3.0 Water Resources

3.1 The Cherry Creek Watershed

A watershed ultimately connects the communities within it through their common dependence on water resources. Our flowing creeks and streams are perhaps the best barometer of how well we accept stewardship of the land on which we live. Watersheds are important in every community because they embody our sense of place in the landscape, and their waters are important in our daily life. Watersheds are the geographic addresses for our communities.

Watershed Setting

Cherry Creek drains a watershed area of approximately 13,314 acres (about 20.8 square miles). The creek is listed as a High Quality Coldwater Fishery for most of its length according to the PA Department of Environmental Resources. Cherry Creek meanders for approximately 15 miles through a narrow, steep-sided valley, eventually emptying into the Delaware River at Delaware Water Gap. The elevation change from source to mouth is only about 370 feet, and numerous tributaries erupting from Kittatinny Mountain feed the creek. It empties into a section of the river that is designated as the Middle Delaware Scenic and Recreational River in close proximity to the Delaware Water Gap National Recreation Area.

Delaware Water Gap National Recreation Area & Delaware River

Delaware Water Gap National Recreation Area is located in New Jersey and Pennsylvania. It encompasses approximately 70,000 acres along 40.6 miles of the Delaware River. It is less than one hundred miles from the metropolitan areas of New York and Philadelphia. As a result, it is highly accessible to the ever-growing numbers of vacationers and new residents being drawn to the Poconos and the Delaware Highlands regions. Over six million people from around the world visit it annually and it is a focal point for intensive water-oriented recreational activity. Water quality in the upper section of the river and in the tributary streams is uniformly good to excellent. Maintaining this exceptional water quality is vital to the continued use and enjoyment of Recreation Area waters, which are a regionally and nationally recognized recreation and fisheries resource.

The National Recreation Area was established on September 1, 1965. It was originally intended to be associated with the lake, which was to be formed by the Tock's Island Dam project proposed by the United States Army Corps of Engineers. Although this project was de-authorized in 1992, the purposes for establishing the National Recreation Area remain and are outlined in its enabling legislation which includes providing: "public outdoor recreation benefits; preservation of scenic, scientific, and historic features contributing to public enjoyment; such utilization of natural resources as in the judgment of the Secretary of the Interior is consistent with, and does not significantly impair, public recreation and protection of scenic, scientific, and historic features contributing to public enjoyment." (16 U.S.C. 460o et seq)

The enabling legislation that created Recreation Area also made it a unit of the National Park System. The general statutes that guide land management are applicable, among them are the National Park Service Organic Act (16 U.S.C sec 1 et seq) and the Act for Administration (16 U.S.C. 1a-1). These two acts also give the Secretary of Interior the authority to promulgate rules and regulations to effectively manage the National Park System.

In 1978, the section of the Delaware River flowing through the National Recreation Area was designated as the Middle Delaware Scenic and Recreational River and added to the national Wild and Scenic River System (16 U.S.C. 1274). This serves as a major impediment to constructing dams on the main stem of the river. This Act states that components of the Wild and Scenic Rivers System be preserved in their free-flowing condition in order "to protect the water quality of such rivers and to fulfill other vital national conservation purposes." (16 U.S.C. 1271).

3.2 Watershed Management Units

At the heart of watershed planning and management is the concept of watershed management units. This watershed conservation plan is meant to set up additional planning efforts at a more manageable scale, to keep the focus of the plan clear. Overall the plan represents a long-term process and continuous management commitment. There are many different watershed management units, including river basins, watersheds, subwatersheds, and catchments. A watershed can be defined as the land area that contributes runoff to a particular point along a waterway. A typical watershed can cover tens to hundreds of square miles, and extend over several political boundaries or jurisdictions. The largest management unit is the basin. The Cherry Creek flows to the Delaware River basin.

Watersheds are broken down into smaller geographic units called subwatersheds. Subwatersheds typically have a drainage area of 2 to 15 square miles, or larger, and include the land area draining to the confluence of two second-order streams or to the limits of a third order stream. This plan's focus is on the Cherry Creek subwatershed and includes all the land that drains to the point where the Cherry Creek meets the Delaware River.

However, two adjacent small subwatersheds to the east that meet the Kittatinny Ridge and that also drain directly into the Delaware River have been included in the study area: The Caledonia Creek subwatershed and the Mount Minsi subwatershed.[1] Both are just over 300 acres in area. Due to their small size and location general management

[1] These small watersheds were included as recommended by the DCNR project manager to provide complete coverage for Monroe County as they are too small to justify separate plans.

strategies may be applied to them as if they were part of the Cherry Creek subwatershed. Specific actions to these subwatersheds will be noted as appropriate.

Management at the subwatershed level refers to assessment-level studies and specific projects within the smaller subwatershed units, while management at the watershed level refers to broader management issues across an entire watershed. The management units of watershed and subwatershed are most practical for local plans such as this one. Every watershed is composed of many individual subwatersheds, each having its own unique water resource objectives.

The recommendations of this plan focus on the more defined issues in the Cherry Creek subwatershed. This plan focuses on the importance of a subwatershed unit for several reasons:

- The influence of impervious cover on water quality, hydrology, and biodiversity is most evident at the subwatershed level, where the influences of individual development projects are easily recognizable.
- Because subwatershed management areas are limited to a smaller area, fewer pollutant sources are present to confuse management decisions.
- Subwatersheds are small enough to be within just a few political jurisdictions where it is easier to establish a clear regulatory authority and incorporate the smaller number of stakeholders into the management process.
- A subwatershed plan can generally be completed within two to three years and still allow ample time for goal development, agency coordination, and stakeholder involvement.

3.3 Estimate of Impervious Cover

Numerous studies have shown a relationship between impervious cover and degraded water resources. Therefore an assessment of impervious cover is a good indicator of the general health of the watershed. An estimate of mean impervious cover by land use category was conducted by BLOSS Associates in the summer of 2002 as part of this conservation plan using a prescribed methodology and field survey assistance from planners at the Delaware River Basin Commission. A windshield survey was conducted from drivable roads in the watershed; land use categories identified on a preliminary map were then generalized to the entire watershed area through interpretation of aerial photography and GIS mapping tools. The majority of the watershed is under the 10% threshold where a watershed is said to be an “impacted” watershed. However, small areas near the confluence and in the headwaters area do have quite high percentages of impervious cover as a result of more intense land development. The creek in these locations is impacted more severely by stormwater runoff and should be high priority for restoration and other watershed management strategies. See: *Mean Impervious Cover* map (Figure 3.1).

3.4 Stream Order

Stream order is a general measure of a stream's location in a watershed and the number of tributaries the stream has. First-order streams have no tributaries. Second-order streams have only first-order streams as tributaries. Third-order streams have only first- and second-order streams as tributaries, and so on.

The furthest reach of Cherry Creek begins as a first-order stream from its point of origin near Saylorsburg and the Twin Ponds. Cherry Creek then turns into a second-order stream after it passes under Fetherman Road where an unnamed run flows into it. By the time the creek's flow reaches Kemmertown Road several unnamed runs have added to its volume making it a third-order stream until it reaches its confluence at the Delaware River. See *Stream Order* map (Figure 3.2).

Headwater streams are defined as first- and second-order streams. Headwater streams, although the smallest streams, are crucial in watershed management because they dominate the landscape through their sheer number and cumulative length. Although typically short in length, headwater streams actually comprise about 75% of the total stream mileage in the United States.

What happens in the local landscape is directly translated to headwater streams. As urbanization increases, streams handle increasing amounts of runoff, which degrades headwater streams and eventually, major tributaries.

Focusing on the headwater stream level in watershed management is important for several reasons:

- Headwater streams are exceptionally vulnerable to watershed changes;
- Headwater streams are often on the same scale as development projects;
- The public intuitively understands streams and strongly supports their protection;
- Headwater streams are good indicators of watershed quality.

Headwater streams have fewer upstream uses to cause problems and can be a reservoir of biodiversity, if protected. In addition, lower-order streams are narrower and therefore are more likely to have overhanging trees, lower temperatures, and better food sources for aquatic invertebrates.

Headwaters areas in the Cherry Creek watershed are delineated by the presence of first- and second-order streams on the *Stream Order* map (Figure 3.2).

3.5 Stream Designations

Water quality throughout the Cherry Creek watershed is generally high. Most of the watershed is classified as a high quality cold water fishery (HQ-CWF) under

Pennsylvania's water quality criteria (PA Code Title 25, Chapter 93.). About one mile from the confluence with the Delaware River the classification changes to cold water fishery, migratory fishery (CWF, MF). See *Stream Designations* map (Figure 3.3).

High Quality (HQ) and Exceptional Value (EV) status signifies that these streams are suitable for Pennsylvania's anti-degradation water quality protection strategies for waters that exceed state standards, and that possess exceptionally high water resource values. The Pennsylvania Fish and Boat Commission (PFBC) classifies a portion of the creek and several tributaries in the watershed as Class A wild trout streams, signifying the presence of significant populations of wild brook trout and brown trout.

State regulations in Chapter 93 define stream classifications and designated uses and describe how designated uses are used to determine allowable impacts from various permitted activities.

- Permitted discharges to Exceptional Value streams cannot change existing water quality.
- Permitted discharges to High Quality streams must maintain existing water quality except when social or economic justification for lowering water quality can be demonstrated.
- Permitted discharges to all other streams must protect existing uses (designations).

Stream Classifications and Designated Uses[2]

EV = Exceptional Value Waters. Special Protection. A surface water which is of exceptional ecological significance, such as thermal springs or wetlands which are exceptional value wetlands under Chapter 105.17(1); or a surface water that has excellent water quality, meeting the tests for High Quality Waters, and also meets other requirements such as: is located in a National wildlife refuge or a State game propagation and protection area; or is located in a designated State park natural area or State forest natural area, National natural landmark, Federal or State wild river, Federal wilderness area or National recreational area; or is an outstanding National, State, regional or local resource water; or is a surface water of exceptional recreational significance; or meets a biological test set forth in DEP regulations at Chapter 93.4b(a)(2) or is designated by the Fish Commission as a "Wilderness Trout Stream."

HQ = High Quality Waters. Special Protection. A surface water having quality which exceeds levels necessary to support designated uses as shown by meeting chemical or biological standards set forth in DEP regulations at Chapter 93.4b (a).

CWF = Cold Water Fishery. Maintenance and/or propagation of fish species including the family Salmonidae and additional flora and fauna which are indigenous to a cold water habitat.

TSF = Trout Stocking Fishery. Maintenance of stocked trout from February 15 to July 31 and maintenance and propagation of fish species and additional flora and fauna which are indigenous to a warm water habitat.

[2] Chapter 93, Title 25, Pennsylvania Code of Regulations.

MF = Migratory Fishery. Passage, maintenance and propagation of anadromous and catadromous fishes and other fishes which ascend to flowing waters to complete their life cycle.

Class A Wild Trout Water. A surface water classified by the Fish and Boat Commission based on species specific biomass standards, which supports a population of naturally produced trout of sufficient size and abundance to support a long term and rewarding sport fishery.

3.6 Wetlands

Wetlands are the transitional areas between clearly defined aquatic environments and clearly defined terrestrial environments. These areas are inundated by water at or near the surface of the land or are covered by shallow water. Wetlands can be scientifically delineated by the presence of hydric soils, hydrophytic plants, and water.

Wetlands serve many valuable functions. They provide quality wildlife habitat, filter runoff before it enters streams, and provide natural catchment basins for stormwater runoff. The natural filtration processes of wetlands have inspired communities and conservation districts to design and construct wetlands for the purposes of stormwater and sewage treatment.

Wetlands have important value in reducing water turbidity and improving water quality. They provide recreational opportunities for fishermen, hikers, hunters, and wildlife watchers. Wetlands also provide extremely important wildlife habitat. They provide water, food, and shelter for a multitude of creatures, ranging from the smallest amoeba to fish, reptiles, amphibians, furbearers, and waterfowl.

The biggest threat to wetlands today is development. Statewide statistics show that between 1956 and 1979 there was a 6 percent loss of wetlands. Forty-six percent of the loss was due to pond and lake construction, 37 percent to development, and 17 percent to agriculture. More recently, the Monroe County Conservation District has issued 142 permits for minor road crossings in wetlands in the last 10 years.

Various programs, such as the Conservation Reserve Program run by the U.S. Department of Agriculture or Ducks Unlimited’s PA Habitat Stewardship Program, offer incentives to farmers and others to protect existing wetlands. Additionally, funds are available to farmers to fence off wet areas, allowing the area to revert to its natural state. Along with incentives, present regulations require anyone filling a wetland to mitigate the action by restoring or constructing replacement wetlands.

Wetland areas have been located on the National Wetland Inventory (NWI) maps by the United States Fish and Wildlife Service (USFWS). However these mapped locations are dated and are not all inclusive. Therefore the presence or absence of wetlands in the watershed should be evaluated at the site level by a qualified specialist. Hydric soils are a good indicator of additional potential wetland areas in the watershed. NWI wetlands and hydric soils are illustrated on the *Wetlands & Floodplains* map (Figure 3.4) for the study area. There are roughly 4,743 acres of NWI wetlands in the watershed; major areas of which are located in the mid-valley section of the watershed primarily in Hamilton Township. Recent land acquisitions by the Nature Conservancy and Pocono Heritage Land Trust serve to protect a significant portion of these wetlands.

3.7 Floodplains

Although there are minimum floodplain management standards established by the Federal Emergency Management Agency (FEMA) and the PA Dept. of Community and Economic Development (DCED), the municipalities are not restricted to providing the minimum protection. In fact, they are encouraged by FEMA and DCED to adopt more restrictive measures.

Table 3.1 - Floodplain Ordinance Provision Matrix

Municipality	Enrolled in NFIP	Minimum Regulatory Provisions	Some Restrictive Regulatory Provisions	More Restrictive Regulatory Provisions	Considering More Restrictive Regulatory Provisions
Hamilton Twp.	X	X			
Smithfield Twp.	X		X		
Stroud Twp.	X		X		X
Delaware Water Gap Borough	X				

There are varying degrees of protection allotted to floodplains throughout the watershed (as noted in Table 3.1, previous page), which has led to uncoordinated management of floodplain corridors. Given the present atmosphere of inter-municipal cooperation, the time is right to consider the conservation of floodplain resources on a watershed basis.

3.8 Storm Water

Addressing stormwater runoff will help to reduce flooding, protect the quality of surface water, and address groundwater recharge. The Monroe County Planning Commission is currently considering the preparation of an Act 167 plan for the Cherry Creek watershed and estimates that this plan will be initiated toward the end of 2005. A model ordinance for the Brodhead watershed has recently been completed by the County and is expected to be adopted by the County in the fall of 2004. Until a detailed study of sub-watersheds and interrelated runoff calculations can be completed for the Cherry Creek watershed, which is integral to the model ordinance provisions, a zero increase in runoff matching predevelopment and post development runoff rates can be utilized so that the basic principals of the model ordinance for the Brodhead watershed could be applied to the Cherry Creek watershed.

A municipal questionnaire sent out as part of the Act 167 Update for the nearby Brodhead and McMichael Creek watersheds showed several occurrences of small stream flooding and stream bank erosion through these watersheds during major storm events, resulting in both public and private property damages. These problems were found to be more pronounced in the more populated areas, most likely due to development encroachments onto floodplain areas, and from undersized culverts or bridges. During winter months, conditions of frozen ground coupled with high snowfall and rapid melting can also lead to flooding. Shallow bedrock can also contribute to rapid runoff.

Stormwater runoff also affects water quality. The conversion of farmland, forests, wetlands, and meadows to rooftops, roads, parking lots, and lawns creates a layer of impervious cover in the landscape. Water from storm events and melting snow runs rapidly off these surfaces, carrying pollutants to streams and aquifers, instead of slowly percolating into the soil. Research has shown that the amount of impervious cover in a subwatershed can be used to project the current and future quality of streams. In many regions of the country, as little as ten percent watershed impervious cover has been linked to stream degradation, with the degradation becoming more severe as the amount of impervious cover increases.

In residential areas, streams are contaminated by residential nutrient runoff from excessive applications of fertilizers, animal waste or malfunctioning septic systems; soil erosion, and streambank erosion. Bacteria, nutrients, sediments and erosion have been identified as water quality problems in the watershed, as a result of agricultural non-point source pollution and sediment from stream bank erosion. Habitat loss and eutrophication are other problems associated with stormwater runoff.

As indicated by the estimate of impervious cover discussed above, and the *Mean Impervious Cover* map (Figure 3.1), particular areas of stormwater concern are located both near the confluence and in the headwater area. These areas of more intense land development should be high priority for restoration and other watershed management strategies.

3.9 Water Quality & Quantity

Water quality data has been collected in the Cherry Creek watershed by the Monroe County Planning Commission and the Brodhead Watershed Association (Cherry Creek Stream Watchers). The results of County monitoring efforts are documented in the annual *Monroe County Water Quality Study.* Monroe County's annual water quality monitoring efforts began in 1985 (see: *Appendix A – Cherry Creek Stream Analysis*). The Cherry Creek is classified in Title 25 of the Pennsylvania Code as HQ-CWF, MF (High Quality Cold Water Fishery – Migratory Fishes) from its source to the SR 2006 Bridge (Cherry Valley Road) and CWF, MF (Cold Water Fishery – Migratory Fishes) from the SR 2006 Bridge to its mouth. Stream analysis has occurred each year since 1995. EPA/County scoring schemes for repeat sites through 2003 have been tabulated and compared. An average score of 30.25 over 8 years and what appears to be an upward trend since the lowest score of 27 in 1997, is encouraging. The 2003 site is a DWGNRA boundary control point and is located over the dike at the corner of the Laird Technologies parking lot, approximately 200 yards upstream of the Route 80 Bridge. A habitat score of 199 and biological assessment score of 31 placed the testing site in the optimal category. No water chemistry samples were collected for lab analysis at the site, but conductivity was measured and elevated above expected levels.

Macroinvertebrate Analysis

Four sites on Cherry Creek were sampled on June 1, 2000. A total of 48 taxa were identified from the 100+ subsamples. The Creek differed from higher gradient, less alkaline Pocono area streams in having a good representation of burrowing mayflies present.

The study concluded that excellent water quality exists at the headwaters area station (near the hatchery); considerable decline is noted in water quality at site 2 (the church), water quality significantly improved at site 3 (near Route 191) to near that found at the headwaters area, and significantly declined at the easterly site in Delaware Water Gap. Reasons for the variations in water quality were not clear; some anthropogenic and some natural causes are suspected.

All stations have optimal water quality based on the presence of the mayfly as the dominant species. Caddis flies were well represented at all stations, and a few stoneflies, beetles and true flies made up most of the remainder of the samples. The full report is included in *Appendix B – Benthic Macroinvertebrates of Cherry Creek*.[3]

Citizen Volunteer Monitoring Program

The Cherry Creek Watershed Sub-Association was formed through a $17,900 Growing Greener grant provided by the Department of Environmental Protection to the Brodhead Watershed Association. The heart of this program is a citizen volunteer stream monitoring program. Monitoring efforts began in the summer of 2001.

An initial training session for potential streamwatchers was held in the Spring of 2001. Forty-six citizens, attended the session which was led by trainers provided by the Environmental Alliance for Senior Involvement (EASI), Lackawanna County. Attendees represented all age groups from Boy Scouts/Girl Scouts to senior aged interested church and community members. Interest at the training session was very high, and monitoring of the Creek began in June, 2001. BWA received three stream monitoring chemical kits for its use through the EASI program, and data is input and recorded via the World Wide Web for this program.

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[3] Benthic Macroinvertebrates of Cherry Creek, Monroe County, PA, for Brodhead Watershed Association, Donald L. Baylor, Aquatic Resources Consulting, June 1, 2000.

The Cherry Creek program is an extension of the BWA effort that began in the Brodhead Watershed in 1989. In effect, streamwatchers in Cherry Creek have become the sixth team in the continuing monitoring effort.

Other components of the Growing Greener grant project included an aquatic assessment (both electro fishing and macroinvertebrate study) at four sites along the length of the creek. Educational materials and activities to bring the watershed concept to the increasing numbers of Cherry Valley residents as well as to the larger community also were funded as a part of that grant.

A total of 28 stream name signs permitting identification of Cherry Creek (and its tributaries) at significant road crossings of the creek were received and subsequently installed by municipal partners; PA Dot installed signs along state roadways at several locations, as well. As a part of the grant, this website was established, and a number of educational brochures were produced to heighten stewardship activities in the region.

In an effort to expedite the orderly and efficient process of stream monitoring on Cherry Creek, two sub-teams were formed, the East team headed by Peter Steele and the West team headed by Donna Faulstick and Nancy Veety. Both are familiar with stream monitoring techniques and processes

Nine monitoring sites on Cherry Creek are tested on a monthly basis, and the water testing kit is rotated between each of the two teams' members. Data sheets, on which the test results are recorded, are subsequently input to the web site by citizen volunteer recorder Nancy Veety.

West Team Monitoring Site Locations:

- Below Twin Lakes
- Cherry Valley Trout Hatchery
- Kemmertown Church Bridge
- Below Blakeslee Farm

East Team Monitoring Site Locations:

- Keller Farm
- Mountain Run
- Charles Grech Property Pool
- Eagle Rest Tree Farm
- Delaware Water Gap

Tests completed each month include the recording of: air and water temperature, pH, water level (low, medium or high), water color and clarity, current weather (clear, cloudy, rain, etc.), odor if present, sulfates, nitrates, phosphates, total dissolved oxygen, specific conductivity, and alkalinity. Should unusual results occur, the stream monitor communicates with team leader who then repeats the test to verify the concern. If measurements beyond safe parameters are confirmed, the Department of Environmental Protection is notified for follow-up and action.

Fecal coliform testing on Cherry Creek was completed in August, 2001, and high levels were reported at several sites. Additional testing and follow-up is in place to better determine the specific sources responsible for the elevated levels. A heavy population of geese and ducks on the stream are likely responsible for the high levels reported. The Swiftwater offices of the PA Department of Environmental Protection complete the laboratory analysis for these tests on an annual basis in Cherry Valley and throughout the Brodhead Watershed. Monitoring results are posted via the EASI Senior Environment Corps Water Monitoring Database (http://www.environmentaleducation.org/action.lasso). An informational summary and suggestions for linking to the databases for each location is included in *Appendix C – PaSEC Database*.

One finding of concern was an increase in nutrient concentrations in the creek. However, no thorough analysis of the available data has been completed for the Cherry Creek watershed. An assessment for Cherry Creek similar to the one done for the Pocono Creek study in the Brodhead Creek watershed would provide a valuable analysis of current conditions and trends.

Threats to the quality of water in the Cherry Creek watershed may be either “man-made” or naturally occurring. Threats to drinking water sources in the Cherry Creek watershed can be considered as Groundwater Threats or Surface Water Threats; since the two are inseparably linked in the hydrologic cycle, a problem with one will inevitably mean a problem with the other.

Groundwater Threats

Man Made Threats. Many human activities can negatively affect both groundwater quality and quantity. For many years it was generally believed that the filtering capabilities of the soil protected groundwater from contamination by human activities on the surface.

But with the discovery in the 1970's of human-made organic chemicals in groundwater, people began to realize how extensively our activities can affect groundwater. In fact, in a nationwide study commissioned by the U.S. Environmental Protection Agency, 65% of the private wells tested failed to meet at least one drinking water standard.

Those activities that can have a negative impact on groundwater can be categorized in four groups: waste disposal, resource extraction, agricultural practices, and urbanization.

Waste Disposal. The best-known source of groundwater contamination is waste disposal sites (landfills), both municipal and industrial, that were in existence before new regulations went into effect in 1988. There are no municipal landfills in the watershed.

A search of the Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) database did not reveal any sites in the watershed. CERCLIS is sponsored by the EPA's Office of Superfund Remediation Technology Innovation, Information Management Center. The database contains information on site inspections, preliminary assessments, and remediation activities at hazardous waste sites

Septic systems are another potential source of groundwater contamination. If septic systems are improperly installed or maintained, bacteria, viruses, nitrate, phosphorus, chlorides, and the organic solvents that are found in many household cleaners as well as products sold to "clean" septic systems can all make their way into groundwater. As a result of poor construction or maintenance of their septic systems, rural homeowners are frequently the cause of contamination of their own wells. Improper management of land application of wastewater may also be a threat. Due to the generally poor soil conditions for septic systems, this is a major concern throughout most of the watershed not served by sewer.

Resource Extraction. As mines intersect aquifers and collect water, they interfere with groundwater storage and can lead to lowered water levels in wells. Stone quarries can have a negative impact on both groundwater and surface water sources. One resource extraction/stone quarry (Hanson Aggregates) operates on the western perimeter of the watershed in Hamilton Township.

Agriculture. Common agricultural practices such as fertilizing and applying pesticides are coming under increased scrutiny because groundwater samples have revealed nitrates and, in some cases, pesticides. The most prevalent problem is high levels of nitrate from over application of manure and fertilizer. Nitrate is especially harmful to babies, interfering with the blood's ability to transport oxygen, which causes the baby to suffocate (known as "blue baby" disease). Most of the agricultural practices in the watershed occur in close proximity to the stream corridor. In addition to the judicious approach with regard to the above practices, suitable riparian buffers can help protect the stream corridor from these and other impacts.

Urbanization. Many human activities and land use practices, which proliferate with urbanization, can negatively affect groundwater. Even cemeteries, for example, can contaminate groundwater. There are numerous old family cemeteries in the watershed (See: *Historic & Cultural Resources* map). Also many of the old farms in the valley buried or piled household waste in their back yards.

One effect of urbanization is recharge diversion. Soils that have been covered with impervious surfaces – roofs, parking lots, or streets – obviously cannot absorb precipitation. Nor can soils that have been compacted by heavy machinery. As a result, much of the water from rain and snowmelt goes directly into streams and is never available to recharge groundwater. The *Mean Impervious Cover* map described earlier provides an indication of urbanization within the watershed.

Large concentrations of people can also lead to over pumping of aquifers. This can result in significant aquifer drawdown, which in turn reduces the quantity of stream flow. Stream water quality then suffers due to higher concentrations of sewage treatment plant effluent. Intensive pumping in coastal areas can cause salt water to be drawn into aquifers and wells. Polluted stream water can also be drawn into drinking water wells.

With increased population comes industrialization and an increase in the amount and variety of industrial activities, many of which can potentially contaminate groundwater. Leaking storage tanks at both industrial sites and gas stations have contaminated groundwater in many instances.

Most Storage tank locations listed in the Pennsylvania Department of Environmental Protection's web site (eMapPA) for the watershed occur in the vicinity of Delaware Water Gap and are listed as being in compliance. A Storage Tank Location is a DEP primary facility type, and its sole sub-facility on eMapPA is the storage tank itself (aboveground or underground), and are regulated under Chapter 245 pursuant to the Storage Tank and Spill Prevention Act. Storage tanks currently contain, have contained in the past, or will contain in the future, petroleum or a regulated hazardous substance.

Individual homeowners also impact groundwater through a number of activities. These include improper disposal of used oil and over application of fertilizer and pesticides on lawns and gardens. Homeowners use four to eight times the amount of fertilizer and pesticides per acre than farms. Golf courses are another potential source of groundwater contamination from overuse of fertilizer and pesticides.

Natural Contamination. Dissolved solids, calcium carbonate, and iron are common, naturally occurring constituents of groundwater that may affect its suitability for drinking water and other uses. High concentrations of chlorides and nitrates can also restrict use of water. These constituents enter water by leaching from rocks as water moves through them. Hardness is a property of water, usually measured by the concentration of calcium carbonate, which increases the amount of soap needed to produce lather. Much of the water drawn from wells in the watershed is "hard" due to the calcareous subsurface geology.

Radon, a naturally occurring radioactive gas formed from decaying uranium or radium deposits, is a natural contaminant of increasing concern. Where radon is present in bedrock it can dissolve in groundwater and become a health hazard either when consumed or when the gas escapes into the air during showering, cooking, and laundering.

Hydrogen sulfide is an infrequent natural contaminant of groundwater caused by water storage in certain types of shale rock. It imparts a characteristic rotten egg odor to the water, but is not seen as a health threat at the levels at which it makes water unpalatable.

Corrosive groundwater is common. Corrosivity involves many factors including high acidity and low concentrations of calcium carbonate. In a recent Penn State survey of groundwater in private wells, 60 percent had corrosive water. Corrosive water dissolves lead and copper from pipes and plumbing fixtures thus causing a health risk.

Surface Water Threats

Because surface waters such as rivers, streams, ponds, lakes, reservoirs and springs are by their nature more "visible," most people have more experience with this water source. Surface waters are often used for recreation, providing us with opportunities for swimming, boating, fishing, and camping. Most of us have pleasant memories and experiences related to these water habitats and view them as a wonder of nature, representing crisp, clear, clean water.

However, surface waters have a higher risk of contamination than groundwater, especially in the Cherry Creek watershed because the watershed is both a recreational area and a high growth area. This increases the human activity within the watershed and, thus, increases the chances of pollution. The largest water bodies in the watershed have either a concentration of housing or are a water feature associated with an adjacent recreational camp. Larger surface waters can be contaminated by pollution from non-point sources or point sources – usually permitted discharges from sewage treatment or industrial waste treatment plants.

Point Sources

Point sources of pollution are those sites, such as industries or sewage treatment plants, which discharge wastewater directly into a body of water. The entry point of the discharge is at one or more discrete locations in the stream and therefore its effects can be readily measured and regulated. The primary regulatory mechanism of point sources is the National Pollutant Discharge and Elimination System (NPDES), a permitting system set up by the Clean Water Act and enforced by the EPA and DEP. Most often these are permits for industrial waste, sewerage wastewater or a stormwater discharge. The permitting process attempts to minimize the impact of human activity on the surface water sources. The single point source discharge (Water Pollution Control Facility/outfall pipe) into the creek is from Laird Technologies, a manufacturer of high performance shielding for a broad range of engineered components for the electronics and building industries. The company was recently known as Instrument Specialties; the name changed after its sale in 2000 to a British company.

Non-Point Sources

Non-point source pollution are threats to surface water sources that cannot be traced to one particular discharge location. Run-off from farms, golf courses, street and highway systems, parking lots, recreational fields, leaking storage tanks or septic systems, railroad or vehicle accidents (i.e., chemical and fuel spills), are all considered "non-point source pollution." Atmospheric deposition is also a significant non-point source of pollution. Airborne pollutants, from sources such as automobiles and coal fired power plants, fall to the ground through rain, snow, or fog, entering surface water.

Combined, these potential sources of pollution in the Cherry Creek watershed area pose the greatest threat to water quality. These threats run the full course of human activity from industrial and manufacturing centers, agriculture, residential homes and recreational uses.

In general, nutrients and pesticides from golf courses, agricultural uses and residential homes can threaten the receiving waters. Chemicals and waste products from industrial and commercial facilities, if not properly treated and disposed of, threaten surface waters; air pollution from automobiles and combustion can find its way into the hydrologic cycle; auto and truck accidents can introduce chemicals or fuels into a water source, and run-off from parking lots and streets and other roadways contains oil and grease, nutrients, sediment and road chemicals.

A contaminated aquifer can influence a surface water source when it discharges into a surface water source (e.g. when groundwater, contaminated by malfunctioning septic systems, parking lot runoff, or overuse of fertilizers or pesticides, enters a stream).

3.10 Water Supply

Private Drinking Water Systems

Everyone who lives, works, or visits the Cherry Creek watershed depends on the watershed for their drinking water supply. Water supplies can be either a private water system (an individual homeowner's well) or a public system.

A common source of drinking water in the Cherry Creek watershed is the private well. Most homeowners and small businesses in the Cherry Creek watershed depend on private wells for their drinking water supplies. Most wells are used for residential purposes, although small commercial entities also utilize wells for their drinking water source.

Unlike Public Water Systems, private systems are neither monitored nor regulated by the Department of Environmental Protection (DEP). The private individual (residential or small commercial operation) is responsible for both the quality and quantity of their private water systems.

Private drinking water systems (wells) can vary in depth from less than 100 feet to over 700 feet deep. In fact many wells in the valley bottom areas are shallow and are more often than not are artesian. These wells face the same threats to their water sources from contaminated groundwater as Public Water Systems, without the monitoring requirements of the Public Water Systems. Private systems depend on pumps, storage tanks and electrical service and, most importantly, the care of the homeowner, in order to operate. Whether affected by a drought, water contamination or a mechanical/electrical malfunction, private drinking water system owners, for the most part, are "on their own" and are responsible for the operation and maintenance of these systems.

Public Drinking Water Systems

Public Water Systems are licensed and regulated by the Pennsylvania Department of Environmental Protection (DEP). A Public Water System provides water to the public for human consumption. The water system includes collection, treatment, and storage and distribution facilities. The system provides water for bottling or bulk hauling for human consumption.

Within this definition, the Department of Environmental Protection regulates three different categories of Public Water Systems as follows:

- **Community water system** - a water system, which serves at least 15 service connections, is used by year-round residents, or regularly serves at least 25 year-round residents.
- **Non-transient non-community water system** - a water system that regularly serves at least 25 of the same persons over 6 months per year; examples are a factory or a school.
- **Transient non-community water system** - a water system, which serves a facility, such as a restaurant, where 25 or more different people may drink the water each day.

Water systems may use "surface water" sources (streams, creeks, springs, lakes or reservoirs) and/or they may use "groundwater" sources (wells). Regardless of their size or the complexity of their treatment facilities, all are regulated by and report to DEP.
Of course, these Public Water Systems are at risk from the various threats common to all water users in the Cherry Creek watershed, whether they utilize groundwater sources or surface water sources.

Community Water Systems in the Cherry Creek watershed include:

- Pennsylvania American Water Company (Blue Mountain System)
- Delaware Water Gap Borough Municipal Authority

Pennsylvania American Water Company

Pennsylvania American Water Company (PAWC), an investor owned public water system, operates the Blue Mountain System (Nazareth Service District / Stony Garden Reservoir and Plant) in the Cherry Creek watershed. PAWC is the largest landowner in Cherry Valley; they own 3,370 acres on the western end of the Valley where wells and two reservoirs are located. PAWC purchased the property in the 1970s from Blue Mountain Water Company who had owned the land since the early 1900s. In the valley, PAWC only taps four of the many springs existing on their property, and they use the water for backup only, generally during the summer months when other sources are low. They maintain a pumping station to move the water through pipes, most of which are located on the surface, up and over the Blue Mountain ridge into Wind Gap and Nazareth.

Permits are in place to withdraw 780 million gallons of water per year from surface sources (streams, springs) and 74 million gallons per year from wells. The company maintains an entitlement with the Delaware River Basin Commission; that is, the company is exempt from making payments to DRBC for water withdrawal because it is "grandfathered", incorporated earlier than the 1961 DRBC Compact. Blue Mountain Water Company earlier owned this tract. PAWC's 2002 Annual Water Quality Report for the "Blue Mountain System" is available on their web site: (http://www.amwater.com/awpr/paaw/media/pdf1442.pdf).

Delaware Water Gap Borough Municipal Authority
The Borough water system is comprised of two active wells and one reserve well. The water is disinfected and stored in a 450,000 gallon storage tank and serves 285 customers. Both a certified operator as well as a certified laboratory monitor the water quality.

Wellhead Protection Areas

Because it is out of sight, groundwater is often out of mind. For many of us, we only take notice of well water if it looks, smells, or tastes funny. But groundwater can be contaminated well before any obvious signs appear. Yet it can be difficult to clearly track a groundwater pollutant to its source, especially considering the many layers of soil and rock that water seeps through to reach an aquifer. Cleaning up a contaminated well is very difficult and costly, and it may not return to potable for a relatively long time. Thus it is important to create a "safe zone" around a wellhead by protecting the surrounding land from any potentially harmful activities.

DEP's Wellhead Protection Program is predicated on the principle that it is cheaper to protect drinking water sources than to clean up after contamination occurs.

As required under the federal Safe Drinking Water Act, the Commonwealth of Pennsylvania, through the Bureau of Water Supply Management of the PADEP has developed a Wellhead Protection Program to protect ground-water sources used by public water systems from contamination that may have adverse effect on public health, Participation in the program is voluntary and builds upon the basic requirement for water purveyors to obtain the best available source and to take the appropriate actions to protect the source, thereby ensuring a continual and safe water supply (DEP, Pennsylvania Wellhead Protection Program, 2000).

The Pennsylvania Safe Drinking Water Regulations define a three-tiered wellhead protection zone. Zone 1, the innermost, ranges from 100 to 400 feet in radius, depending on source and aquifer characteristics. Zone 2 has been defined as the capture zone that is by default a half mile radius around the source, unless a rigorous hydrogeologic delineation is performed. Zone 3 is the area beyond Zone 2 that contributes to the recharge to the aquifer within the capture zone.

The public water systems in the watershed are not involved in local Wellhead Protection Programs.

The *Pollution Vulnerability* map (Figure 3.5) illustrates the relative vulnerability of water supplies to pollution from surface or near-surface releases of contaminants. Natural protection of bedrock aquifers is provided by soil and sediment cover. Highly permeable soils (hydrologic soil groups A & B) provide little protection while less permeable soils (hydrologic soil groups C & D) provide progressively greater levels of protection. Alluvial deposits of sand and gravel serve as shallow water table aquifers in Monroe County. These deposits are highly permeable and, regardless of soil cover, are highly vulnerable to pollution.

[Insert: ***Mean Impervious Cover*** map]

Terry Hough of DCNR notes that area of the headwaters and at the confluence could be stormwater problem areas

[Insert: ***Stream Order*** map]

[Insert: ***Wetlands & Floodplains*** map]

[Insert: ***Stream Designations*** map]

[Insert ***Pollution Vulnerability*** map.]