association	Fishing on the Schuylkill	DELEP	2000
\$550,000	Schuylkill Center for Env Education	Environmental education, trails	WPF	2000
\$797,500	Schuylkill River Development Council	Masterplan for tidal Schuylkill	WPF	2000
\$3,500	Schuylkill River Keeper	Riparian planting		2000
\$55,000	University City District	Clark park revitalization plan	WPF	2000
\$85,020	Upper Merion Township	Streambank restoration	PA GG	2000
\$10,120	Villanova University	Stormwater bmps on campus	PA GG	2000
\$25,000	Riverbend Env Education Center	Develop a master site plan	PA GG	2001
\$120,000	Lower Merion Township	Develop Rolling Hill Park trail	PA GG	2001
\$350,000	Fairmount Park Commission	Develop East Fairmount Park	PA GG	2001
\$240,000	Philadelphia Water Department	Fairmount Water Works	PA GG	2001
\$59,112	Villanova University	detention basin into wetland	PA GG	2000
\$85,500	Villanova University	Porous concrete demonstration	PA GG	2001
\$385,000	Bryn Mawr College	Ashbridge Memorial Park	PA GG	2001
\$34,985	The Miquon School	Crayfish Creek restoration	PA GG	2001
\$250,000	University of Pennsylvania	Public stormwater management	PA GG	2001

Figure 3.2.6-2 summarizes the distribution of grant dollars for the Wissahickon Creek Watershed by project type. Seventy-five percent of the funds were allocated for restoration projects.

Figure 3.2.6-2 Distribution of Wissahickon Creek Watershed Grants by Project Type

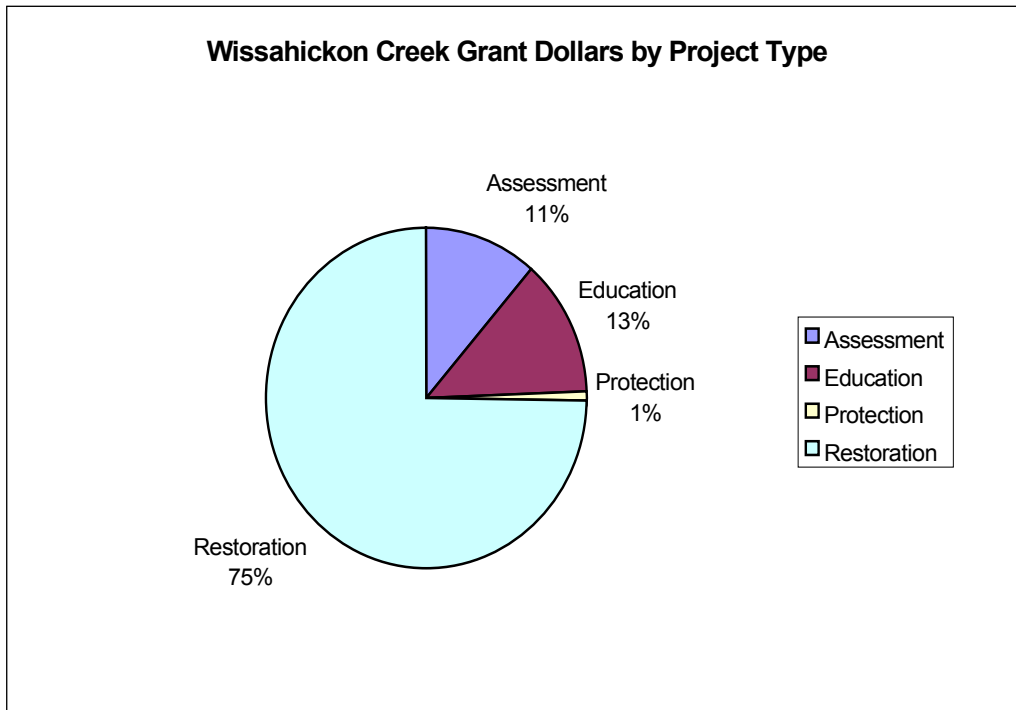


Table 3.2.6-2 shows the grants awarded within the Wissahickon Creek Watershed. The majority of grant dollars (39%) within the Wissahickon have gone to the Morris Arboretum (University of Pennsylvania) for demonstration projects for urban stormwater best management practices.

Table 3.2.6-2 Projects Receiving Grants in the Wissahickon Creek Watershed from 1995-2001

Grant	Awardee	Project Description	Source	Year
\$76,250	Morris Arboretum	Urban bmps	PA DEP 319	1997
\$108,750	Morris Arboretum	Urban bmps	PA DEP 319	1998
\$115,273	Schuylkill River Keeper	Streambank stabilization		1998
\$30,000	Lower Gwynedd Township	Urban bmps retrofits	PA WRAP	1999
\$8,400	Montgomery County Land Trust	Land preservation	WPF	1999
\$127,101	Morris Arboretum	Urban bmps	PA DEP 319	1999
\$33,426	Schuylkill River Keeper	Streambank restoration		1999
\$4,626	Schuylkill River Keeper	Streambank restoration		1999
\$5,004	Schuylkill River Keeper	Streambank restoration		1999
\$20,000	Wissahickon Valley W.A.	Water quality monitoring	PA DEP 319	1999
\$24,515	Alliance for a Sustainable Future	Stormwater quality monitoring	PA GG	2000
\$75,560	Alliance for a Sustainable Future	Stormwater quality monitoring	PA GG	2000
\$20,633	Center in the Park	Educational curriculum	PA GG	2000
\$3,300	Bioblitz with NLREEP: FPC	Streambank restoration	DELEP	2000
\$4,035	Schuylkill River Keeper	Streambank restoration		2000
\$3,038	Schuylkill River Keeper	Streambank restoration		2000
\$3,000	Stroud Water Research Center	Water quality monitoring	PA LOWV	2000
\$126,500	Morris Arboretum	Environmental education	WPF	2000
\$26,000	Wissahickon Restoration Volunteers	Streambank restoration	PA GG	2000
\$53,500	Wissahickon Valley W.A.	Streambank restoration	PA GG	2000
\$5,714	Stroud Water Research Center	Macroinvertebrate analysis	WYO & WPF	1995-2000
\$100,000	Ambler Borough	DAF	PA GG	2001
\$150,000	Philadelphia Water Department	Stormwater treatment wetland	PA GG	2001

3.2.7 Public Participation Process

Key Points

- Public kick-off meetings, Technical Advisory Group meetings, media articles and a Website were some of the methods used to involve the public in the Source Water Assessment Program (SWAP).
- A Technical Advisory Group (TAG) was established to facilitate communication among stakeholders, and to gather information about the watershed.
- The TAG meets quarterly to assist the Source Water Assessment Partnership in the SWAP process.
- Sixteen people attended the two public kick-off meetings held to introduce the SWAP.
- SWAP project information is available through the project Website, www.schuylkillswa.org.

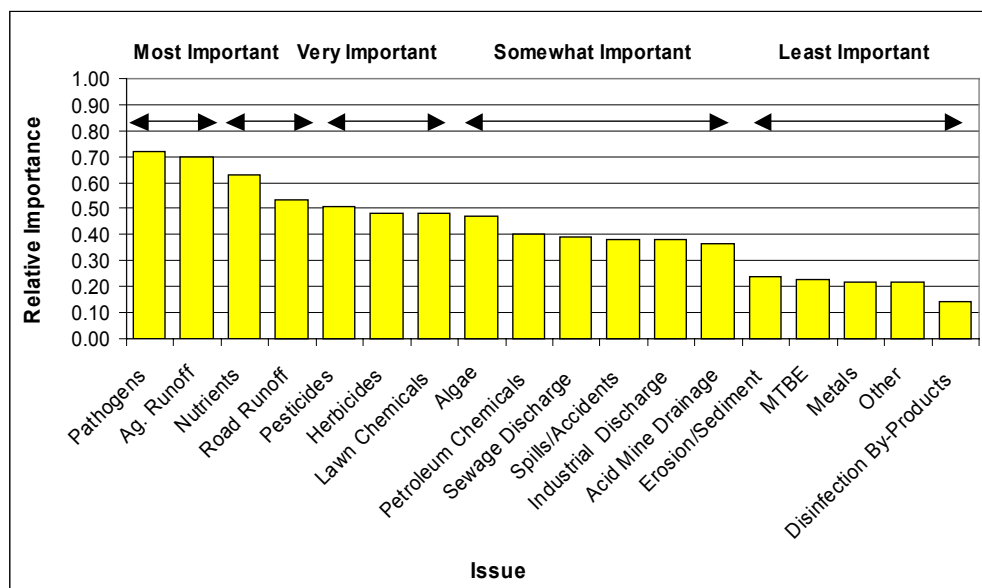
The involvement of the public in the Schuylkill Source Water Assessments included several avenues to provide opportunities for stakeholder and public involvement. These included:

- Public Kickoff Meetings
- Public Wrap-up Meetings
- Technical Advisory Group Meetings
- Legal Notices
- Newspaper Articles
- SWAP Website

Overall, these avenues appear to have been successful at reaching the public and stakeholders. Two public meetings resulted in 16 attendees, six advisory group meetings resulted in 161 attendees, 3 legal notices/ advertisements were published, 5 newspaper articles were published about the project, and the website has been accessed 521 times to date. Public Wrap-up meetings discussing the results of the project are anticipated for Spring 2002.

One of the important goals of gathering stakeholder input was to determine the perceived importance of various water quality issues so that comparisons could be conducted once the assessment was completed. According to the stakeholder input, the 17 water quality issues that were ranked fell into five general priority bins going from most important to least important (see Figure 3.2.7-1). Overall, pathogens, agricultural runoff, and nutrients were of greatest concern by stakeholders. Erosion and sedimentation control, metals, and disinfection-by-product precursors were considered the least important.

Figure 3.2.7-1 Ranking of Water Quality Issues by Stakeholders



3.2.7.1 Advisory Groups

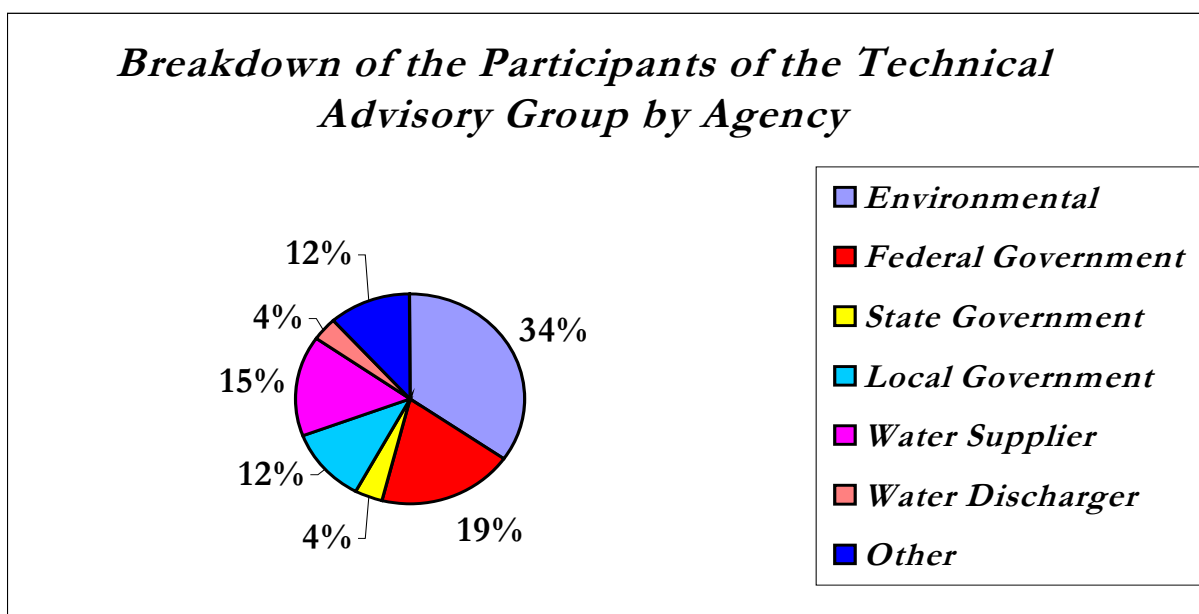
In order to better facilitate communication among the Source Water Assessment Partnership and the regions of the Schuylkill River Watershed to be assessed, an open Technical Advisory Group (TAG) was formed. This TAG was developed by the partnership as a way to closely interact with the stakeholders, and in turn, gather integral information about each region of the Schuylkill River Watershed. All of the 200 stakeholders were invited by the partnership to participate. Meeting quarterly, it is the primary responsibility of the TAG to inject public interest into the SWA process. Moreover, others duties of this group include:

- Sharing information with stakeholders;
- Verifying the information put forth by the partnership;
- Providing input on the assessment techniques and criteria used by the partnership;
- Offering general information regarding the areas local to each TAG;
- Participating in public outreach and education;
- Describing current protection activities;
- Identifying “potential” sources of contamination and preservation, and
- Assisting in the development of summary reports.

Technical Advisory Group Participants

Composed of watershed organizations, public interest groups, dischargers, suppliers, and local government agencies, the TAG offers a broad variety of perspectives and visions. Figure 3.2.7-2 is illustrative of the various types of agencies participating in the Technical Advisory Group.

Figure 3.2.7-2 Technical Advisory Group Breakdown



The following is a summation of some of the TAG's participants:

It is the mission of the *Department of Environmental Protection (DEP)* to protect the air, land, and water of Pennsylvania from pollution and to provide for the health and safety of its citizens through a cleaner environment. DEP works as partners with individuals, organizations, governments, and businesses for the prevention of pollution and the restoration of natural resources and achieves these goals via public service, protection, teamwork, communication, and pollution prevention. DEP is the state agency largely responsible for administering Pennsylvania's environmental laws and regulations. Its responsibilities include: reducing air pollution; making sure that our drinking water is safe; protecting water quality in our rivers and streams; making sure waste is handled properly; managing the Commonwealth's recycling programs and helping citizens prevent pollution and comply with the Commonwealth's environmental regulations. DEP is committed to general environmental education and encouraging effective public involvement in setting environmental policy.

Incorporated in 1969, the *Western Berks Water Authority* supplies water to the Borough of Wyomissing from its water treatment plant located on the Tulpehocken Creek, thereby meeting all of the water needs of the residents of Wyomissing, West Reading,

and Shillington. The Authority also supplies water to Mohnton and Lincoln Park, as well as portions of Cumru Township, and small quantities to the Citizens Utility Water Company, the Blue Marsh Lake Park and the fire companies. The Authority's present water system facilities include a complete water treatment plant with a capacity of supplying up to eight million gallons of water per day. Aligns with the Borough of Wyomissing's mission to provide services identified with the tradition of excellent living in Wyomissing.

PennFuture is an organization that takes pride in defending the environment. In achieving its mission of defending nature, PennFuture effectively resists those who attack it and rallies against those who fail to do their duty to protect it. By combating global warming, smog, acid rain, and illness and advocating the increase of desperately needed funding for farmland preservation, among other things, PennFuture is making great strides in assuring that polluters and their allies no longer decide the fate of the environment and the economy. Comments and concerns may be voiced to Brenna Herpmann at (800) 321-7775. PennFuture's mailing address is 212 Locust Street, Suite 410, Harrisburg, PA 17101.

In order to share the responsibility of managing the water resources of the Delaware River Basin, the **Delaware River Basin Commission (DRBC)** was formed by the signatory parties of the Delaware River Basin Compact (Delaware, New Jersey, New York, Pennsylvania, and the United States). Since its inception on October 27, 1961, the very day that Compact became law, DRBC has been a pacesetter in environmental protection. As mentioned in its mission statement, DRBC focuses mainly on protecting, enhancing, and developing the water resources of the Delaware River Basin for the benefit of present and future generations. In achieving their mission, DRBC has developed such programs as water pollution abatement, water supply allocation, regulatory review (permitting), water conservation initiatives, regional planning, drought management, and flood control. Questions, comments, and concerns may be forwarded to Jon Zangwill via e-mail, zangwill@drbc.state.nj.us or telephone, (609) 883-9500 x 307. DRBC's mailing address is 25 State Police Drive, West Trenton, NJ 08628.

The **Schuylkill River Greenway Association** is a membership organization that has been working with citizens, community groups, and a host of other partners for close to 25 years. The primary objective of the Association is to promote the advocacy of river resources and open space. In 1995, with the designation of the Schuylkill River Corridor as Pennsylvania's seventh Heritage Park, the association expanded its mission to include such focal points as the conservation of the historic and cultural resources within the watershed as well as the economic development of such resources. Inquiries may be voiced to Executive Director Dixie Swenson via telephone, (610) 372-3916 or e-mail, serga@ptd.net. The Schuylkill River Greenway Association's mailing address is 960 Old Mill Road, Wyomissing, PA 19610-2522.

Clean Water Action (CWA) is a national citizens' organization that works toward the following goals: affordable water, prevention of health-threatening pollution, creation of environmentally safe jobs and businesses, and the empowerment of people to make

democracy work. In addition, CWA organizes grass roots groups, coalitions, and campaigns with the common interest of protecting health and quality of life, so that they may better promote environmental well being within a community. The mailing address of the CWA National Office is 4455 Connecticut Avenue NW – Suite A300, Washington, DC 20008-2328 (Telephone: (202) 895-0420). The mailing address of the CWA Philadelphia Office is 1201 Chestnut Street, #602, Philadelphia, PA 19107. All inquiries may be directed to Bob Wendelgass at the Philadelphia Office via e-mail, bwendelgass@cleanwater.org or telephone, (215) 640-8800.

Since its inception in 1950, the *Montgomery County Planning Commission (MCPC)* has made great strides in promoting order and development while also preserving the elements of the Montgomery County Watershed that define the community's quality of life. The MCPC is an advisory body on the following subjects: land transportation of all types, the environment, water and sewer service, parks and open space, farmland preservation, stormwater management, site design, housing, zoning, development patterns, and the demographic trends within Montgomery County. MCPC is composed of 9 member-appointed Board Members as well as a professional staff of 44, all of who provide support to municipal governments via innovative solutions to the challenges at hand. All questions, comments, and concerns may be voiced to MCPC Director, Kenneth B. Hughes via telephone, (610) 278-3722. The MCPC mailing address is P.O. Box 311, Norristown, PA 19404-0311.

The mission of the *Schuylkill Riverkeeper Program* is to protect and restore the Schuylkill River, its tributaries and habitats, through advocacy, enforcement, and citizen action. The Riverkeeper is a field office of the Delaware Riverkeeper Network and collaborates with the Patrick Center for Environmental Research at the Academy of Natural Sciences. The primary focus of the Riverkeeper Program is to identify and restore degraded streambanks throughout the Schuylkill River Watershed while also working with landowners in order to address the effects of sediment and nutrient pollution on waterways, all of which is encompassed within the Schuylkill Riverkeeper's Streambank Restoration Project. All inquiries may directed to Chari Towne via telephone, (610) 469-6005 or e-mail, srk@worldlynx.net. The mailing address of the Schuylkill Riverkeeper Program is P.O. Box 459, St. Peters, PA 19470-0459.

The *Berks County Conservancy*, a non-profit organization established in 1974, is dedicated to preserving Berks County's unique Cultural and Environmental Heritage for the benefit of future generations. In order to achieve this, the conservancy has focused its efforts on the preservation of agricultural land and open space, the protection of the quality of the streams and ground water of Berks County, and the preservation of historic landmarks and scenic landscapes, all of which contribute to a sustainable future for the Berks County Community. Simply put, protecting water, habitat, and the natural environment are conservancy priorities. Questions may be forwarded to Joseph Hoffman, Director of Environmental Management, via telephone, (610) 372-4992. Berks County Conservancy's mailing address is 960 Old Mill Road, Wyomissing, PA 19610.

It is the mission of the *Nature Conservancy* to preserve the plants, animals, and natural communities that represent the diversity of life on Earth by protecting the lands and waters needed to survive. Since its inception in 1951, the Nature Conservancy, the world's largest private international conservation group, has formed partnerships with communities, businesses, and individuals in order to pave the road for the protection of millions of acres of valuable lands and waters worldwide. It is the commitment of the Nature Conservancy to expand the boundaries of conservation in order to save the Earth's last great places for future generations. All questions, comments, and concerns may be directed to Randy Gray, State Director, via telephone, (610) 834-1323 x116. The Nature Conservancy's mailing address is 1100 East Hector Street, Suite 470, Conshohocken, PA 19428.

Formed in September 1995 when the Lower Merion-Narberth Watershed Association merged into the Lower Merion Preservation Trust, the *Lower Merion Conservancy* has since acted to protect the Lower Merion area's natural and historic resources, open space, and watersheds for residents and future generations by promoting collective responsibility for these resources via education, advocacy, and research. Questions and concerns may be voiced to Executive Director Mike Weilbacher at (610) 645-9030. The mailing address of the conservancy is 1301 Rose Glen Road, Gladwyne, PA 19035.

The *Natural Lands Trust* is a nonprofit regional land trust that is committed to working with the region's communities to protect old-growth forests, diverse wildflower meadows, and dynamic wetlands. Through acquisition, conservation, easements, planning, and education, this organization encourages others to ensure the preservation of natural and cultural resources for many generations to come. Questions may be forwarded to Andy Pitz at (610) 353-5587. The mailing address of the Trust is 1031 Palmer's Mill Road, Media, PA 19063.

Incepted in 1964, the *Perkiomen Watershed Conservancy* has since been dedicated to protecting and conserving the natural resources within the Perkiomen Creek Watershed. This nonprofit organization reaches out to the surrounding community via environmental education and land conservation and protection. Questions, comments, and concerns may be forwarded to Executive Director Tish Ryan at (610) 287-9383. The mailing address of the conservancy is 1 Skippack Pike, P.O. Box 55, Schwenksville, PA 19473.

It is the mission of the *Pennsylvania Environmental Council (PEC)* to improve the quality of life for all Pennsylvanians. In doing so, PEC enhances the commonwealth's natural and man-made environments by integrating the advocacy, education, and implementation of both community and regional action programs. Director of Watersheds Programs Ann Smith will be accepting questions, concerns, and comments at (215) 563-0250. The mailing address of the PEC is 117 South 17th Street, Suite 2300, Philadelphia, PA 19103-5022.

Technical Advisory Group Meetings

Six TAG meetings were held as of September 2001. The following table outlines the date, location, and number of attendees of each meeting.

Table 3.2.7-1 Summary of Technical Advisory Group Meeting Dates and Locations

Meeting	Date	Location	Number of Attendees
1	October 25, 2001	DEP Offices Conshohocken, PA	47
2	January 17, 2001	DEP Offices Conshohocken, PA	29
3	April 4, 2001	DEP Offices Conshohocken, PA	24
4	May 9, 2001	DEP Offices Conshohocken, PA	28
5	June 13, 2001	DEP Offices Conshohocken, PA	19
6	September 24, 2001	DEP Offices Conshohocken, PA	14
			Total Attendees 161

These meetings were, in essence, discussion forums in which local stakeholders were enabled to voice their concerns and share their opinions of the project. The following is a summation of the minutes from the first five meetings:

MEETING 1

This meeting acted as an introduction to the Schuylkill River Watershed as well as to the Source Water Assessment. The watershed of the Schuylkill River was described as a significant, industrial, agricultural, and commercial corridor, a home to three million people in Pennsylvania in which 40% of the land is forested, 48% is agricultural, and 12% is developed. The region was cited as a source of heritage, history, culture, and recreation.

The specific aspects of the Schuylkill River Watershed as a drinking water supply are as follows:

- 58 surface water intakes
- 47 intakes for systems serving < 10,000
- 265 MGD withdrawn on average from the river and its tributaries serves over 1.8 million people

The Source Water Assessment was explained to be a multi-phase process. The process identifies potential or existing sources of contamination, evaluates the vulnerability/susceptibility of a water supply to contaminant sources, and determines protection priorities and activities for the water supply. The ultimate goal of a SWA was specified as developing local sources of water protection initiatives and educating the public about the source of their drinking water and its challenges. The SWA was

depicted as an iterative and continuous process of assessing, planning, and implementing.

Utilities and stakeholders were encouraged to take an interest in the SWAs because the program was based on federal regulations mandated by Congress. Responding to requests by the public to know more about their water supply and how to protect it, Congress included provisions for a SWA within the Safe Drinking Water Act Reauthorization of 1996. It is the goal of Congress to have 50% of the United States population enveloped under Source Water Protection Plans by 2005.

The SWAs were said to benefit the stakeholders present at the meeting because stakeholders of the TAG would be directly involved by:

- Identifying sources of contamination and areas for protection;
- Having their organization highlighted for interested persons to contact/join;
- Determining potential linkages between their efforts and protection efforts;
- Increasing potential funding opportunities by incorporating projects into approved SWA plans.

The Schuylkill River SWA area to be covered was said to be comprised of 42 surface water intakes, 3 PADEP regions, 2,000 square miles of area, 130 miles of river, and 10 counties. The organization of the SWA was described as two distinct, but linked phases.

Phase I is inclusive of:

- 7 intakes
- 4 water systems
- 73% of the population
- 80% of river withdrawal for drinking water supplies
- bottom of the watershed
- industrial/urban/suburban issues

Phase II includes:

- 35 intakes
- 14 water systems
- 27% of the population
- 20% of withdrawal

- headwaters to middle of river
- rural, mining, agricultural, suburban issues

A schedule and timeline were presented in which Phase I, which began in July 2000, was marked for completion by December 2001. Phase II is scheduled to begin in July 2001 and end in July 2003.

MEETING 2

It is at this meeting that Phase I of the SWA was further discussed. Of particular focus was the Stakeholder Survey, a document that was sent to stakeholders prior to the meeting, which noted key contaminant issues, and asked that the recipients rank those issues on a relative scale of zero to one, with one being of the highest priority. Those stakeholders who responded to the survey included one municipal water supplier, one federal agency, and nine not-for-profit agencies. These respondents ranked pathogens and agricultural runoff as those issues having the highest priority with a ranking of approximately 0.7. On the opposite end of the scale, disinfection by-products were ranked as having the lowest priority with a score of 0.2.

The water quality of the Schuylkill River was also discussed. Parameters affecting water treatment were identified. When discussing contaminant source issues, it was determined that contaminant issues will vary with each perspective. For instance, the outlook of a fisherman will be significantly different from that of the upstream water suppliers and likewise, the downstream water suppliers will have a differing perspective than that of the stakeholders. Table 3.2.7-2 outlines the parameters of concern from both a drinking water perspective and a finished water quality perspective.

Table 3.2.7-2 Parameters of Concern from a Drinking Water and a Finished Water Quality Perspective

Drinking Water Perspective	Finished Water Quality Perspective
<ul style="list-style-type: none"> • Algae – clogs filters • Alkalinity & pH – affect coagulation • Turbidity – impacts coagulant & residual management costs • Metals – require additional chemicals for removal 	<ul style="list-style-type: none"> • Algae – may cause taste & odor episodes • Salts – not removed by treatment & affect those on low sodium diets • <i>Cryptosporidium</i> – resistant to chlorine & may affect immune compromised sub-populations • Total Organic Carbon & Bromide – affect disinfection by-product formation

Water quality data, spanning a period of 30 years (1970 – 2000), for dozens of locations in the Schuylkill River Watershed had been compiled from several organizations. Of this data, conductivity, nutrients, metals, salts, and dissolved oxygen were identified as the most frequently monitored parameters, with pesticides, herbicides, and pathogens making up those parameters that are less frequently monitored.

MEETING 3

It was at this meeting that the four main sources of contaminant source compilation were established:

- Right to Know Network (www.rtk.net)
- Envirofacts (www.epa.gov/enviro)
- Efacts (www.dep.state.pa.us/dep/efacts/resources)
- ESRI Business MapPro

Within the RTK and Envirofacts systems, four Federal databases were accessed: PCS (Permit Compliance System), RCRIS (Resource Conservation and Recovery Act Information System), CERCLIS (Comprehensive Environmental Response, Compensation, and Liability Act Information System), and TRI (Toxic Release Inventory). In order to populate the databases, data was downloaded from RTK by county and then “clipped” in RTK for the purpose of eliminating those data points outside of the watershed boundaries. Missing “x-y” coordinates were filled in by geocoding in ArcView and cross-referencing the same facility with other databases and Envirofacts. Facility data was then further cross-referenced with Envirofacts. Quality and contaminant data was populated via Envirofacts.

A second keynote feature of this meeting was the discussion of the process used to evaluate and prioritize the most critical sources within the Schuylkill River Watershed. It was determined that this process must be:

- Inclusive of all potential sources
- Equitably applied everywhere within the watershed
- Logical and well founded
- Reproducible and defensible

In order to satisfy this need, EVAMIX was introduced. This is a computerized matrix based evaluation method and ranking tool that uses a pair-by-pair comparison of each source against each other source via a criterion. This method is capable of performing hundreds of comparisons and calculations while handling units properly, as well as quantitative and qualitative criteria. This method results in a single number or “appraisal score,” which is the single number that encompasses all of the data included in the criteria as well as the criteria weights. This number is also representative of the relative rank of Source A against all other sources, which in turn provides a strong foundation for assigning priorities to each particular source. The primary use of EVAMIX is decision support; via this system, it is possible to evaluate alternatives, prioritize options, organize data to facilitate decisions, formalize and document the decision process, and act as evidence in defense of the decision made.

It was determined that the results gathered from the EVAMIX matrix will be further reviewed and “reality checked.” Any results for high-ranking sources will be added to other sources outside the scope of the analysis, e.g., highway spills, pipeline breaks, etc. All high-ranking sources will be flagged for follow-up data collection in a later phase in order to verify results. Zones were broken down into categories A, B, and C and calculated using the Geographical Information System (GIS) and river time travel estimates. The zone delineation is as follows, beginning with an area wide inventory:

- Zone A: critical segment, all potential sources
- Zone B: second segment, all significant sources
- Zone C: remainder, just area wide inventory

The goal of the Schuylkill Source Water Assessment was again cited as gaining an understanding of which sources within the Schuylkill River Watershed are most significant and which are not as critical. In doing so, a better understanding of present water quality concerns as well as a sharper focus on the most critical sites will be provided. This, in turn, will lead to a more limited number of high priority sites within the Schuylkill River Watershed.

MEETING 4

A main topic of this meeting was the population of missing data. The Schuylkill River Approach offers controlled screening for point sources as well as for non-point sources which will allow for an end result of a limited number of high priority sites, i.e., approximately 50 sites per intake. Missing information including flow, quantity, chemical group, and SIC code matching PADEP activity were identified.

Another keynote point of this meeting is significance screening, which aids in the development of the best estimate of quantity, concentration at the release point, as well as the dilution at the intake. The steps to be taken regarding this approach are as follows:

- Development of the best estimate of the worst case release (quantity)
- Calculation of concentration at the release point
- Calculation of dilution at the intake
- Comparison to “Threshold Impact”

When too little data is available, screening will be conducted using the number of releases, the amount stored, the chemical stored, and the location relative to the floodplain. Other steps include choosing a Threshold Value in terms of Drinking Water Standards and Ambient Mean Concentrations, determining a background concentration, calculating discharge in order to increase concentration by ten percent of ambient or of

standard at the intake, and calculating the amount of spill of pure contaminant where appropriate.

Table 3.2.7-3 outlines the contaminant categories suggested at this meeting as well as their potential fields, for the purpose of populating the databases.

Table 3.2.7-3 Suggested Contaminant Categories and their Potential Fields

Suggested Contaminant Categories	Potential Fields
Fecal Coliform	<ul style="list-style-type: none"> • Possible Threshold: 200 count/100ml • Threshold Type: Contact Recreational Water Standard • Discharge Volume to Exceed Threshold: 100 MGD of wastewater die off at 2000 count/100 ml • Spill size to Exceed Threshold: Not Applicable
Turbidity (TSS)	<ul style="list-style-type: none"> • Possible Threshold: 10 mg/l • Threshold Type: Ambient Concentration • Discharge Volume to Double Threshold: 5 MGD at 200 mg/l (average wastewater) • Spill Size to Double Threshold: 10,000 lb of silt runoff in one day
Nutrients (Phosphorous)	<ul style="list-style-type: none"> • Possible Threshold: 0.12 mg/l • Threshold Type: Ambient • Discharge Volume to Exceed Threshold: 5 MGD to raise by 10% • Spill Size to Exceed Threshold: 110 lb of pure Phosphorous in one day
VOC (total)	<ul style="list-style-type: none"> • Possible Threshold: 5 parts per billion (ug/l) • Threshold Type: Drinking Water Standard for Benzene • Discharge Volume to Exceed Threshold: Not Applicable • Spill Size to Exceed Threshold: < 5 gallons per day of pure product
Metals (Pb as indicator)	<ul style="list-style-type: none"> • Possible Threshold: 0.015 mg/l • Threshold Type: Drinking water treatment trigger value • Discharge Volume to Exceed Threshold: approx. 1.5 MGD of industrial wastewater at 10 mg/l • Spill Size to Exceed Threshold: approx. 15 lb per day
<i>Cryptosporidium/Giardia</i>	<ul style="list-style-type: none"> • Possible Threshold: 1 oocyst per liter • Threshold Type: Drinking Water Guideline Value • Discharge Volume to Exceed Threshold: 10 oocysts per liter
Nitrates	<ul style="list-style-type: none"> • Possible Threshold: 10 mg/l • Threshold Type: Drinking Water Standard • Discharge Volume to Exceed Threshold: > 50 MGD • Spill Size to Exceed Threshold: 10,000 lb
DPB Precursors (TOC)	<ul style="list-style-type: none"> • Possible Threshold: 2.7 mg/l • Threshold Type: Ambient Median Value • Discharge Volume to Raise Threshold by 10%: 4 MGD of wastewater at 100 mg/l • Spill Size to Exceed Threshold: approx. 2000 lb per day
Petroleum Hydrocarbons (TPH)	<ul style="list-style-type: none"> • No Identified Possible Threshold • Threshold Type: Ambient (data sparse) • Discharge Volume to Exceed Threshold: Not yet determined
Salts (Chloride as indicator)	<ul style="list-style-type: none"> • Possible Threshold: 250 mg/l • Type of Threshold: Drinking Water Standard • Discharge Volume to Exceed Threshold: 1 MGD of brine (sea water) • Spill Size to Exceed Threshold: 200,000 lb of salt per day

Meeting 5

The primary focus of this meeting was on Source Priority Ranking. In essence, three questions needed to be answered:

- Are criteria missing?
- Are the qualitative scores properly defined?
- Are the criteria priorities (weighting factors) satisfactory to the group?

It was at this meeting that the diverse group including water suppliers, stakeholders, and dischargers reached a consensus on the criteria and the weighting factors to be used for the ranking sources. The group also agreed that the nine criteria of Relative Impact at Intake, Time of Travel, Existing Removal Capacity, Impact on Treatment, Potential Health Impacts, Potential for Release/Controls, Potential for Release Frequency, Violation Type/Frequency, and Location were sufficient to complete the ranking criteria. It was agreed upon that no other criteria were missing. Weighting factors and qualitative definitions were determined for the criteria being used to rank sources across all contaminant categories as well as within the six individual categories, thus answering the three primary questions posed. The following two tables (Table 3.2.7-4 and Table 3.2.7-5) outline the actual criteria, criteria type, and the percentages agreed upon for both the nine contaminant categories and the 6 individual contaminant categories at this fifth meeting of the SWA. Figures 3.2.7-3 and 3.2.7-4 graphically depict this breakdown.

Table 3.2.7-4 Consensus Weighting Values for Nine Criteria

Criteria	Type	Weight (%)
Relative Impact at Intake	Intake Related	12
Time of Travel	River Flow Related	5
Existing Removal Capacity	Intake Related	10
Impact on Treatment	Intake Related	10
Potential Health Impacts	User Related	20
Potential for Release/Controls	Source Related	14
Potential for Release/Frequency	Source Related	14
Violation Type/Frequency	Source Related	10
Location	River Flow Related	5

(To be used in the EVAMIX analysis across contaminant categories)

Figure 3.2.7-3 Breakdown of Criteria Type for Contaminant Groups

Contaminant Categories

Source Related Factors: 38%

Intake Related Factors: 32%

User Related: 20%

River Flow Related: 10%

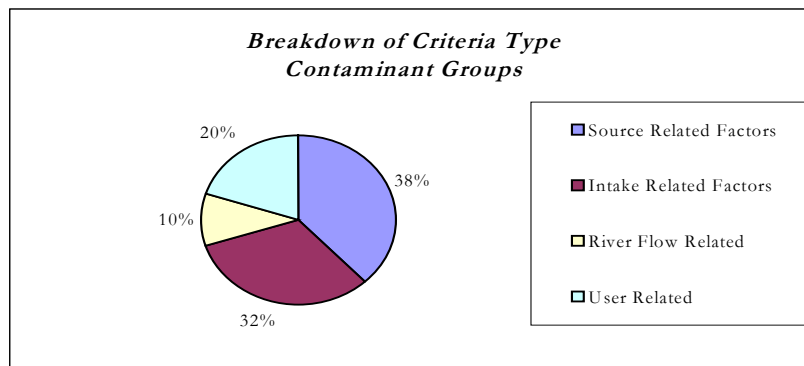


Table 3.2.7-5 Consensus Weighting Values for Six Criteria

Criteria	Type	Weight (%)
Relative Impact at Intake	Intake Related	40
Time of Travel	River Flow Related	5
Potential for Release/Controls	Source Related	20
Potential for Release/Frequency	Source Related	15
Violation Type/Frequency	Source Related	15
Location	River Flow Related	5

(To be used in the EVAMIX analysis within individual contaminant categories)

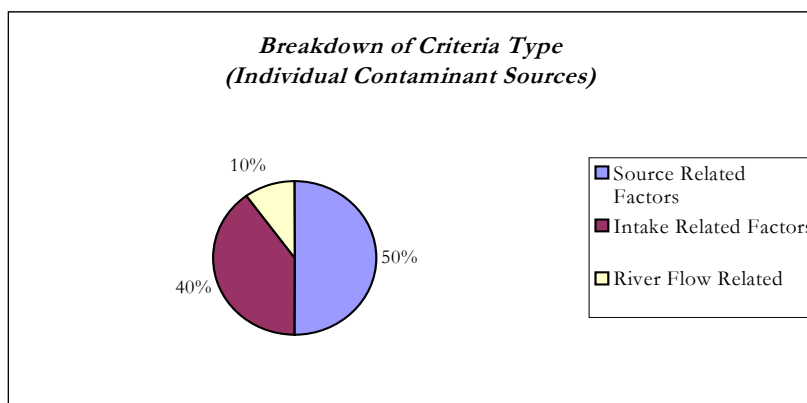
Figure 3.2.7-4 Breakdown of Criteria Type for Individual Contaminant Sources

Individual Contaminant Categories

Source Related Factors: 50%

Intake Related Factors: 40%

River Flow Related: 10%



3.2.7.2 Public Meetings

In an attempt to better educate the public about the importance of the Source Water Assessment Program (SWAP), two public kick-off meetings were conducted. Each public kick-off meeting utilized the following general approach in order to generate public interest:

- Press releases produced by the Philadelphia Water Department and the local stakeholders were sent to the local media and newspapers;
- Legal notices were sent to the local media and newspapers; and
- Advertisements were published in the Pennsylvania Department of Environmental Protection (PADEP)'s *Update*.

Hosted by local watershed organizations in order to promote a sense of credibility as well as to establish a connection with local residents, these meetings were, in essence, informational forums where members of the public were able to voice their concerns as well as share their visions for the project. Table 3.2.7-6 outlines the host, location, date, and number of attendees for each of the four aforementioned public meetings.

Table 3.2.7-6 Public Kickoff Meetings Held for PWD's Intakes

Meeting	Host(s)	Location	Date	Number of Attendees
1	Wissahickon Valley Watershed Association	Wissahickon Valley Watershed Association Ambler, PA	2/20/01	8
2	Schuylkill Environmental Education Center	Schuylkill Environmental Education Center Philadelphia, PA	3/14/01	8
				Total Attendees 16

A standard meeting agenda was developed and followed at each meeting. This agenda was composed of an introduction and an explanation of the purpose of the meeting. Another component of this agenda was an overview of Source Water Assessments, which included a brief yet thorough description of the SWAP as well as the areas to be assessed, i.e., the Schuylkill River Watershed. In addition, a discussion of contaminant source issues and water quality concerns was a keynote feature of the agenda. Finally, each meeting was concluded with an exercise in identification of potential contaminant sources, in which the attendees were asked to identify local sites that may impact the water supply. Questions, concerns, and comments were addressed as they were raised.

Prior to these kick-off meetings, several avenues were pursued in an attempt to notify the public. Letters produced by the Philadelphia Water Department, local stakeholders, and watershed groups specifying the location and directions, date, time and nature of the meetings were mailed to numerous stakeholders, including many of the businesses, government agencies, and environmental organizations located within or affected by the

Schuylkill River Watershed. The information contained in these letters was also posted on the SWAP website, www.schuylkillswa.org. In order to further generate public interest, various watershed groups and local stakeholders posted flyers throughout their respective areas and sent press releases to their local newspapers. Additionally, many of those local newspapers featured articles describing the nature of the meetings as well as the outcome, where applicable (Please see Figures A&B in the attached Appendix). Legal notices detailing the location, time, and date of each meeting were printed in the newspapers local to each area with which the SWAP is affiliated for the purpose of opening the meetings to everyone within the watershed. Table 3.2.7-7 is illustrative of the publications in which the legal notices appeared, the dates of publication, and the general areas reached.

Table 3.2.7-7 Legal Notices Published for Public Kickoff Meetings

Date of Notice	Publication Name	Area Reached
2/14/01	The Ambler Gazette	Ambler, PA
3/12/01	The Philadelphia Daily News	Philadelphia, PA
3/12/01	The Philadelphia Inquirer	Philadelphia, PA

3.2.7.3 Website

A website was developed for the project (www.schuylkillswa.org) in order to provide a location where information about the project could be easily accessed by the public and stakeholders (see Figure 3.2.7-5). Though this was a task beyond the scope of the contract, it was considered to be a necessary form of information delivery. Most importantly, the website was considered to be the best way of providing the advisory group meeting information, meeting handouts, and meeting minutes without producing a significant burden of production on staff, given that there are over 200 stakeholders to mail information to on a quarterly basis at minimum.

The website was set up to provide general information about the purpose of the SWAPs and who to contact for information. It also provided links to information about public meetings, advisory group meetings, meeting materials, general watershed information, limited maps, watershed organizations, and general water quality information. Another special feature was an on-line stakeholder survey that stakeholders could fill out information about their water quality issues.

Figure 3.2.7-5 Picture of Schuylkill River SWAP Website (www.schuylkillswa.org/)



3.2.8 PWD-Queen Lane Conclusions and Recommendations

The following discusses the findings of the assessment, and provides recommendations for projects and initiatives that are general for the entire watershed, regional, and intake specific. It also attempts to provide some specific examples of the best management practices that could be employed on some of the recommended projects.

Overall, the following activities were identified as having high priority for protection efforts to address:

- Sanitary Sewer Overflows of raw sewage from sewer collection systems, sewage lift stations, and manholes from upstream communities due to infiltration and inflow of stormwater into the sewer system or lack of wastewater treatment capacity.
- Combined Sewer Overflows from upstream communities such as Bridgeport and Norristown
- Communities discharging untreated sewage without proper sewage treatment such as New Philadelphia.
- Urban, residential, and agricultural runoff from various areas of the watershed, mostly located along the mainstem of the Schuylkill River from Reading to Philadelphia
- Discharges from municipal and industrial sources such as sewage treatment plants and chemical manufacturing facilities
- Acid Mine Drainage from Schuylkill County
- Spill and accidents from cars, tanker trucks, railroad cars, pipelines, tire piles, and fires at industrial facilities near the river and its tributaries

Table 3.2.8-1 summarizes the protection priorities assigned to the various types of sources overall and for each contaminant category. As shown, non-point sources and municipal or industrial discharges had the greatest overall priority compared to other sources.

It is important to note that just because an activity is given a high priority, that does not mean that any individual site is in violation of current environmental laws and regulations or negatively impacts the water quality at the facility. An activity with a high ranking means that it has the potential to negatively impact water supply quality under certain conditions.

Table 3.2.8-1 Summary of Protection Priority of Various Types of Potential Contaminant Sources

(A-C = significant protection priority, D-F = lower protection priority)

Contaminant Group	Permitted Municipal and Industrial Dischargers (NPDES)	Urban, Residential, and Agricultural Runoff	Industrial Facilities with Toxic Chemical Releases (TRI)	Hazardous Waste Facilities (RCRA)	AST (above ground storage tanks)	CERCLA (landfills, brownfields, etc.)	Overflows/ Discharges From Sewers	Acid Mine Drainage	Spills & Accidents
Overall (combined)	A-C	A-C	C	D-F	C	C	A	A	A
Chloride	D-F	A-C	A-C	D-F	A	C	D-F	D-F	A
<i>Cryptosporidium</i>	A-C	C	D-F	D-F	D-F	D-F	A	D-F	A
Fecal Coliforms	A-C	A-C	D-F	D-F	D-F	D-F	A	D-F	A
Metals	A-C	B-C	A-C	B-C	C	C	N/A	A	A
Nitrate	A-C	B-C	A-C	D-F	D-F	D-F	C	D-F	A
Petroleum Hydrocarbons	D-F	A-B	D-F	D-F	A-C	A	D-F	D-F	A
Phosphorus	A-C	C	A-C	D-F	A	D-F	C	D-F	A
Disinfection By Products	A-C	B-C	B-C	D-F	B	C	D-F	D-F	C
Turbidity	A-C	B-C	D-F	D-F	D-F	D-F	D-F	D-F	C
Volatile Organic Compounds	A	D-F	A-B	B-C	A-C	C	D-F	D-F	A
Herbicides/Pesticides	N/A	A	N/A	B-C	D-F	C	N/A	D-F	A
Radionuclides	A*	D-F	D-F	D-F	D-F	D-F	D-F	D-F	C

*only two locations

Note: if only one source fell into a protection priority, that rank was given to the type of source for a given contaminant group

Just because an activity is given a high priority does not mean that any individual site is in violation of current environmental laws and regulations. An activity with a high ranking means that it possibly can have a high potential to have negative impacts on water supply quality under certain conditions.

Geographically, most of the priority point sources for the Queen Lane Intake are located within priority non-point source watersheds. In fact, over 82 percent of the point sources fell within priority non-point source watershed areas. Over 90 percent of the high protection priority point sources fell within priority non-point source watershed areas. Therefore, it appears that in general protection and restoration efforts should be focused in those areas.

Tables 3.2.8-2 and 3.2.8-3 provide summaries of the protection priorities of point and non-point sources in various watershed areas. Overall, the primary protection areas in which to focus in order to protect and improve PWD's protection efforts include the mainstem areas of the Schuylkill River between Reading and Philadelphia, the Wissahickon Creek, and Perkiomen Creek. The Valley Creek, French Creek, and Tulpehocken Creeks appear to have secondary protection priority. However other parts of the watershed may need limited attention for contaminant specific issues (i.e. metals and acid mine drainage).

In reality however, water quality data and dye studies of the Wissahickon Creek show that its impacts are quite significant on source water quality and potentially significant sources in this watershed should be given extremely high priority. Under various conditions dye studies have shown that 11-28 percent of the water supply withdrawn by the Queen Lane intake originates from the Wissahickon Creek.

Table 3.2.8-2 Summary of Protection Priority Ranking of Various Mainstem Schuylkill Areas for Point and Non-point Sources

River Segment	Protection Priority			
	A High	B Moderately High	C Moderate	D-F Low
Philadelphia – Conshohocken	N & P			
Conshohocken – Norristown	N & P			
Norristown to Valley Forge	N & P			
Valley Forge to Phoenixville	N & P			
Phoenixville to Royersford	P			N
Royersford to Pottstown	P	N & P	P	
Pottstown to Douglassville	P	N & P	P	
Douglassville to Reading	P	N & P	P	
Reading to Leesport	P	N & P	P	
Upper Schuylkill	P*	P		N
Little Schuylkill River	P*			N

* untreated sewage communities and acid mine drainage only

Note : N – Non-point source runoff, P- Point sources

Table 3.2.8-3 Summary of Protection Priority Ranking of Various Tributaries for Point and Non-point Sources

Tributary / Watershed	Protection Priority			
	A High	B Moderately High	C Moderate	D-F Low
Wissahickon	N & P		P	
Perkiomen Creek	P	N & P	P	
Valley Creek		N	P	
Pickering Creek				N & P
French Creek				N & P
Manatawny Creek		N & P		
Monocacy Creek				N & P
Hay Creek				N & P
Allegheny Creek				N & P
Tulpehocken Creek			N & P	
Maiden Creek				N & P

Note : N – Non-point source runoff, P- Point sources

3.2.8.1 General Recommendations

Based on the results of the susceptibility analysis, water quality data, and stream impairments, it is clear that the impacts from stormwater runoff need to be addressed for the communities along the mainstem of the Schuylkill River from Reading to Philadelphia. Efforts to reduce these impacts require:

- Development of incentives for upstream communities to mitigate stormwater runoff;
- Education of township officials along the protection priority corridor about stormwater impacts;
- Preservation of existing greenspace along the Schuylkill River in the protection area;
- Acquisition of conservation easements or adjustment of zoning areas or local ordinances to reduce stormwater impacts from future development in the protection priority corridor between Philadelphia and Reading;
- Enforcement of the Phase II stormwater regulations for townships in the protection priority corridor between Philadelphia and Reading;
- Enforcement of compliance requirements for industries and municipalities discharging wastewater into the protection priority corridor between Philadelphia and Reading;
- Development and support of watershed or local community/environmental organizations to restore and protect various segments of the protection priority corridor between Philadelphia and Reading;

- Ensure that TMDL process and requirements along the Schuylkill River include components to address drinking water impacts;
- Development of special State or Federal legislation that provides funding and authority for water supply protection efforts in the protection priority corridor between Philadelphia and Reading.
- Include *Cryptosporidium* impacts in the permitting process for wastewater dischargers upstream of drinking water intakes.

In addition, the following actions are recommended for protection efforts in the Wissahickon Creek Watershed:

- Development of regulatory and financial incentives for enhanced wastewater discharge for pathogen removal and inactivation to address *Cryptosporidium* impacts;
- Development of incentives and controls for mitigation of stormwater runoff impacts. This includes requiring that current TMDL efforts in the watershed include specific components to address drinking water issues and concerns. This will provide an example of how the Safe Drinking Water Act and Clean Water Act should be integrated.
- Conduct an examination of current zonings and ordinances with the Montgomery County Planning Commission, Montgomery County Conservation District, and local townships to determine ways they can be enhanced to address current and future stormwater impacts. Identify areas where innovative techniques and incentives can be used to mitigate stormwater impacts and assist in the development and implementation of these efforts.
- Support of existing greenways, riparian corridor areas, and future riparian corridor easement and acquisition being conducted by the Wissahickon Valley Watershed Association and Montgomery County;
- Encourage and support the development of an Act 167 Stormwater Management Plan for the Wissahickon Creek.

The Philadelphia Suburban Water Company already works with numerous stakeholders to protect its water supply in the Perkiomen Creek. Therefore, it is recommended that any protection efforts be coordinated with the Philadelphia Suburban Water Company environmental initiatives and programs in the Perkiomen Creek Watershed.

In addition to the previous specific geographic recommendations, the following general efforts are recommended:

- Emergency Response Planning activities should be focused on priority AST, TRI, and RCRA facilities since they have been shown to have the greatest relative

impact on water quality. Efforts should also be initiated to collect more detailed data on these sites for reprioritization. Also, state authorities should be encouraged to implement a 2 hour notice requirement for downstream users from spills instead of allowing 24 hour requirement since most spills can make it to a number of intakes in less than a day under various conditions.

- Given the potential catastrophic impacts from spills and accidents, an early warning system similar to that on the Ohio River should be installed along the mainstem Schuylkill River to provide water suppliers warning and accurate real time data when spills and accidents occur. It is recommended that USGS should be involved in the implementation of the early warning system.
- Long-term protection efforts by PWD should be focused on enhancing wastewater discharges and mitigating stormwater runoff. These will have the greatest overall impacts on improving source water quality.
- Sources of pathogens appear to be the sources of greatest priority to PWD when examined in the overall rankings. Therefore, these sources should be addressed accordingly.
- Given the significant amount of activity in the watershed by various organizations, protection efforts should be coordinated in such a way as to support and enhance existing efforts in the watershed.
- A corporate environmental stewardship program should be developed to educate, provide incentives, and engage businesses in water supply protection and stormwater mitigation.
- A workshop should be sponsored by PADEP to educate golf courses about the benefits of joining the environmental certification program by the Audubon Society.
- Special mechanisms and funding should be developed to allow the distribution of monies to support or initiate specific initiatives outside the City of Philadelphia that will protect or restore the water supply. This may involve development of a quasi-governmental or non-profit organization that can raise funds and distribute them to various organizations conducting protection activities beneficial to PWD. This organization may also need the ability acquire conservation easements or land in sensitive areas to maintain protected areas.
- Efforts should be made to encourage PADEP and DRBC to address and prioritize the impacts of CSOs and untreated discharges of raw sewage upstream of drinking water intakes. Similar efforts should also be allocated for mitigation of acid mine drainage impacts.

3.2.8.2 Regional Recommendations

There are several regional recommendations based on the results of the study and stakeholder input. These include the following:

- Development of a regional watershed coalition or council for improved coordination of watershed activities and grant funding between watershed organizations, public agencies, municipalities, and planning commissions for water supply protection. This would include a special matching source water protection grant fund for the Schuylkill River Watershed that members would contribute to the state for matching. The watershed council including representatives from PADEP, water suppliers, counties, Schuylkill Riverkeeper, and other organizations would then review the grant applications and fund projects with the most value to water supply protection.
- Development of a coordinated regional protection plan that will be adopted by water suppliers, planning commissions, and municipalities for establishment and protection of sensitive and high priority protection areas to the multiple and overlapping water supply areas between Reading and Philadelphia.
- Enforcement of rigorous and regular revision and implementation of ACT 537 Sewage Facilities Management Plans in Montgomery, Chester, Berks, and Schuylkill Counties. In addition, the sewage facility related issues from the SWAs should be incorporated into the ACT 537 plan with emphasis on monitoring and measuring progress towards addressing identified problems.

Recommendation #1 – A Watershed Coalition and Local Source Water Protection Grant Funding Process

The development of a regional watershed coalition or council for improved coordination of watershed activities and grant funding between watershed organizations, public agencies, municipalities, and planning commissions for water supply protection is strongly needed in the watershed. The goal is to develop a partnership of state, public, and private organizations to specifically address and implement source water protection projects. Conceptually members of the coalition would be required to pay a membership fee to a state matching fund account. The membership fee would be based on the size of the organization and type of organization. For example, large water suppliers would be required to pay the largest membership fees (several thousand dollars) while small water suppliers would only be required a token \$50-\$100 fee. Planning commissions, public agencies, or environmental organizations would need to be determined.

The membership fee would be placed in a special state fund that is matched by that state for implementation of source water protection projects. Requests for proposals would be distributed to watershed organizations and other stakeholders to implement protection projects. Suggested locations and types of projects based on the results of the Source Water Assessments and regional source water protection plan will be recommended depending on the area of the project. Representatives from PADEP,

water suppliers, counties, Schuylkill Riverkeeper, and other organizations would then review the grant applications and recommend funding to projects with the most value to water supply protection.

For example, if the membership raised \$100,000 and was matched by PADEP into this special fund, a total of \$200,000 would be available for projects. This could fund four to five specific protection projects a year such as parking lot BMPs, streambank restoration, riparian buffer plantings, streambank fencing, detention pond retrofits, etc. This would result in potentially 20 coordinated and focused source water protection projects being implemented in high protection priority areas over four years. This positive interaction with local community organizations would also raise awareness of source water protection issues and increase public awareness and potentially spur other project partnerships between private, public, and community organizations beyond the confines of the grant process and the watershed coalition.

Recommendation #2 - A Regional Source Water Protection Plan For Protection of the Source Water Protection Priority Corridor from Philadelphia to Reading

The same high priority protection areas along the mainstem Schuylkill River from the SWAs of PWD's intakes overlaps significantly with the protection priority areas from SWAs for the Pennsylvania American Water Company – Norristown, Philadelphia Suburban Water Company, Phoenixville Boro, Citizen's Utilities – Royersford, and Pottstown Boro water supply intakes. Therefore, the development of a regional source water protection plan for these intakes would provide the necessary coordination of source water protection projects to prevent duplication, overlap, and conflicting source water protection efforts. This plan would designate "home" areas where each water supplier would lead specific localized efforts and "team" areas where all water suppliers shared interest and need to coordinate and organize efforts accordingly.

This protection corridor also warrants special assistance, as evidenced by stream impairments and recreational water quality issues. The runoff and point sources in this corridor impact the water supplies for the over 1.3 million people that receive drinking water from these sources in the Berks, Chester, Montgomery, and Philadelphia county area. Given that many industries also withdraw water for electric generation and the majority of persons in the watershed reside in or near the protection corridor and conduct recreation in or along it, the benefits to aquatic life, recreation, industry, and quality of life for citizens in general are significant and cannot be ignored. The protection priority corridor is also coincidentally the location of significant efforts for greenway creation and recreational trails. In this case, the desire for increased recreational opportunities and greenways coincides with a desire for greenways to protect water supplies and represents a significant opportunity for numerous stakeholders to benefit.

Priority for funding of Growing Greener and DCNR grants for projects in the protection priority area should be given to projects that address sustainable mitigation of stormwater impacts and restoration or preservation of areas. In addition, agricultural land within the protection priority corridor would also be given easier access and higher

priority for USDA funding such as EQIP or CRP to keep sensitive land areas out of production to protect local streams. PADEP and USDA could designate farms within the priority protection area as high priority for development of nutrient management plans. Townships located within the priority protection area should also be required to adopt uniform ordinances to address stormwater impacts from current and future activities.

Recommendation #3 – Rigorous Enforcement of Act 537 Sewage Facilities Management Plan Revision and Implementation

A number of the sewage related issues identified during the assessment were related to the operation, maintenance, and planning of sewer systems in the watershed. Therefore, rigorous enforcement of ACT 537 Sewage Facilities Management Plan revisions and implementation is required throughout Montgomery, Chester, Berks, and Schuylkill Counties. In addition, the sewage facility related issues from the SWAs should be incorporated into the ACT 537 Plan with emphasis on monitoring and measuring progress towards addressing identified problems. The ACT 537 already has many components in it designed to assist counties with addressing sewer overflow problems and be linked or integrated with Phase II stormwater compliance for municipalities since many overflows are stormwater related.

3.2.8.3 Intake Specific Recommendations: Example Project List and Best Management Practices

There are numerous specific projects that can be implemented throughout the watershed to protect and improve water supplies. The following list of projects provides a project title and location, potential project partners, and a general description of the components that could be incorporated into the protection project.

It may not be possible to implement all of the projects listed due to numerous unforeseen and unknown issues. Therefore, the list should be used as a resource to brainstorm and provide techniques for other projects that may be just as effective and valuable for source water protection. Specific descriptions and pictures of technologies and techniques that have been used locally or nationally to address a specific issue are provided in section 3.2.8.4 so that the reader can envision the mentioned technologies.

Some specific projects or initiatives include:

1. Stormwater Treatment Wetland at Maple Avenue, Ambler
2. Office Center & Business Parking Lot Runoff BMPs in Abington & Fort Washington
3. Residential runoff BMPs in Flourtown, Oreland, Fort Washington Abington, and Roslyn
4. Montgomeryville Mall parking lot BMPs and infiltration swales at Knapp Park to protect headwaters of Wissahickon Creek in Montgomeryville/Lansdale area

5. Improved urban runoff BMPs to protect the Wissahickon Creek headwaters in the Lansdale/Upper Gwynedd area
6. Acquisition, Riparian Buffer, and Water Quantity Addition During Low Flows from Coorsons Quarry/Lorraine Run in Whitmarsh Township
7. Extension of Riparian Buffer/Green Ribbon Preserve from Fort Washington State Park in Ambler to Lansdale
8. Chestnut Hill College roof and parking lot stormwater BMPs
9. Urban Runoff BMPs in Chestnut Hill, Germantown, and Andorra
10. Philadelphia University roof and parking lot runoff stormwater BMPs
11. Agricultural BMPs and educational program at Saul Agricultural High School
12. Venice Island and Manayunk Canal Development/Redevelopment Ordinances, Runoff Controls, and Best Management Practices
13. Lower Merion Township Riparian Buffer Protection & Stormwater Mitigation
14. Alternative Road Salt Technology Initiative
15. Mitigation of Illegal Sewage Discharges and Failing Septic Systems and Parkland Creation At River Road
16. Innovative Stormwater Controls for Redevelopment of Waterfront Properties in Conshohocken, Norristown, Bridgeport, and Pottstown Business & Industrial Parks
17. Best Management Practices at City and Suburban Golf Courses
18. Corporate Environmental Stewardship Program

Wissahickon Creek Projects & Initiatives

1. Stormwater Treatment Wetland at Maple Ave. in Ambler and Stormwater Detention Pond Retrofitting

Location: Ambler Borough

Partners: Wissahickon Valley Watershed Association, Temple University Ambler Campus, Ambler Borough, Lower Gwynedd, Whitpain, Upper Dublin Township

Description: A study should be conducted to examine the feasibility of converting the abandoned pond on Maple Ave. into a stormwater treatment wetland or augmentations to retain more stormwater runoff. If feasible, then implementation plans should be

developed and funding sources identified. Additional investigations of the conversion of existing detention basins into infiltration basins or stormwater treatment wetlands in the tri-township area around near Ambler should also be investigated. A similar project is being conducted by the Perkiomen Watershed Conservancy in the Perkiomen Creek Watershed through a growing greener grant.

2. Office Center & Business Parking Lot Runoff BMPs in Abington/Fort Washington

Location: Fort Washington area, Sandy Run watershed

Partners: Fort Washington Office Center, businesses, Abington, Upper Dublin, and Springfield Township

Description: A series of coordinated stormwater controls should be implemented to reduce and treat stormwater runoff from the large impervious parking areas in the watersheds. This could include special infiltration swales and infiltration basins in and around the office center or simple retrofits of the detention basins.

3. Residential Runoff BMPs in Flourtown, Oreland, Fort Washington, Abington, and Roslyn

Location: Flourtown, Oreland, Fort Washington, Abington, and Roslyn

Partners: Abington, Upper Dublin, Springfield Township, Fort Washington State Park, and the Wissahickon Valley Watershed Association

Implement a series of coordinated stormwater controls to reduce and treat stormwater runoff from the large impervious parking areas in the watersheds. This could include special infiltration swales and infiltration basins in and around the office center or simple retrofits of the detention basins. In addition, the township should work with the local country clubs along the Sandy Run and Wissahickon to determine if stormwater control projects can be implemented on township or bordering country club properties. For example redirecting a portion of the runoff from the densely packed residential neighborhoods near the country clubs and township parklands into small treatment wetlands, detention ponds, infiltration swales, or combinations of these techniques could reduce stormwater runoff issues in the area. Examples of open space available for such projects which could include educational and open space enhancements include Roslyn Park, Ardsley Park, Burn Brae Park, Penbryn Park, and the many country clubs in the area as well as portions of Fort Washington State Park provide available space for potential opportunities.

4. Montgomeryville Mall parking lot BMPs and infiltration swales at Knapp Park to protect Wissahickon Creek headwaters

Knapp Park could be utilized in order to better retain and infiltrate stormwater from the Montgomeryville Mall if BMPs cannot be implemented on mall property to improve infiltration and water quality. This would help aid in temperature shocks to biologicals as well as reduce pollutant loadings from parking lot runoff and stream erosion.

5. Urban Runoff BMPs to protect the Wissahickon Creek Headwaters in Lansdale/Upper Gwynedd

Location: Lansdale and Upper Gwynedd

Description: A demonstration project that includes a series of BMPs such as redirecting urban stormwater runoff from an area of Lansdale into infiltration basins or swales should be implemented.

6. Riparian Buffer Acquisition and Water Quantity Addition During Low Flows from Coorsons Quarry/Lorraine Run in Whitemarsh Township

Partners: Philadelphia Cricket Club, Whitemarsh Twp, and Fort Washington State Park

Description: Measurements have shown that currently the Coorson's Quarry discharges several million gallons of water per day into Lorraine Run and ultimately the Wissahickon Creek. This is a significant dry weather flow that is necessary in diluting the impacts of wastewater discharge at the headwaters of the stream especially during drought periods. Without this flow, the relative percentage of wastewater discharge to flow would increase dramatically during low or stable flow periods. The quantity of the groundwater discharge in this area is necessary for not only dilution, but biological communities. The loss of this discharge would only exacerbate the "flashiness" of the stream and increase streambank erosion. Since the future of the quarry is not known, efforts should be made to determine the longevity of the quarry and purchase the property and water rights or withdrawal permits from the quarry to continue to maintain the discharge rates. This may be done by individual organizations or even a combination of DCNR/Fort Washington State Park, the Philadelphia Cricket Club, and Whitemarsh Township. Even simply developing an agreement with the quarry to the water rights for the site upon sale to any future owner could be helpful.

7. Extension of Riparian Buffer/Green Ribbon Preserve from Fort Washington State Park in Ambler to Lansdale

Partners WVWA & DCNR

Description: Continued support for acquisition of land through purchase and easements to complete the riparian buffer along the Wissahickon Creek.

8. Chestnut Hill College roof and parking lot stormwater BMPs

Location: Chestnut Hill College, Philadelphia

Partners: Chestnut Hill College, PWD, and Morris Arboretum

Description: A number of the stormwater BMPs that have been initiated at Morris Arboretum such as porous pavement, streambank stabilization, and infiltration swales should be implemented at the adjacent property at Chestnut Hill College. This could be part of an environmental curriculum at the college where students monitor the effectiveness of these practices. These practices include, but are not limited to rain barrels on small buildings, porous pavement, infiltration swales, riparian filter strips, etc.

9. Urban Runoff BMPs in Chestnut Hill, Germantown, and Andorra

Partners: Philadelphia Water Department, Fairmount Park Commission, Andorra Shopping Center, Summit Park Apartments, Henry on the Park Apartments, Andorra Civic Association, etc.

Location: Andorra, Germantown, Chestnut Hill

Description: The project would include a series of BMPs to reduce parking lot and roof runoff while encouraging infiltration into the groundwater table. These include tree shading/cover for large parking areas with infiltration swales in parking medians. Parking curb islands converted into infiltration swales and the placement of medians with trees and infiltration swales in large steeply sloped parking areas to slow down runoff and reduce temperature impacts during summer. The development of an interconnected rain gardens to withhold and treat roof runoff from the large apartment complexes is also recommended. Installation of treatment wetlands or additional infiltration basins below these large areas would also be useful. Installation of “greenscape” rooftops for large commercial facilities could also be explored.

10. Philadelphia University roof and parking lot runoff stormwater BMPS

Location: Philadelphia University

Partners: United States Army Corps of Engineers, Fairmount Park Commission, Philadelphia Water Department, and Philadelphia University

Description: The stormwater runoff from the university complex can be reduced through a number of improved practices including examination of detention pond utilization, development of infiltration swales, and other techniques. Students involved in environmental service learning projects and environmental programs could participate in design, implementation, and monitoring effectiveness of any stormwater BMPs that are installed or operated.

11. Agricultural BMPS and educational program at Saul Agricultural School

Partners: USDA, Philadelphia School District, Philadelphia Water Department

Description: Develop an educational program that includes the development and implementation of a good environmental practices plan with school students and faculty at Saul Agricultural High School. This includes developing grass filter strips and infiltration swales to capture runoff and remove pollutants from pastureland and barnyard runoff.

Mainstem Schuylkill River Projects

1. Extension of the Belmont Intake Protection Area Meadow

Location: West River Drive, Fairmount Park

Partners: Philadelphia Water Department, Fairmount Park Commission

Description: This project would extend the current demonstration meadow at the Belmont Intake and extend it approximately 0.25 miles upstream to the Strawberry Mansion Bridge. This would provide a riparian buffer to reduce runoff and erosion impacts near the intake as well as deter geese. The area would have interpretive and educational signing included to educate park users about the source of their water.

2. Venice Island and Manayunk Canal Development/Redevelopment Ordinances, Runoff Controls, and Best Management Practices

Location: Venice Island / Manayunk Canal

Partners: Manayunk Development Corporation, Philadelphia Planning Commission, Developers, Philadelphia Streets Department, Philadelphia Water Department, Fairmount Park Commission

Description: The development of a focused stormwater plan for this highly developed area should include special ordinances should be developed for the Manayunk / Venice Island Area that require the installation of appropriate technologies to treat and/or reduce the amount or intensity of runoff from parking lots and rooftops prior to discharge into the Manayunk Canal or Schuylkill River. It would also include a program of several focused public/private partnership projects to reduce and/or treat stormwater runoff from parking lots and rooftops. This could include the use of rainbarrels, development of raingardens on vacant lots, infiltration swales or ditches in parking lots, and planting of trees in parking lots to reduce temperature impacts.

3. Lower Merion Township Riparian Buffer Protection & Stormwater Mitigation

Location: Saw Mill Run, Mill Creek, and Gulley Run.

Partners: Lower Merion Township, Lower Merion Conservancy, Philadelphia Water Department, Philadelphia Country Club

Description: Develop ordinances preventing mowing of streambank areas while identifying partners for streambank plantings to reduce erosion or demonstrate aesthetically pleasing alternatives to mowed streambanks. A series of projects to reduce stormwater runoff could be implemented in areas of high impervious cover that have no runoff controls such as detention basins. In these areas projects such as infiltration ditches and swales for ground runoff or rain barrels for roof runoff should be piloted.

4. Alternative Road Salt Technology Initiative

Location(s): West River Drive, Kelly Drive, Chestnut Hill, Manayunk, Belmont, City Line Avenue, Lower Merion Township

Partners: Manayunk Development Corporation, Philadelphia Streets Department, Philadelphia Water Department, Pennsylvania Department of Environmental Protection, Lower Merion Township

Another component would also include testing alternative technologies to reduce the amount of salt applied to roads and parking lots in the area during the winter while maintaining safety. This could include finding funding sources to acquire special “fogging” machines that put down light mists of salt water on a road that require less salt application on an area.

5. Mitigation of Illegal Sewage Discharges and Failing Septic Systems and Greenspace Creation At River Road

Location: River Road, Philadelphia

Partner: Federal Emergency Management Agency, The State of Pennsylvania, The City of Philadelphia, and Schuylkill Environmental Education Center

Description: Failing septic systems or illegal sewage discharges into the river upriver from floodplain properties on River Road, jeopardize the recreational water quality of the Schuylkill River and the entrance to the Manayunk Canal. A long term program of acquisition of the properties to link the Schuylkill Environmental Education Center and Fairmount Park area along the canal to the Philadelphia City limits would eliminate these discharges and reduce future issues with floodplain development in the area.

6. Innovative Stormwater Controls for Redevelopment of Waterfront Properties in Conshohocken, Norristown, Bridgeport, and Pottstown Business & Industrial Parks

Location: Riverfront Areas along Conshohocken, Norristown, Bridgeport, and Pottstown

Partners: Municipalities, Montgomery County Planning Commission, Philadelphia Water Department, Pennsylvania American Water Company, Philadelphia Suburban Water Company, Montgomery County Conservation District

Description: This project includes installation of new technologies to treat and/or reduce the amount or intensity of runoff from parking lots and rooftops prior to discharge into the Schuylkill River. It would also include a program of several focused public/private partnership projects to reduce and/or treat stormwater runoff from parking lots and rooftops. This could include the use of rainbarrels, development of raingardens on vacant lots, infiltration swales or ditches in parking lots, pervious pavement, conversion of detention basins into treatment wetlands, and planting of trees in parking lots to reduce temperature impacts and reduce rainfall that reaches the pavement. These technologies could be implemented upon initial construction/redevelopment or be added to currently redeveloped areas in such a way as to improve aesthetics.

7. Encouraging Best Management Practices at City and Suburban Golf Courses

Location(s): Walnut Lane Golf Course, Philadelphia Country Club, and Eagle Lodge Country Club

Partners: Philadelphia Water Department, Lower Merion Township, Whitemarsh Township, Philadelphia Department of Recreation, Riverbend Environmental Education Center, Schuylkill Environmental Education Center, Philadelphia Country Club, and Eagle Lodge Country Club

Description: The three golf courses mentioned are located in high priority areas for source water protection. The owners, managers, and members of the golf course need to be educated about the importance of their property and how significant it is to the protection of the water supply. Also, efforts should be made to inventory and examine the environmental practices of the golf courses to identify improvements that can be made over time. One specific way is to encourage the golf courses to obtain Audubon

certification that requires such a process and certain levels of success. Since the two country clubs are located nearby two very active environmental centers with good education programs and members of both the country clubs may also be members of the environmental centers, they should be involved in the process to maximize education opportunities and build neighborhood public-private environmental relationships.

8. A Corporate Environmental Stewardship Program

Project Partners: PWD, Partnership for the Delaware Estuary, Chester County Water Resources Authority, Schuylkill Environmental Education Center, Schuylkill Riverkeeper

Description: A program that engages, educates, and rewards businesses for participating in and completing various levels of source water protection should be established. The goals of this program include the following:

- Increase businesses awareness about the water supply and runoff impacts
- Provide opportunities for businesses to engage in piloting, demonstrating, or implementing various activities to reduce runoff from their location or other location(s) identified by stakeholders

3.2.8.4 Data Needs

Based on the various analyses that were conducted to identify specific sources of contamination, their location, and other characteristics, the following data gaps and information needs were identified.

Study of Cryptosporidium Presence in Wastewater Effluents

The national guidance documents for the SWAPs and DEP's own SWAP process has very specific interests in identifying and ranking sources of *Cryptosporidium*. However, the information, data, and tools were not available at the local level for an accurate analysis of this information. Preliminary studies by the Philadelphia Water Department, Philadelphia Suburban Water Company, and the PADEP have detected *Cryptosporidium* frequently at elevated levels in raw and treated sewage. The potential contribution of the pathogen *Cryptosporidium* from wastewater discharges, unsewered communities, and illicit discharges upstream of drinking water supplies is necessary to understand the daily impacts they have on pathogen challenges to the water treatment plants downstream. This could lead to strategies to reduce routine levels or viability of *Cryptosporidium* from discharges and better protect water supplies. Over the past three years, the Water Environment Research Federation has been conducting a research method to accurately detect and quantify levels of *Cryptosporidium* in wastewater. This study is almost complete and it is recommended that local studies that are conducted use this new method.

Shared GIS Information

Compilation and housing of up to date GIS information for upstream municipalities including sewer and stormsewer infrastructure characteristics (sewersheds, outfalls), zoning areas, ACT 167 information, preserved or potentially preserved agricultural land, county and township parklands, lands with conservation easements. Better information on abandoned or historical industrial sites and brownfields is also needed. Suggested partners interested in housing this information include the Delaware River Basin Commission.

3.2.8.5 Selection of Best Management Practices in Proposed Protection Projects

Selection of best management practices (BMPs) requires the careful weighting of various factors including capital and operational costs, land consumption, and effectiveness. This section describes the various costs and choices when selecting any bmps.

There are two types of BMPs that can be employed to address stormwater runoff, structural and non-structural. Structural practices usually involve the construction of some control structure or device. Non-structural practices usually involve activities that include changing public behavior and land use practices through education, training, and legal requirements. A comprehensive list of these practices is provided below in Tables 3.2.8-4 and 3.2.8-5.

Table 3.2.8-4 Structural BMPs for Stormwater Control

Ponds
Dry extended detention ponds
Wet ponds
Infiltration practices
Infiltration basin
Infiltration trench
Porous pavement
Filtration practices
Bio-retention
Sand and organic filters
Vegetative practices
Storm water wetland
Grassed swales
Grassed filter strip
Runoff pretreatment practices
Catch basins/Catch basin insert
In-line storage
Manufactured products for storm water inlets

Table 3.2.8-5 Nonstructural BMPs for Stormwater Control

Experimental practices
Alum injection
On-lot Treatment
On-Lot treatment
Better site design
Buffer zones
Open space design
Urban forestry
Conservation easements
Infrastructure planning
Narrower residential streets
Eliminating curbs and gutters
Green parking
Alternative turnarounds
Alternative pavers
BMP inspection and maintenance
Ordinances for post-construction runoff
Zoning

Employment and selection of the various structural bmp techniques and technologies requires additional familiarity with the pros and cons of the technologies, site selection and design issues, operation and maintenance and costs. Tables 3.2.8-6 and 3.2.8-7 provide examples of estimates of capital and maintenance costs of various structural bmps. Table 3.2.8-8 provides estimated land consumption for various structural bmps. Table 3.2.8-9 provides a description of the various contaminants non-structural bmps can address. Tables 3.2.8-10 through 14 provide data on the effectiveness of pollutant removal by various bmps. These tables are taken directly from EPA's website at **URL:** http://www.epa.gov/ost/stormwater/usw_d.pdf.

Table 3.2.8-6 Base Costs of Typical Applications of Storm Water BMPs

BMP Type	Typical Cost (\$/BMP)	Application	Data Source
Retention Basin	\$100,000	50-Acre Residential Site (Impervious Cover – 35%)	Adapted from Brown and Schueler (1997b)
Wetland	\$125,000	50-Acre Residential Site (Impervious Cover – 35%)	Adapted from Brown and Schueler (1997b)
Infiltration Trench	\$45,000	5-Acre Commercial Site (Impervious Cover – 65%)	Adapted from SWRPC (1991)
Infiltration Basin	\$15,000	5-Acre Commercial Site (Impervious Cover – 65%)	Adapted from SWRPC (1991)
Sand Filter	\$35,000-\$70,000 ^{2,3}	5-Acre Commercial Site (Impervious Cover – 65%)	Adapted from Brown and Schueler (1997b)
Bioretention	\$60,000	5-Acre Commercial Site (Impervious Cover – 65%)	Adapted from Brown and Schueler (1997b)
Grass Swale	\$3,500	5-Acre Residential Site (Impervious Cover – 35%)	Adapted from SWRPC (1991)
Filter Strip	\$0-\$9,000 ³	5-Acre Residential Site (Impervious Cover – 35%)	Adapted from SWRPC (1991)

1. Base costs do not include land costs.

2. Total capital costs can typically be determined by increasing these costs by approximately 30%.

3. A range is given to account for design variations.

Source: http://www.epa.gov/ost/stormwater/usw_d.pdf

Table 3.2.8-7 Operation and Maintenance Cost Estimates

BMP	Annual Maintenance Cost (% of Construction Cost)	Source(s)
Retention Basins and Constructed Wetlands	3%-6%	Wiegand et al, 1986 Schueler, 1987 SWRPC, 1991
Detention Basins ¹	<1%	Livingston et al, 1997; Brown and Schueler, 1997b
Constructed Wetlands ¹	2%	Livingston et al, 1997; Brown and Schueler, 1997b
Infiltration Trench	5%-20%	Schueler, 1987 SWRPC, 1991
Infiltration Basin ¹	1%-3%	Livingston et al, 1997; SWRPC, 1991
	5%-10%	Wiegand et al, 1986; Schueler, 1987; SWRPC, 1991
Sand Filters ¹	11%-13%	Livingston et al, 1997; Brown and Schueler, 1997b
Swales	5%-7%	SWRPC, 1991
Bioretention	5%-7%	(Assumes the same as swales)
Filter strips	\$320/acre (maintained)	SWRPC, 1991

1. Livingston et al (1997) reported maintenance costs from the maintenance budgets of several cities, and percentages were derived from costs in other studies

Table 3.2.8-8 Land Consumption of Various BMPs

BMP Type	Land consumption (% of Impervious Area)
Retention Basin	2-3%
Constructed Wetland	3-5%
Infiltration Trench	2-3%
Infiltration Basin	2-3%
Porous Pavement	0%
Sand Filters	0%-3%
Bioretention	5%
Swales	10%-20%
Filter Strips	100%

Note: Represents the amount of land needed as a percent of the impervious area that drains to the practice to achieve effective treatment.

Source: Claytor and Schueler, 1996

Source: http://www.epa.gov/ost/stormwater/usw_d.pdf

Table 3.2.8-9 Non-Structural BMPs Suited to Controlling Various Pollutants
Pollutant Appropriate BMPs

	BMPs
Solids	Street Sweeping Land Use Modifications
Oxygen-Demanding Substances	Street Sweeping Education: Storm Drain Stenciling Land Use Modifications Education: Pet Scoop Ordinance Illicit Connections Eliminated
Nitrogen and Phosphorus	Street Sweeping Education: Pet Scoop Ordinance Land Use Modifications Proper Materials Handling Illicit Connections Eliminated Education: Lawn Care Materials Storage and Recycling
Pathogens	Illicit Connections Eliminated Land Use Modifications Education: Pet Scoop Ordinance
Petroleum Hydrocarbons	Street Sweeping Education: Storm Drain Stenciling Proper Materials Handling Illicit Connections Eliminated Materials Storage and Recycling Land Use Modifications
Metals	Street Sweeping Education: Storm Drain Stenciling Proper Materials Handling Illicit Connections Eliminated Materials Storage and Recycling Land Use Modifications
Synthetic Organic Compounds	Illicit Connections Eliminated Education: Storm Drain Stenciling Proper Materials Handling Education: Lawn Care Materials Storage and Recycling Land Use Modifications
Temperature	Land Use Modifications
pH	Illicit Connections Eliminated Proper Materials Handling Materials Storage and Recycling Land Use Modifications

Source: http://www.epa.gov/ost/stormwater/usw_d.pdf

Table 3.2.8-10 Structural BMP Expected Pollutant Removal Efficiency

BMP Type	Typical Pollutant Removal (percent)				
	Suspended Solids	Nitrogen	Phosphorus	Pathogens	Metals
Dry Detention Basins	30 - 65	15 - 45	15 - 45	< 30	15 - 45
Retention Basins	50 - 80	30 - 65	30 - 65	< 30	50 - 80
Constructed Wetlands	50 - 80	< 30	15 - 45	< 30	50 - 80
Infiltration Basins	50 - 80	50 - 80	50 - 80	65 - 100	50 - 80
Infiltration Trenches/ Dry Wells	50 - 80	50 - 80	15 - 45	65 - 100	50 - 80
Porous Pavement	65 - 100	65 - 100	30 - 65	65 - 100	65 - 100
Grassed Swales	30 - 65	15 - 45	15 - 45	< 30	15 - 45
Vegetated Filter Strips	50 - 80	50 - 80	50 - 80	< 30	30 - 65
Surface Sand Filters	50 - 80	< 30	50 - 80	< 30	50 - 80
Other Media Filters	65 - 100	15 - 45	< 30	< 30	50 - 80

Source: Adapted from US EPA, 1993c.

Table 3.2.8-11 Pollutant Removal by Infiltration Practices

Parameter	Median or Average Removal Efficiency (percent)	Number of Observations
Total Phosphorus	65	5
Ammonia-Nitrogen	83	3
Nitrate	82	3
Total Nitrogen	83	2
Suspended Solids	89	2
Organic Carbon	82	1
Lead	98	1
Zinc	99	1

Source: Brown and Schueler, 1997a

Source: http://www.epa.gov/ost/stormwater/usw_d.pdf

Table 3.2.8-12 Pollutant Removal by Retention Basins

Parameter	Median or Average Removal Efficiency (percent)	Range of Removals (percent)		Number of Observations
		Low	High	
Soluble Phosphorus	34	-12	90	20
Total Phosphorus	46	0	91	44
Ammonia-Nitrogen	23	-107	83	14
Nitrate	23	-85	97	27
Organic Nitrogen	23	2	34	6
Total Nitrogen	30	-12	85	24
Suspended Solids	70	-33	99	43
Bacteria	74	-6	99	10
Organic Carbon	35	-30	90	29
Cadmium	47	-25	54	5
Chromium	49	25	62	5
Copper	55	10	90	18
Lead	67	-97	95	34
Zinc	51	-38	96	32

Source: Brown and Schueler, 1997a

Source: http://www.epa.gov/ost/stormwater/usw_d.pdf

Table 3.2.8-13 Pollutant Removal Efficiency of Constructed Wetland Systems

Parameter	Median Removal Efficiency (percent)	Range of Removals (percent)		Number of Observations
		Low	High	
Soluble Phosphorus	23	-30	78	12
Ortho-Phosphate	28	-109	93	7
Total Phosphorus	46	-120	97	37
Ammonia-Nitrogen	33	-86	62	15
Nitrate	46	4	95	18
Organic Nitrogen	7	-36	39	7
Total Nitrogen	24	-20	83	11
Suspended Solids	76	-300	98	26
Bacteria	78	55	97	3
Organic Carbon	28	-31	93	15
Cadmium	69	-80	80	6
Chromium	73	38	98	3
Copper	39	2	84	10
Lead	63	23	94	17
Zinc	54	-74	90	16

Sources: Strecker et al (1992); Organic Carbon, Bacteria and Metals from Brown and Schueler, 1997a

Source: http://www.epa.gov/ost/stormwater/usw_d.pdf

Table 3.2.8-14 Pollutant Removal Efficiency of Open Channel Vegetated Systems

Parameter	Average or Median Removal Efficiency (percent)	Range of Removals (percent)		Number of Observations
		Low	High	
Soluble Phosphorus	11	-45	72	8
Total Phosphorus	15	-100	99	18
Ammonia-Nitrogen	3	-19	78	4
Nitrate	11	-100	99	13
Organic Nitrogen	39	11	86	3
Total Nitrogen	11	-100	99	10
Suspended Solids	66	-100	99	18
Bacteria	-25	-100	0	5
Organic Carbon	23	-100	99	11
Cadmium	49	20	80	6
Chromium	47	14	88	5
Copper	41	-35	89	15
Lead	50	-100	99	19
Zinc	49	-100	99	19

Source: Brown and Schueler, 1997a

Source: http://www.epa.gov/ost/stormwater/usw_d.pdf

3.2.8.6 Descriptions and Pictures of Technologies for Stormwater Control

Though many technologies are recommended for use of best management practices, not everyone can envision how they would look and operate. The following section provides descriptions and pictures of these technologies. More detailed information such as design criteria, pros and cons to construction and operation, technical fact sheets, effectiveness, and various diagrams are also provided on EPA's websites at the following URLs.

<http://www.epa.gov/npdes/menuofbmps/post.htm>

http://www.epa.gov/ost/stormwater/usw_c.pdf

The following descriptions have been taken from these websites to provide the reader with descriptions of the following BMP technologies and techniques:

- Infiltration trenches
- Bio-retention areas
- Stormwater wetlands
- Infiltration basins
- Wet ponds
- Dry extended detention ponds
- Grass filter strips
- Grass swales
- Green parking
- Porous pavement
- Sand and organic filters
- Catch basins and inserts
- Storm water inlet products
- Log veins and coir fabric for streambank restoration

Bio-retention Areas

Post-construction Storm Water Management in New Development and Redevelopment



Bioretention areas can be used in parking areas to collect and treat storm water (Source: University of Maryland, 2000)

Description

Bio-retention areas are landscaping features adapted to provide on-site treatment of storm water runoff. They are commonly located in parking lot islands or within small pockets of residential land uses. Surface runoff is directed into shallow, landscaped depressions. These depressions are designed to incorporate many of the pollutant removal mechanisms that operate in forested ecosystems. During storms, runoff ponds above the mulch and soil in the system. Runoff from larger storms is generally diverted past the facility to the storm drain system. The remaining runoff filters through the mulch and prepared soil mix.

Typically, the filtered runoff is collected in a perforated under-drain and returned to the storm drain system.

Infiltration Basin

Postconstruction Storm Water Management in New Development and Redevelopment



Infiltration basins are designed to collect storm water from impervious areas and provide pollutant removal benefits through detention and filtration

Description

An infiltration basin is a shallow impoundment that is designed to infiltrate storm water into the ground water. This practice is believed to have a high pollutant removal efficiency and can also help recharge the ground water, thus restoring low flows to stream systems. Infiltration basins can be challenging to apply on many sites, however, because of soils requirements. In addition, some studies have shown relatively high failure rates compared with other management practices.

Storm Water Wetland
Post-construction Storm Water Management
in New Development and Redevelopment



A storm water wetland detains storm water, removes pollutants, and provides habitat and aesthetic benefits (Source: The Bioengineering Group, Inc., no date)

Description

Storm water wetlands (a.k.a. constructed wetlands) are structural practices similar to wet ponds (see [Wet Pond](#) fact sheet) that incorporate wetland plants into the design. As storm water runoff flows through the wetland, pollutant removal is achieved through settling and biological uptake within the practice. Wetlands are among the most effective storm water practices in terms of pollutant removal and they also offer aesthetic value.

Although natural wetlands can sometimes be used to treat storm water runoff that has been properly pretreated, storm water

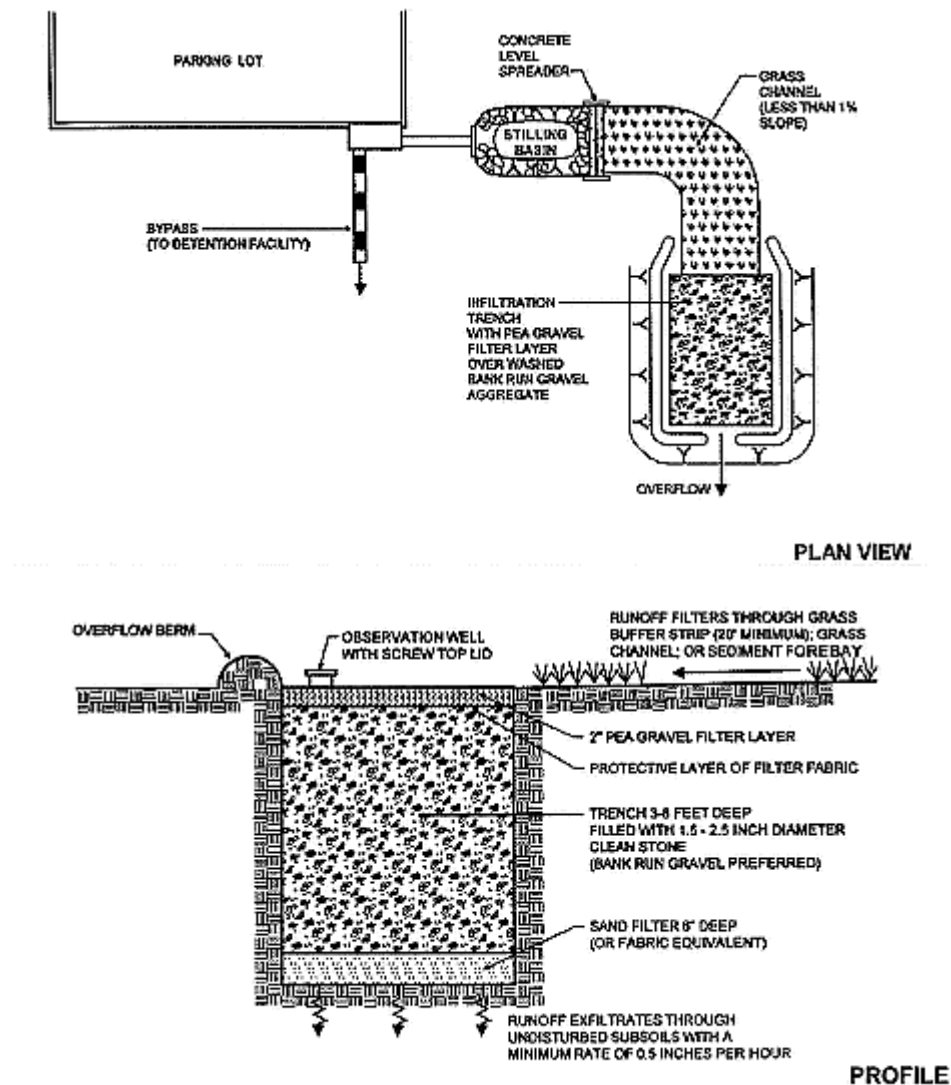
wetlands are fundamentally different from natural wetland systems. Storm water wetlands are designed specifically for the purpose of treating storm water runoff, and typically have less biodiversity than natural wetlands in terms of both plant and animal life. Several design variations of the storm water wetland exist, each design differing in the relative amounts of shallow and deep water, and dry storage above the wetland. A distinction should be made between using a constructed wetland for storm water management and diverting storm water into a natural wetland. The latter practice is not recommended because altering the hydrology of the existing wetland with additional storm water can degrade the resource and result in plant die-off and the destruction of wildlife habitat. In all circumstances, natural wetlands should be protected from the adverse effects of development, including impacts from increased storm water runoff. This is especially important because natural wetlands provide storm water and flood control benefits on a regional scale.

Infiltration Trench

Post-construction Storm Water Management in New Development and Redevelopment

Description

An infiltration trench (a.k.a. infiltration galley) is a rock-filled trench with no outlet that receives storm water runoff. Storm water runoff passes through some combination of pretreatment measures, such as a swale and detention basin, and into the trench. There, runoff is stored in the void space between the stones and infiltrates through the bottom and into the soil matrix. The primary pollutant removal mechanism of this practice is filtering through the soil.



A schematic of an infiltration trench (Source: MDE, 2000)

Grassed Filter Strip
Post-construction Storm Water Management
in New Development and Redevelopment



Grassed filter strips protect water quality by filtering pollutants before they reach the water (Source: USDA, 1997)

Description

Grassed filter strips (vegetated filter strips, filter strips, and grassed filters) are vegetated surfaces that are designed to treat sheet flow from adjacent surfaces. Filter strips function by slowing runoff velocities and filtering out sediment

and other pollutants, and by providing some infiltration into underlying soils. Filter strips were originally used as an agricultural treatment practice, and have more recently evolved into an urban practice. With proper design and maintenance, filter strips can provide relatively high pollutant removal. One challenge associated with filter strips, however, is that it is difficult to maintain sheet flow, so the practice may be "short circuited" by concentrated flows, receiving little or no treatment.

Grassed Swales
Post-construction Storm Water Management
in New Development and Redevelopment



Grassed swales can be used along roadsides and parking lots to collect and treat storm water runoff

Description

The term swale (a.k.a. grassed channel, dry swale, wet swale, bio-filter) refers to a series of vegetated, open channel management practices designed specifically to treat and attenuate storm water runoff for a specified water quality volume. As storm water runoff flows through these channels, it is treated through filtering by the vegetation in the channel, filtering through a subsoil matrix, and/or infiltration into the underlying soils. Variations of the grassed swale include the grassed channel, dry swale, and wet swale. The specific design features and methods of treatment differ in

each of these designs, but all are improvements on the traditional drainage ditch. These designs incorporate modified geometry and other features for use of the swale as a treatment and conveyance practice.

Wet Ponds

Post-construction Storm Water Management in New Development and Redevelopment



The primary functions of a wet pond are to detain storm water and facilitate pollutant removal through settling and biological uptake

Description

Wet ponds (a.k.a. storm water ponds, retention ponds, wet extended detention ponds) are constructed basins that have a permanent pool of water throughout the year (or at least throughout the wet season). Ponds treat incoming storm water runoff by settling and algal uptake. The primary removal mechanism is settling as storm water runoff resides in this pool, and pollutant uptake, particularly of nutrients, also occurs through biological activity in the pond. Wet ponds are among the most cost-effective and widely used storm water

practices. While there are several different versions of the wet pond design, the most common modification is the extended detention wet pond, where storage is provided above the permanent pool in order to detain storm water runoff in order to provide settling.

Dry Extended Detention Pond

Post-construction Storm Water Management in New Development and Redevelopment



A dry extended detention pond is designed to temporarily detain runoff during storm events

Description

Dry extended detention ponds (a.k.a. dry ponds, extended detention basins, detention ponds, extended detention ponds) are basins whose outlets have been designed to detain the storm water runoff from a water quality design storm for some minimum time (e.g., 24 hours) to allow particles and associated pollutants to settle. Unlike wet ponds, these facilities do not have a large permanent pool. However, they are often designed with small pools at the inlet and outlet of the basin. They can also be used to provide flood control by including additional flood detention storage.

***Porous Pavement
Post-construction Storm Water Management
in New Development and Redevelopment***



A porous pavement parking lot (Source: Invisible Structures, no date)

Description

Porous pavement is a permeable pavement surface with an underlying stone reservoir to temporarily store surface runoff before it infiltrates into the subsoil. This porous surface replaces traditional pavement, allowing parking lot storm water to infiltrate directly and receive water quality treatment. There are a few porous pavement options, including porous asphalt, pervious concrete, and grass pavers. Porous asphalt and pervious concrete appear to be the same as traditional pavement from the surface, but are manufactured without "fine" materials, and incorporate void spaces to allow infiltration. Grass pavers are

concrete interlocking blocks or synthetic fibrous gridded systems with open areas designed to allow grass to grow within the void areas. Other alternative paving surfaces can help reduce the runoff from paved areas but do not incorporate the stone trench for temporary storage below the pavement (see [Green Parking](#) fact sheet). While porous pavement has the potential to be a highly effective treatment practice, maintenance has been a concern in past applications of the practice.

***Green Parking
Post-construction Storm Water Management
in New Development and Redevelopment***



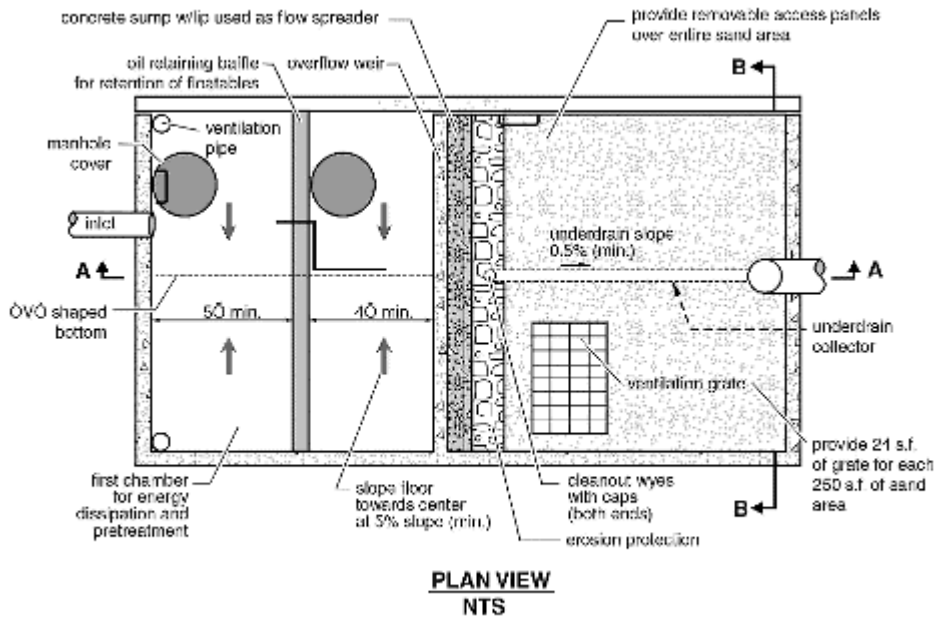
A green parking lot at the Orange Bowl in Miami, Florida (Source: Invisible Structures, no date)

Description

Green parking refers to several techniques applied together to reduce the contribution of parking lots to the total impervious cover in a lot. From a storm water perspective, application of green parking techniques in the right combination can dramatically reduce impervious cover and, consequently, the amount of storm water runoff. Green parking lot techniques include setting maximums for the number of parking lots created, minimizing the

dimensions of parking lot spaces, utilizing alternative pavers in overflow parking areas, using bioretention areas to treat storm water, encouraging shared parking, and providing economic incentives for structured parking.

Sand and Organic Filters Postconstruction Storm Water Management in New Development and Redevelopment



Schematic of a sand filter (Source: King County, Washington, 2000)

Description

Sand filters are usually two-chambered storm water practices; the first is a settling chamber, and the second is a filter bed filled with sand or another filtering media. As storm water flows into the first chamber, large particles settle out, and then finer particles and other pollutants are removed as storm water flows

through the filtering medium. There are several modifications of the basic sand filter design, including the surface sand filter, underground sand filter, perimeter sand filter, organic media filter, and Multi-Chamber Treatment Train. All of these filtering practices operate on the same basic principle. Modifications to the traditional surface sand filter were made primarily to fit sand filters into more challenging design sites (e.g., underground and perimeter filters) or to improve pollutant removal (e.g., organic media filter).

Catch Basins/Catch Basin Inserts
Post-construction Storm Water Management
in New Development and Redevelopment



A worker inserts a catch basin insert for oil and grease, trash, debris, and sediment removal from storm water as it enters the storm drainage system (Source: AbTech Industries, 2001)

Description

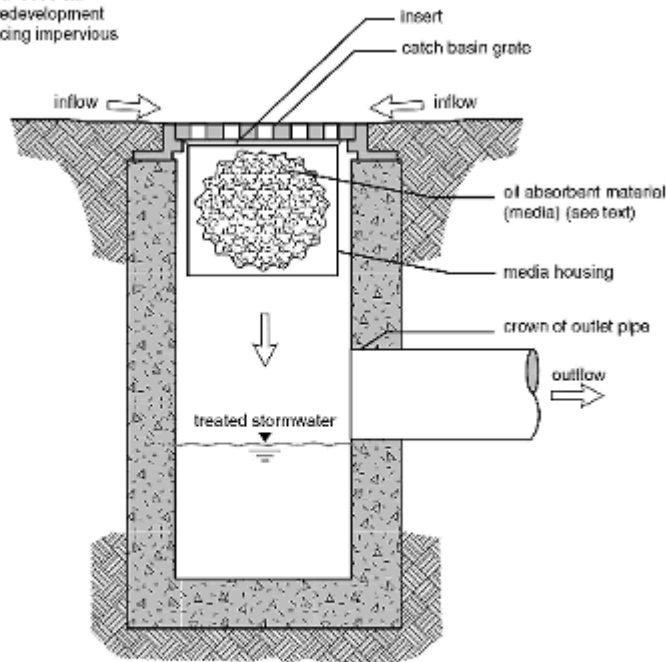
A catch basin (a.k.a. storm drain inlet, curb inlet) is an inlet to the storm drain system that typically includes a grate or curb inlet and a sump to capture sediment, debris, and associated pollutants. They are also used in combined sewer overflow (CSO) watersheds to capture floatables and settle some solids. Catch basins act as pretreatment for other treatment practices by capturing large sediments. The performance of catch basins at removing sediment and other pollutants depends on the design of the catch basin (e.g., the size of the sump) and maintenance procedures

to retain the storage available in the sump to capture sediment.

Catch basin efficiency can be improved using inserts, which can be designed to remove oil and grease, trash, debris, and sediment. Some inserts are designed to drop directly into existing catch basins, while others may require extensive retrofit construction.

***Manufactured Products for Storm Water Inlets
Post-construction Storm Water Management
in New Development and Redevelopment***

Tributary area 5000 s.f.
(7000 s.f. if redevelopment
project replacing impervious
surface).



**SECTION VIEW
NTS**

The typical design of a catch basin insert is a set of filters that are specifically chosen to address the pollutants expected at that site (Source: King County, Washington, 2000)

several different types of proprietary separators, each of which incorporates slightly different design variations, such as off-line application. Another common manufactured product is the catch basin insert. These products are discussed briefly in the [Catch Basin](#) fact sheet.

Description

A variety of products for storm water inlets known as swirl separators, or hydrodynamic structures, have been widely applied in recent years. Swirl separators are modifications of the traditional oil-grit separator and include an internal component that creates a swirling motion as storm water flows through a cylindrical chamber. The concept behind these designs is that sediments settle out as storm water moves in this swirling path. Additional compartments or chambers are sometimes present to trap oil and other floatables. There are

Examples of Materials Used in a Streambank Restoration and Protection: Log veins redirect streamflow back to the center channel or slow side stream velocities protecting the streambank. The coir fabric stabilizes the streambank and allows new plantings such as tall warm seasoned grasses time to grow. Over time the coir fabric biodegrades back into the soil.



Conversion of Detention Ponds and Construction of Treatment Wetlands: A typical detention pond that is mowed has little water quality benefit and can be converted into something more beneficial. Treatment wetlands can be aesthetically pleasing and ecologically diverse. Both of the areas shown above are located in the Philadelphia Region.



3.2.9 PWD-Queen Lane Intake Public Summary

Introduction

As part of the requirements of the 1996 Safe Drinking Water Act Reauthorization, the Pennsylvania Department of Environmental Protection (PADEP) has been conducting assessments of all potentially significant sources of contamination to all public drinking water sources. The Philadelphia Water Department has prepared this Source Water Assessment Public Summary to provide information to support local and state efforts to protect the quality of the City of Philadelphia's drinking water sources. The information in this summary pertains to the water supply area for the Philadelphia Water Department's Queen Lane Water Treatment Plant. The water withdrawn for the Queen Lane Water Treatment Plant is treated and meets all state and federal regulations for safety and quality before being distributed to West Philadelphia. The assessment conducted for the Queen Lane Water Treatment Plant is of the "source" (river water) rather than "tap" (drinking) water. Information on "tap" (drinking) water quality is available from the Philadelphia Water Department's Annual Consumer Confidence Report that can be obtained by calling 215-685-6300 or www.phila.gov.

What is the Source of Your Drinking Water?

The source of water for the Philadelphia Water Department – Queen Lane Water Treatment Plant is surface water from the Schuylkill River. An average of 80 million gallons is withdrawn from the river per day. The water system serves approximately 350,000 customers in Philadelphia between the boundaries of the Schuylkill River and Broad Street (Route 611). The water supply intake is located in Fairmount Park section of Philadelphia. Approximately 1,900 square miles of land covering portions of 11 counties including large sections of Berks, Schuylkill, Montgomery, and Chester Counties drain into the river upstream from the intake. The land upstream of the intake is 47% forested/greenspace, 36 % agricultural, and 14 % developed. Approximately 3 million people live in the Schuylkill River Watershed.

Water Quality and Treatment Information

Water withdrawn from the Schuylkill River is coagulated, settled, filtered, and disinfected with chlorine prior to distribution to customers. Drinking water quality meets or exceeds all state or federal requirements. In addition, the Queen Lane Water Treatment Plant participates in the Partnership for Safe Water program. This program is an intensive voluntary program nationwide by water suppliers that strives for optimized water quality well beyond that required by state and federal agencies.

Evaluation of Significant Sources of Contamination

This assessment identifies and evaluates the possibility for contaminants to potentially enter the Schuylkill River upstream from the water intake prior to treatment. The contaminants addressed in this assessment include those regulated under the federal Safe Drinking Water Act as well as those PADEP has determined may present a concern to human health. These sources are then ranked to determine their protection priority to the water supplier. The protection priority is the level of importance and potential contamination a particular source represents the water supply. A description of the protection priority assigned to various types of sources upstream from the Belmont

Intake is provided in Table 3.2.9-1. Each type of source has a qualitative protection priority rating ranging from A to F. The “A” rating is considered a source of highest protection priority, while “F” is considered lowest protection priority. Sources with ratings between A and C are considered potentially significant sources for protection consideration. Sources with rating between D and F are considered to have less significance.

As indicated in Table 3.2.9-1, discharges of treated and untreated sewage upstream of the water intake were given the highest protection priority due to their potential to release pathogens and nutrients into the water supply. Polluted runoff from stormwater was also given a high protection priority due to the potential impacts of runoff from urban areas and agricultural lands that introduce pathogens, nutrients, and sediment into the water supply. Acid mine drainage was also considered a high protection priority due to the impacts it has on metals concentrations in the river.

Table 3.2.9-1 Summary of Protection Priorities for Various Upstream Sources

Source	Protection Priority	Description	Priority Area(s)	Contaminants
Treated Sewage	A - High	Wastewater discharges from wastewater treatment plants	Reading to Philadelphia	Pathogens, bacteria, viruses, <i>Cryptosporidium</i> , nutrients, sediment, organic chemicals
Untreated Sewage	A - High	Combined and sanitary sewer overflows/discharges	Bridgeport, Norristown, & Schuylkill County	Pathogens, bacteria, viruses, <i>Cryptosporidium</i> , nutrients
Urban/Residential Runoff	A – C Moderate - High	Stormwater runoff from roads, parking lots, roofs	Reading to Philadelphia	Pathogens, bacteria, viruses, <i>Cryptosporidium</i> , nutrients, metals, sediment
Agricultural Runoff	A-C Moderate - High	Stormwater runoff from croplands, pastures, livestock	Perkiomen Creek & Tulpehocken Creek	Pathogens, bacteria, viruses, <i>Cryptosporidium</i> , nutrients, sediment
Acid Mine Drainage	A - High	Discharge from abandoned coal mining areas	Schuylkill County	Metals
Industrial Facilities	A-C Moderate - High	Facilities that store or use hazardous chemicals	Reading to Philadelphia	Metals, nutrients, organic chemicals
Above Ground Storage Tanks	A-C Moderate - High	If storage tank spilled into river	Reading to Philadelphia	Petroleum hydrocarbons, metals, phosphorus
Landfills	C Moderate	Leaching of contaminants into streams	Reading to Philadelphia	Petroleum hydrocarbons, metals
Spills and Accidents	A-C Moderate - High	Car, truck, train, or pipeline accident spilling benzene	Watershed wide	Petroleum hydrocarbons, organic chemicals

Note: Petroleum hydrocarbons include chemicals found in oils and greases. Organic chemicals include chemicals found in solvents, degreasers, varnishes, paints, gasoline, plastics, insect and weed killers.

Ongoing Source Water Protection Activities

The Philadelphia Water Department (PWD) has an active source water protection program that works closely with state, federal, and local officials to address water quality issues. PWD also participates in various activities with upstream dischargers, businesses, communities, water suppliers, and watershed organizations that encourage communication, cooperation, education, protection, and restoration of the Schuylkill River and its tributaries.

Source Water Protection Needs

Overall, the primary areas to protect and improve PWD's water supply include the areas along the Schuylkill River between Reading and Philadelphia, the Wissahickon Creek, and Lower Perkiomen Creek. The Valley Creek, French Creek, and Tulpehocken Creeks appear to have secondary protection priority. In addition, other specific parts of the watershed may need limited attention for contaminant specific issues (i.e. acid mine drainage in Schuylkill County).

Based on these observations, the areas along the mainstem Schuylkill River between Reading and Philadelphia should be considered a priority protection corridor and have special protective regulations and legislation to restore and protect water quality. This includes development of initiatives to reduce or prevent pathogens such as *Cryptosporidium* from entering the river.

Long-term protection efforts should be focused on enhancing wastewater discharges and mitigating stormwater runoff from urban and residential areas. These will have the greatest overall impacts on improving source water quality and the Schuylkill River.

How to Obtain More Information

This Source Water Assessment Public Summary was completed in December 2001. Individuals interested in learning more about this water system and watershed can contact the Philadelphia Water Department at 215-685-6300 or access information from the Internet at www.phila.gov/departments/water or www.schuylkillswa.org.

How Do I Get Involved in Protecting the River and My Water Supply?

There are many ways you can help protect the river and your water supply. You can join a local watershed organization, join a citizens advisory committee, or write your state and local representatives or congressmen about your views and opinions on issues. Instead of joining organizations, you can also lend a hand when these various organizations conduct trash cleanup, stream restoration, tree planting activities, stenciling storm drains, or conducting stream monitoring. Even the smallest of things can help protect your stream, river, or water supply. Just simply calling the proper authorities when you see illegal dumping, dead fish, or other polluting activities can make a big difference (see Table 3.2.9-2). Below are a list of numbers to call for various situations and a list of websites to find more information about local watershed and environmental organizations in the area (see Table 3.2.9-3).

Table 3.2.9-2 Who to Call to Report Various Situations

Situation	Who To Call	Phone
Dead Fish	Fish & Boat Commission PADEP	717-626-0228 800-541-2050
Illegal Dumping & Related Pollution Activities	PADEP Environmental Police Unit	800-541-2050 215-685-6300
Sewage Spills	PADEP PWD	800-541-2050 215-685-6300
Oil & Gas Spills / Accidents	PADEP PWD	800-541-2050 215-685-6300

Table 3.2.9-3 Getting Involved: Places to go for More Information About Local Organizations

Information About	Phone Number	Website Address
Philadelphia Area Watershed Organizations	215-685-6300	www.schuylkillswa.org
Wissahickon Creek	215-646-8866	www.wvwa.org
Fairmount Park Friends Groups	215-685-0000	www.schuylkillswa.org
Schuylkill Riverkeeper	610-469-6005	email: srk@worldlynx.net
Perkiomen Watershed	610-287-9383	www.schuylkillswa.org
Tidal Schuylkill River	215.985.9393	www.srdc.net
Lower Merion Area	610-353-5587	www.schuylkillswa.org

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List of Acronyms

ACCESS	Microsoft Access Database software
AMD	Acid Mine Drainage
AST	Aboveground Storage Tank
BOD	Biological Oxygen Demand
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Act Information System
CFS	Cubic Feet per Second
COWAMP	Pennsylvania's Comprehensive Water Quality Management
CRP	Conservation Reserve Program
CSO	Combined Sewer Overflow
CSX	CSX Transportation Rail Company
CWA	Clean Water Act
CWA	Clean Water Action
DBP	Disinfection by-product Precursor
DCNR	Department of Conservation and Natural Resources
DMR	Discharge Monitoring Report
DRBC	Delaware River Basin Commission
DVRPC	Delaware Valley Regional Planning Commission
EPA	Environmental Protection Agency
EQIP	Environmental Quality Incentives Program
ESRI	Environmental Systems Research Institute
EVAMIX	Mixed Data Multi-criteria Evaluation Software Program
FHWA	Federal Highway Administration
FWS	Fish and Wildlife Service
GIS	Geographic Information System
GPD	Gallons Per Day
LQG	Large Quantity Generators
MCPC	Montgomery County Planning Commission
MGD	Millions of Gallons per Day
MSL	Mean Sea Level
MTBE	Methyl Tertiary Butyl Ether
NCDC	National Climatic Data Center
NLCD	National Land Cover Data Set
NPDES	National Pollutant Discharge Elimination System Permit Program
NPL	National Priority List
NPS	Non-Point Source
NRCS	Natural Resources Conservation Resources
NSF	National Science Foundation
NURP	National Urban Runoff Pollutants Study
PADEP	Pennsylvania Department of Environmental Protection
PAWC	Pennsylvania American Water Company
PCB	Polychlorinated Biphenols
PCS	Permit Compliance System
PEC	Pennsylvania Environmental Council
PECO	Pennsylvania Electric Company
PEMA	Pennsylvania Emergency Management Agency Program
PWD	Philadelphia Water Department

PWS	Public Water Supply
RCRA	Resource Conservation and Recovery Act
RCRIS	Resource Conservation and Recovery Act Information System
RTK	Right To Know
SDWA	Safe Drinking Water Act
SOC	Synthetic Organic Compounds
SQG	Small Quantity Generators
SSO	Sanitary Sewer Overflow
STEPS	Student Technical Experience in Problem Solving
STORET	USEPA's Environmental Data System of STORage and RETrieval
STP	Sewage Treatment Plant
SWA	Source Water Assessment
SWAP	Source Water Assessment Program
TAG	Technical Advisory Group
TDS	Total Dissolved Solids
TM	Thematic Mapper
TMDL	Total Maximum Daily Load
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbons
TRI	Toxic Release Inventory
TS	Total Solids
TSS	Total Suspended Solids
USACE	US Army Corps of Engineers
USACOE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
VOC	Volatile Organic Compounds
WHP	Wellhead Protection Program
WRP	Wetlands Reserve Program
WWTP	Wastewater Treatment Plant

APPENDIX

Figure A

200015 River study calls for an engineer

As one of the municipalities covered in a study on Schuylkill River contamination, Abington officials say they need a professional to monitor the coming meetings.

By Russell Mosley
Staff Writer

Abington Township will likely hire a firm to monitor the findings of a study being conducted on possible contamination of the Schuylkill River Basin.

At a public works meeting Monday, the committee voted to recommend spending \$10,000 from the wastewater account to contract with Environmental Engineering and Management Associates Inc. for engineering representation in connection with Schuylkill Source Water Assessment meetings.

"It is incumbent on us to protect our interests by following the project," said Robert Leber, superintendent of the Abington Wastewater Treatment Plant.

The Schuylkill Source Water Assessment is a combined effort of the state Department of Environmental Protection, Philadelphia Water Department, Philadelphia Suburban Co., and Pennsylvania American Water Co.

The group identifies surface water contaminants in the Schuylkill River Basin, which increases the expense of producing drinking water, and attempts to eliminate the sources of those contaminants. The group will also determine exactly where the contaminants originate.

Leber said Abington discharges all wastewater

into the Schuylkill Basin from one pipe and at one point.

As a point source discharger, Abington township contributes two types of bacterial contaminants, giardia and cryptosporidium, which are not easily eliminated, he said.

Leber said the plant uses chlorine and ultraviolet radiation to kill any contaminants, but said some of these contaminants can filter into the basin.

A majority of drinking water in Abington is obtained from surface water which is collected, treated extensively and then piped into homes by Philadelphia Suburban Co., according to Leber. The water is treated again, after being used in the home, by the plant before being distributed back into the Schuylkill Basin.

He also said 40 percent of contaminants in the Schuylkill Basin are caused by point source discharges, while the other 60 percent are caused by non-point sources such as surface water runoff, septic systems, wildlife and decaying vegetation.

Leber said each new contaminant the treatment plant is required to eliminate will require construction of a new process.

He said representatives for Abington Township will monitor the source water assessment meetings and report the findings to the township. He said these efforts may result in new regulations for wastewater treatment plants.

"[Representatives will] report back on issues we may want to respond to, have input on, and after all of the conclusions, advise Abington whether to accept conclusions or ask for clarification," he said.

Leber said it is important for Abington to have representation at the meetings to make sure the findings are scientifically sound and the conclusions are balanced.

Figure A (con't)

GLENSIDE NEWS

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River study calls for an engineer

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See Engineer, page 11

Study calls for an engineer

■ Engineer, from Page 9

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Figure B

The Times Herald
Page 1 of 2



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Front Page

Water groups form SWAP to protect Schuylkill River

GARY PULEO, Times Herald Staff
March 26, 2001

PERKIONEN — It may not be as dramatic and immediate as an oil spill in waters off the Galapagos Islands, but the much more gradual and ongoing pollution of the Schuylkill River is just as insidious.

That's the premise behind the seemingly inevitable alliance between the Perkionen Watershed Conservancy, the Philadelphia Water Department, Pennsylvania American Water Company and Philadelphia Suburban Water Company, which is being called the Schuylkill River Source Water Assessment Partnership (SWAP).

"Basically, we're looking into things as far as source water issues are concerned — different pollutants that get into the streams and eventually into the Schuylkill River that impact drinking water, not only for Philadelphia, but everyone along the river who draws water from there," said Ted Radzinski, Perkionen Watershed Conservancy director.

Nutrients like phosphorous are getting into the stream from agricultural runoff and lawn fertilization, said Radzinski, as well as waste from cows and horses, which changes the ecology of the stream.

"Another big issue is salt, this time of year, as we're seeing a definite rise in sodium in the water, as the salt from de-icing the roads eventually runs into the streams," he said. "And there's really no way to prevent that or treat it. Even people on low-sodium diets may be getting sodium from their drinking water."


"What the new SWAP study will do is determine methods of improving upon these problems and come up with recommendations of how the groups can minimize impact on the streams."

Preston Luitwiler, senior manager of water resources for Suburban Water Company, agreed, citing the 1998 Safe Drinking Water Act Amendments, which required states to do source-water assessments for all of the public water supplies within their states.

"The Environmental Protection Agency (EPA) and the Department of Environmental Protection (DEP) spent about a year working on providing some guidance for how the states should do their assessments," he said.

Though the assessments are being done all over the country, each state seems to be handling the job differently, Luitwiler said.

"What's a little different about the situation on the Schuylkill River is that a couple of water suppliers got together and decided it didn't make sense to have a consultant come in and ask for information and then do all of this work for him, when we could just do the project for our own intakes," said Luitwiler.



Win
BU
gan

West

http://www.zwir.../news.cfm?newsid=1583545&BRD=1672&PAG=461&dept_id=33380&rfi=3/27/01

Luttweller.

"On the Schuylkill River, there are a variety of issues at different portions of the watershed, because it is so large. At the upper part of the watershed, acid drainage is a big issue. By the time that water gets down to the Philadelphia Water Department and Philadelphia Suburban Water Company, it's no longer a major issue.

"In more developed areas, it's waste-water discharges and sanitary sewer overflows that are the issues," he said.

Where the watershed organizations come in, Luttweller said, "is that we've had a longstanding relationship with PWC over the years and we recognize that it's important to have them as partners in this activity, because they bring knowledge of what's going on in the watershed and they bring an interested membership to the process, as well as dedication."

The utilities suggested to the DEP that an advisory committee be formed, consisting of representation from the conservationists, the county planning commissions, watershed organizations, water utilities, waste-water people — any group that might have an interest in the source-water assessment.

Quarterly SWAP meetings will be open to the public, hosted by different watershed organizations up and down the Schuylkill, such as PWC, the Schuylkill Center for Environmental Education, the Schuylkill River Keeper and the Pottstown-Schuylkill Alliance.


"It may take awhile for this concept to catch on and people to realize what's going on," said Luttweller. "I think people are being bombarded with so much that's going on from these watersheds, all covering the same ground from a different perspective.

"So people may be having a hard time figuring out who all these players are and what they're doing here."

©The Times Herald 2001

Reader Opinions

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on this story

Questions or comments? Email the Webmaster.

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Group examining contamination in Schuylkill River

Times Herald,
2/22/01

By MICHELLE MONAGH
Times Herald Staff

SCHWENKSVILLE — The Schuylkill River Source Water Assessment Partnership (SWAP) will hold a public meeting at 7 p.m. today at the Perkiomen Watershed Conservancy to discuss potential sources of contamination of the Schuylkill River and possible actions for water quality improvement.

The SWAP, composed of regulatory agencies, drinking water suppliers, grassroots watershed organizations and other interested parties, is a public-private initiative designed to explore and understand the environmental challenges that affect local streams.

In 1986, amendments were passed to the Federal Safe Drinking Water Act that require state agencies and water suppliers to survey drinking water sources for contaminants and make this information available to the public.

The Schuylkill River SWAP embraced and expanded this original mandate in its desire to make the water quality assessments an important tool in furthering the protection of drinking water quality while enhancing the natural environment of the river and the land surrounding it.

The SWAP is working with organizations such as the Perkiomen Watershed Conservancy, the hosts of today's meeting at 1 Shipneck Pike, to foster public participation in this study.

The conservancy believes identifying existing and potential pollution sources is necessary to ensure the protection of drinking water supplies.

It works to protect and

restore the Perkiomen Creek, its tributaries and habitats and offers local citizens opportunities to get involved in hands-on watershed protection efforts.

In other news, the conservancy has selected Tad Radzinski to serve as the new executive director.

Radzinski, of Limerick and formerly Collingsville and Royersford, is familiar with the explosive growth and development in the area. His impact has significantly altered the Perkiomen Watershed, he said.

"We all impact the environment from taking showers to driving our cars, and watershed issues involve more than just water," said Radzinski. "I look forward to working to raise people's awareness of these issues and to expand the services that the conservancy provides."

Radzinski serves on the Limerick Parks and Recreation Committee and was involved with the planning of the Limerick Center for Sustainability and Watershed Education.

In the past, he worked on a national program for the Environmental Protection Agency, served as project manager for an environmental consulting firm and spent 13 years working for Peco Energy Co.

He presently serves as an adjunct associate professor at Temple University in the civil and environmental engineering department.

Radzinski has an undergraduate degree in mechanical engineering from Drexel University and master's degree in water resources and environmental engineering from Villanova University.

Figure D

Schuykill water assessment meeting

*Roxborough
Reserve
3/14/2004
p.1*

The Schuykill River Source Water Assessment Partnership (SWAP) is holding a public meeting on March 14, at 7 p.m. at the Schuykill Center for Environmental Education, 8480 Hagy's Mill Rd. in Roxborough, to discuss potential sources of contamination to the Schuykill River.

The Schuykill River SWAP is a public-private initiative designed to explore and understand the environmental challenges to the Schuykill River watershed as a means to identify its existing and potential pollution sources to drinking water supplies. In 1986, amendments were passed to the federal Safe Drinking Water Act that

required state agencies and water suppliers to survey drinking water sources for contaminants and to make the information available to the public.

The Partnership, composed of regulatory agencies, drinking water suppliers, watershed organizations and other interested stakeholders, embraced and expanded this original mandate in its desire to make the water quality assessments an important tool in furthering the protection of our drinking water quality while enhancing the natural environment of the river and the land surrounding it.

The SWAP wants to involve the public in this study to gain their knowledge about their local environment and

to solicit the public's assistance in identifying problems and solutions through education or changes in public behavior, to sustain the pollution prevention measures that are ultimately implemented. A report documenting the project will be available at its completion.

The public meeting is an opportunity for individuals and organizations to become involved and to add their voice to the project. For additional information, visit www.schuykillswap.org or call 215-685-4944.

**Career
fair for**

Figure E

READERS' VIEWS

THE MERCURY 4-3-81 Help win the war against trash

On Feb. 16 the Greater Pottstown Watershed Alliance and the Schuylkill Riverkeeper hosted a public meeting for the Schuylkill River Source Water Assessment Partnership. During the presentation photographs of pollution sources were shown. One was of a large pile of tires with a dead deer lying on the top, right next to the Schuylkill River. It was labeled North Coventry Township. Since several of us live in Norco we asked for the explicit location. It was on Route 724 between Scholl Road and the Union Township line. Never once to let a good pile of trash wait for too long, we decided this area would be our first priority for the year.

On Saturday, March 24, 18 volunteers met at the site. Several were from North Coventry, several from Pottstown, the Pottsgroves, Phoenixville, Sanatoga and one from Bryn Mawr. One of the volunteers was a Philadelphia Suburban Water Co. watershed watchdog, and the person who took the photograph that started all this. To our surprise and delight, six of the volunteers were Americorps volunteers working in Sanatoga and took time out to come to our aid (thanks to a notice in The Mercury). These great young people hailed from California, Boston and Las Vegas among other places.

In just four hours, we filled up two of Norco's dump trucks. We picked up 40 tires (bringing our total to 1,116 tires cleaned up and recycled). The trash included furniture, mattresses, box springs, medical waste, house shingles, car parts, carpets, wire fencing, oil bottles along with thousands of cans and bottles. We also filled up two pickups with metal scraps, which we recycled. All this in just three-quarters of a mile!

We wondered how many passersby thought we were court ordered to clean up this trash, instead of being volunteers.

Our thanks go to Firestone in Pottstown and Sears at the Coventry Mall for taking these tires. Waste Management provided free dumping. Our old friends at Recycling Services Inc. took the truckloads of metals. Thanks to North Coventry for the use of its trucks and a Norco employee, for bringing them.

Thanks to the volunteers of Americorps.

To those of you who continue to litter and illegally dump your trash anywhere you want, we are tired of looking at it and tired of picking it up. We would rather be with our families, fishing, canoeing, and enjoying our beautiful waterways.

We need your help. We are a small group and can't possibly do it all. Call the police when you see someone littering. Pick up trash when you see it. Make sure your trash does not get blown out of the containers. And if you want to spend a fulfilling Saturday morning picking up other people's trash, call us, we would love to have you join us.

The Greater Pottstown Watershed Alliance Inc. is a non-profit group of local volunteers who hold monthly cleanups, monitor water quality parameters and promote watershed restoration efforts.

Anyone interested can call me at 610-326-3918.

BILL CANNON
GPWA

Figure F

Water groups form SWAP to protect Schuylkill River

Partnership to study remedies for pollution

By GARY PULEO
Special to The Mercury 3/19/01

PERKIOMEN — It may not be as dramatic and immediate as an oil spill in waters off the Galapagos Islands, but the much more gradual and ongoing pollution of the Schuylkill River is just as insidious.

That's the premise behind the seemingly inevitable alliance between the Perkiomen Watershed Conservancy, the Philadelphia Water Department, Pennsylvania American Water Company and Philadelphia Suburban Water Company, which is being called the Schuylkill River Source Water Assessment Partnership (SWAP).

"Basically, we're looking into things as far as source water issues are concerned — different pollutants that get into the streams and eventually into the Schuylkill River that impact drinking water, not only for Philadelphia, but everyone along the river who draws water from there," said Tad Radzinski, Perkiomen Watershed Conservancy director.

Nutrients like phosphorous are getting into the stream from agricultural runoff and lawn fertilization, said Radzinski, as well as waste from cows and horses, which changes the ecology of the stream.

"Another big issue is salt, this time of year, as we're seeing a definite rise in sodium in the water, as the salt from deicing the roads eventually runs into the streams," he said. "And here's really no way to prevent that or treat it. Even people on low-sodium diets may be getting sodium from their drinking water."

"What the new SWAP study will do is determine methods of improving upon these prob-

Water groups form SWAP to protect Schuylkill River

(SWAP from P 1)

lems and come up with recommendations of how the groups can minimize impact on the streams."

Preston Luitweiler, senior manager of water resources for Suburban Water Company, agreed, citing the 1996 Safe Drinking Water Act Amendments, which required states to do source-water assessments for all of the public water supplies within their states.

"The Environmental Protection Agency (EPA) and the Department of Environmental Protection (DEP) spent about a year working on providing some guidance for how the states should do their assessments," he said.

Though the assessments are being done all over the country,

each state seems to be handling the job differently, Luitweiler said.

"What's a little different about the situation on the Schuylkill River is that a couple of water suppliers got together and decided it didn't make sense to have a consultant come in and ask for information and then do all of this work for him, when we could just do the project for our own intakes," said Luitweiler.

"On the Schuylkill River, there are a variety of issues at different portions of the watershed, because it is so large. At the upper part of the watershed, acid drainage is a big issue. By the time that water gets down to the Philadelphia Water Department and Philadelphia Suburban Water Company, it's no longer a

major issue.

"In more developed areas, it's wastewater discharges and sanitary sewer overflows that are the issues," he said.

Where the watershed organizations come in, Luitweiler said, "is that we've had a long-standing relationship with PWC over the years and we recognize that it's important to have them as partners in this activity, because they bring knowledge of what's going on in the watershed and they bring an interested membership to the process, as well as dedication."

The utilities suggested to the DEP that an advisory committee be formed, consisting of representation from the conservationists, the county planning commissions, watershed organizations, water utilities, waste-

water people — any group that might have an interest in the source-water assessment.

Quarterly SWAP meetings will be open to the public, hosted by different watershed organizations up and down the Schuylkill, such as PWC, the Schuylkill Center for Environmental Education, the Schuylkill River Keeper and the Pottstown-Schuylkill Alliance.

"It may take awhile for this concept to catch on and people to realize what's going on," said Luitweiler. "I think people are being bombarded with so much that's going on from these watersheds, all covering the same ground from a different perspective."

"So people may be having a hard time figuring out who all these players are and what they're doing here."

Figure H

Daily News
3/12/2001
p. 55

Marketing Metrics

SPYGLASS, INC. AND TFC III

PUBLIC NOTICE
The Philadelphia Housing
Authority Board of Com-
missioners Meeting will be
held on Thursday, March
13, 2003 at 2:00 p.m., in the
Mayor's Reception Room,
City Hall, 2nd Floor, Room
202, Philadelphia,
Pennsylvania.

Executive Director

The Philadelphia Water Department will host a public meeting to discuss studies conducted recently by the U.S. Environmental Protection Agency on the Schuylkill River watershed. The meeting will take place on Wednesday, March 14 from 7 to 9 p.m. at the Schuylkill County Environmental Center, 4401 Locust St. MFL Hall in Haverhill. For more information or directions, call 215-385-4044.

2001
Auction will be held in the
of Market Street - 2nd floor,
Room, March 13, 2003 at 11:00
to submit a bid is required to
attend.
Philadelphia Parking Authority
800 Market Street - 2nd Floor
Philadelphia, PA 19104-2807

1. AUTHORITY AUTOMATIC
BACKUP TO 2001
19-08-01

TO: JUDGE

TO INQUIRE
sign 2052 will be received until
March 28, 2007, by the Phleg-
"me Authority". A body cor-
-less of the Commonwealth of
-64 with the Act of June 5, 1947,
-am as the "Parking Authority
-turally, 2101 Market Street -
-PA 19104-2807, at which time
-d. read aloud and recorded

and Specifications may be obtained from the Authority between 9:00 a.m. and 4:00 p.m. prevailing time during

Bids will be held in the office of 3301 Michigan Street - 2nd floor 21, 2001 at 11:00 a.m. All bidders must attend the pre-bid

Philadelphia Parking Authority
1101 Market Street - 3rd Floor
Philadelphia, PA 19106-3807

Working Notes

PUBLIC NOTICE

PUBLIC NOTICE
The Philadelphia Housing
Authority Board of Com-
missioners Meeting will be
held on Thursday, March
28, 2002 at 3:00 p.m., in the
Mayor's Reception Room,
City Hall 2nd Floor, Room
202, Philadelphia
Pennsylvania.

Carl R. Greene
Editorial Director

The Philadelphia Water Department will host a public meeting to discuss a proposed \$100-million, 10-year contract to build a new water supply in the Schuylkill River Watershed. The meeting will be held on Wednesday, March 14 from 7 to 9 p.m. at the Schuylkill Center for Environmental Education.

Inquirer
3/12/2001
p. A9


(No.)



Under Art. No. 537, Approved May 16, 1929, P.L. 1784, as Last Amended by
Act. No. 526 of July 5, 1917

William T. Murray, Publisher of THE TIMES HERALD, of the County and State aforesaid, being duly sworn, deposes and says that THE TIMES HERALD, a newspaper of general circulation published at Marley, Ann and Airy Streets, Borough of Norristown, County and State aforesaid, was established January 1, 1923, since which date THE TIMES HERALD has been regularly issued in said County, and that the printed notice or publication attached hereto, is exactly the same as was printed and published in the regular edition and issues of THE

Copy of Notice

Affiant further deposes that he is an officer duly authorized by THE TIMES HERALD PUBLISHING COMPANY, INC., a corporation, publisher of THE TIMES HERALD, a newspaper of general circulation, to verify the foregoing statement under oath, and affiant is not interested in the subject matter of the aforesaid notice or advertisement, and that all allegations in the foregoing statements as to time, place and character of publications are true.

• • • • •

Rock Island -

Figure J

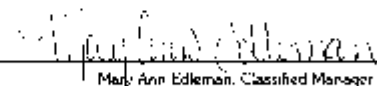
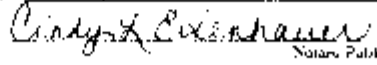
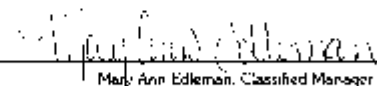
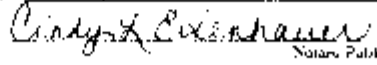
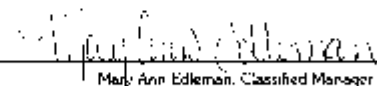
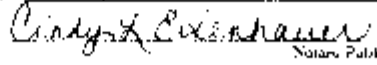
<h1>THE MERCURY</h1> <p>Publishers of The Mercury, The Penny Pincher and Real Estate Today</p> <h2>PROOF OF PUBLICATION OF NOTICE</h2> <p>Under Act No. 587, Approved May 6, 1929</p> <p>STATE OF PENNSYLVANIA COUNTY OF MONTGOMERY 55</p> <p><u>Mary Ann Edleman</u>, of The Mercury, of the County and State aforesaid, being duly sworn, deposes and says that THE MERCURY, a newspaper of general circulation published at 24 N. Hanover Street, Borough of Pottstown, County and State aforesaid, was established September 29, 1931, since which time, The Mercury has been regularly issued in said County, and that the printed notice of publication attached hereto is exactly the same as printed and published in the regular editions and issues of the said THE MERCURY on the following dates; viz.</p> <p style="text-align: center;"><u>February 22, 2001</u></p> <p>Affiant further deposes that herself is duly authorized by Dennis Pfeiffer, Publisher of said MERCURY, a newspaper of general circulation, to verify the foregoing statement under oath, and affiant is not interested in the subject matter of the aforesaid notice of advertisement, and that all allegations in the foregoing statements as to time, place and character of publication are true.</p> <table border="0"><tr><td style="vertical-align: top;"><div style="border: 1px solid black; padding: 5px; width: 150px;"><p>Drinking Water Supply Study</p><p>There will be a public meeting from 7 to 8pm on February 22, 2001 at the Perkiomen Watershed Conservancy in Schwansville to discuss a study underway to identify potential sources of contamination to water supplies in the Schuylkill River and its tributaries. For more information or directions please call 215-668-4844 or visit www.schuylkillswa.org.</p></div></td><td style="vertical-align: top;"><div style="border-bottom: 1px solid black; text-align: center; margin-bottom: 5px;"> Mary Ann Edleman, Classified Manager</div><div style="margin-bottom: 10px;">Sworn to and subscribed before me this <u>1st</u> day of <u>March</u>, 20<u>01</u></div><div style="text-align: center; margin-bottom: 10px;"> Cindy K. Cieschauer Notary Public</div><div style="border: 1px solid black; padding: 5px; text-align: center; width: 150px; margin: 0 auto;"><p>Notary Public Cindy K. Cieschauer Notary Public</p></div></td></tr></table>		<div style="border: 1px solid black; padding: 5px; width: 150px;"><p>Drinking Water Supply Study</p><p>There will be a public meeting from 7 to 8pm on February 22, 2001 at the Perkiomen Watershed Conservancy in Schwansville to discuss a study underway to identify potential sources of contamination to water supplies in the Schuylkill River and its tributaries. For more information or directions please call 215-668-4844 or visit www.schuylkillswa.org.</p></div>	<div style="border-bottom: 1px solid black; text-align: center; margin-bottom: 5px;"> Mary Ann Edleman, Classified Manager</div> <div style="margin-bottom: 10px;">Sworn to and subscribed before me this <u>1st</u> day of <u>March</u>, 20<u>01</u></div> <div style="text-align: center; margin-bottom: 10px;"> Cindy K. Cieschauer Notary Public</div> <div style="border: 1px solid black; padding: 5px; text-align: center; width: 150px; margin: 0 auto;"><p>Notary Public Cindy K. Cieschauer Notary Public</p></div>
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Figure K

<h1 style="margin: 0;">THE MERCURY</h1> <p style="margin: 0;">Publishers of The Mercury, The Penny Pincher and Real Estate Today</p>	
<h2 style="margin: 0;">PROOF OF PUBLICATION OF NOTICE</h2> <p style="margin: 0; font-size: small;">Under Act No. 587, Approved May 6, 1929</p>	
<p>STATE OF PENNSYLVANIA COUNTY OF MONTGOMERY SS.</p>	
<p><u>Mary Ann Edleman</u>, of The Mercury, of the County and State aforesaid, being duly sworn, deposes and says that THE MERCURY, a newspaper of general circulation published at 24 N. Hanover Street, Borough of Pottstown, County and State aforesaid, was established September 29, 1931 since which time, The Mercury has been regularly issued in said County; and that the printed notice of publication attached hereto is exactly the same as printed and published in the regular editions and issues of the said THE MERCURY on the following dates: viz</p> <p style="text-align: center; font-size: 1.5em; margin-top: 10px;"><u>February 11, 2001</u></p>	
<p>Affiant further deposes that he/she is duly authorized by Dennis Pfeiffer, Publisher of said MERCURY, a newspaper of general circulation, to verify the foregoing statement under oath, and affiant is not interested in the subject matter of the aforesaid notice of advertisement, and that all allegations in the foregoing statements as to true, place and character of publication are true.</p>	
<div style="border: 1px solid black; padding: 5px; font-size: 0.8em;"> <p>Drawing Water Supply Study</p> <p>There will be a public meeting from 7 to 9pm on February 15, 2001 at the Montgomery County Community College West Campus in Pottstown to discuss a study underway to identify potential sources of contamination to water supplies in the Schuylkill River and its tributaries. For more information or directions please call 215-685-4844 or visit www.galaxyhillpress.org.</p> </div>	<div style="text-align: center;"> <p style="margin: 0;">Mary Ann Edleman, Classified Manager</p> </div> <p style="margin-top: 20px;">Sworn to and subscribed before me this <u>15th</u> day of <u>February</u>, 20<u>01</u></p> <div style="text-align: center;"> <p style="margin: 0;">Cindy A. Ehrenhauser Notary Public</p> </div> <div style="border: 1px solid black; padding: 5px; margin-top: 10px; font-size: 0.7em;"> <p style="text-align: center;">Notary Seal</p> <p>Cindy A. Ehrenhauser, Notary Public Montgomery County, PA My Comm. Expires 12/31/2006</p> </div> <p style="font-size: 0.6em; margin-top: 5px;">MEMBER: Pennsylvania Notary Association</p>

Figure L

Proof of Publication of Notice

THE AMBLER GAZETTE

State of Pennsylvania,
County of Montgomery ss:

Fred Behringer, Vice President of MONTGOMERY PUBLISHING/METROWEEK, a corporation of the County and State aforesaid, being duly sworn, deposes and says that THE AMBLER GAZETTE is a weekly newspaper published at Ambler, County and State aforesaid, which was established in the year 1879, since which date said newspaper has been regularly issued in said County, and that a copy of the printed notice of publication is attached hereto exactly as the same was printed and published in the regular editions and issues of the said weekly newspaper on the following dates, viz:

and the 14th day of Feb., A.D., 2001.

Affiant further deposes he is duly authorized by Montgomery Publishing/Metroweek, a corporation publisher of The Ambler Gazette, a weekly newspaper, to verify the foregoing statement under oath and also declares the affiant is not interested in the subject matter of the aforesaid notice or publication, and that all allegations in the foregoing statement as to time, place and character of publication are true.

[Signature]
Vice President, Montgomery Publishing/
Metroweek, a Corporation

Sworn to and subscribed by me this
22nd day of February, 2001.

[Signature]
Notary Public
My Commission Expires:

During Water Supply Study
The Valley & South Branch
watersheds will be on February 22,
2001 in the Washington Valley
Watershed Association in Ambler
to discuss a study underway to
identify potential sources of con-
tamination to water supplies in the
Shickelkill River and its tributaries.
For more information or directions
please call 215-265-4141 or visit
www.montgomerycountypa.gov

NOTARIAL SEAL

Lynn V. McGarvey, Notary Public
Upper Merion Twp., Montgomery County
My Commission Expires Oct. 2, 2004

Figure M

No. Form, 19

Proof of Publication of Notice in the Reporter

Under Act No. 567 Approved May 10, 1929

Copy of notice or publication

State of Pennsylvania I SS
County of Montgomery

Bernard N. DeAngelis, Assistant Treasurer of the GANNETT SATELLITE INFORMATION NETWORK, INC., a DELAWARE corporation, being duly sworn, deposes and says that THE REPORTER, a daily newspaper published at Lansdale, County and State of said State, which was established in the year 1870, since which date said daily newspaper has been regularly issued in said County, and that a copy of the printed notice or publication is attached hereto exactly as the same was printed and published in the regular editions and issues of the said daily newspaper on the following date:

vs.

.....
the 17th day of February A.D. 2001

Affiant further deposes he is an officer duly authorized by the GANNETT SATELLITE INFORMATION NETWORK, INC., a corporation, publisher of THE REPORTER, a daily newspaper, to verify the foregoing statement under oath and also declares that affiant is not interested in the subject matter of the aforesaid notice or publication, and that all allegations in the foregoing statement as to time, place and character of publication are true.

Bernard N. DeAngelis
Assistant Treasurer
Gannett Satellite Information Network, Inc.
FEB 19 2001

Sworn to and subscribed before me this date

Cynthia M. Stanton
Notary Public

Notarial Seal
Cynthia M. Stanton, Notary Public
Lansdale Boro, Montgomery County
My Commission Expires Nov. 22, 2004

Member, Pennsylvania Association of Notaries
My Commission Expires:
Notary Seal
Cynthia M. Stanton, Notary Public
Lansdale Boro, Montgomery County
My Commission Expires Nov. 22, 2004
1500 Locust Street, Suite 200
PHILADELPHIA, PA 19102

Statement of Advertising Costs

TO GANNETT SATELLITE INFORMATION NETWORK, INC.
For publishing the notice or advertisement attached hereto on
the above stated date

	\$ 52.50
Notary Fee	\$ 2.00
Total	<u>\$ 54.50</u>

Publisher's Receipt for Advertising Costs


GANNETT SATELLITE INFORMATION NETWORK, INC., a corporation, publisher of THE REPORTER, a daily newspaper, hereby acknowledges receipt of the aforesaid advertising and publication, and certifies that the same have been fully paid.

By

Lansdale, Pa.
Established 1870

**LEGAL NOTICE
DRINKING WATER
SUPPLY STUDY**
There will be a public meeting from 7 to 9pm on February 20, 2001 at the Wissahickon Valley Watershed Association in Ambler to discuss a study underway to identify potential sources of contamination to water supplies in the Schuylkill River and its tributaries. For more information or directions please call 215-685-4844 or visit www.schuylkillwaters.org.

Figure N



No. Term, 20 ..

PROOF OF PUBLICATION NOTICE IN THE TIMES HERALD

Under Act No. 587, Approved May 16, 1929, P.L. 1704, as Last Amended by
Act No. 526 of July 5, 1947

STATE OF PENNSYLVANIA)
COUNTY OF MONTGOMERY.)

SS.

RECEIVED

FEB 27 2001

CAMPBELL, BEEBE & COCKEE
PHILADELPHIA, PA.

William T. Murray, Publisher of THE TIMES HERALD, of the County and State aforesaid, being duly sworn, deposes and says that THE TIMES HERALD, a newspaper of general circulation published at Markley, Ann and Airy Streets, Borough of Norristown, County and State aforesaid, was established January 1, 1923, since which date THE TIMES HERALD has been regularly issued in said County, and that the printed notice or publication attached hereto, is exactly the same as was printed and published in the regular edition and issues of THE

TIMES HERALD on the following dates, viz.:


.....th..... and the
 19th day of February, A.D. 2001

Copy of Notice

DRINKING WATER SUPPLY STUDY

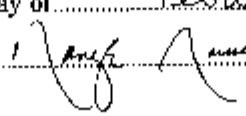
There will be a public meeting from 7 to 9pm on February 22, 2001 at the Norristown Water- shed Conservancy in Schuylkill County to discuss a study underway to identify potential sources of contamination to water supplies in the Schuylkill River and its tributaries. For more information or directions, please call 215-682-4944 or visit www.schuylkillwa.org

Affiant further deposes that he is an officer duly authorized by THE TIMES HERALD PUBLISHING COMPANY, INC., a corporation, publisher of THE TIMES HERALD, a newspaper of general circulation, to verify the foregoing statement under oath, and affiant is not interested in the subject matter of the aforesaid notice or advertisement, and that all allegations in the foregoing statements as to time, place and character of publications are true.



 Publisher, The Times Herald

Sworn to and subscribed before me this 22nd day of February, 2001



 Notary Public