CHAPTER 9: WATER RESOURCES

Introduction

Spa Creek near Truxtun Park

Annapolis recognizes that the protection of its water resources, particularly the condition of Chesapeake Bay, is of paramount importance to its future vitality. The Land Use and Municipal Growth chapters have indicated that the city is built-out and that the population growth projected will occur primarily through redevelopment. For this reason, the recommended water resource goals and policies presented in this Chapter are directed more toward reducing any existing impacts on water quality from existing development rather than extending service or accommodating large population increases.

This element addresses state planning requirements related to water supply, wastewater and storm drainage in accordance with Article 66B, Land Use, Section 3.05(4)(vi). It generally follows guidance provided by "*Models & Guidelines, Volume 26: The Water Resources Element*," by the Maryland Department of Planning (MDP). Similar to the Ch. 5 - *Municipal Growth & Community Facilities*, the Water Resources element makes every effort to work within guidance offered by MDP. The Water Resources element and Ch. 7 - *Environment* are complementary, particularly in regards to stormwater management issues.

The City embraces three main Policies; further details are in the Policy Recommendation section:

- Protect and conserve the existing Water Supply and Distribution Systems.
- Enhance the Wastewater Collection and Treatment Systems.
- Maintain Water Resource Management Areas.

Existing Conditions

Topics required by State guidelines are addressed in this section. They include:

- *Land Use Patterns and Growth*
- *Water System Supply & Demand*
- *Wastewater Collection & Treatment*
- *Drainage and Stormwater Management*
- *Water Resource Management Areas*
- *Coastal and Shoreline Protection*
- *Impervious Cover, and*
- *Adjustments to the Land Use Plan*

Land Use Patterns & Growth

- Growth in Annapolis, as indicated in Ch. 3 - *Land Use & Economic Development*, is expected to occur through development or redevelopment of a limited number of "opportunity areas" throughout the community with emphasis on creating urban spaces appropriate to the desired character for the area as well as efforts to continue to improve environmental and fiscal conditions.

Bembe Beach Marina

- Annapolis' population is projected to increase by 2,320 new households, between 2008 and 2030, as documented in Ch. 5 – *Municipal Growth & Community Facilities*.
- Ch. 7 - *Environment* recommends incorporation of a variety of environmentally friendly techniques into site and structure design, including opportunities to retrofit existing structures, as a means of reducing impacts on the natural environment.

Water System Supply and Demand

Water Supply

Groundwater drawn from seven deep wells located near the water treatment plant supply the City's water system. Water is pumped from three Coastal Plain aquifers – the Magothy, Upper Patapsco and Lower Patapsco aquifers. These aquifers slope downward from northwest to southeast and, where situated below Annapolis, are protected by confining layers of relatively impermeable, clayey soil.

The principal source of water for Annapolis is the Magothy formation. The aquifer is recharged where it crops out, an area of approximately 70 square miles in Anne Arundel County and another eight square miles in Prince Georges County. Possible exposures to the Magothy aquifer in the form of rock outcroppings have been reported in Bowie, which is approximately 10 miles west of Annapolis. Possible surface exposures to the deeper Patapsco aquifers would be more likely found further west and northwest, in the Columbia/BWI area. A study conducted jointly by the City and Anne Arundel County in 2003 concluded that there are no immediate threats to the raw water quality. A 2007 Study by the Maryland Geological Survey found that sufficient ground water is available to supply the projected demand through 2040, however ground water supply should continue to be monitored in order to plan for any shortfalls or threats that may arise in the future.

The 2008 Water Supply Capacity Management Plan (WSCMP) for the City of Annapolis, has provided the following observations:

- In the past five years, Annapolis' highest annual average daily water demand was 4.77 million gallons per day (mgd) – see Figure 9.1. This translates to household water use of 300 gallons per day (gpd). When this figure is adjusted for commercial and institutional water consumption, leakage, and unaccounted for water uses, household water demand is consistent with MDE's rule of thumb of 250 gpd per household.

- The City has been allocated an average daily use of 5.70 million gallons by the Maryland Department of Environment (MDE) with an average daily supply of 10.0 million gallons during the month of maximum use. State permitting conditions require that water be drawn from the Upper and Lower Patapsco aquifers to the "greatest extent possible," instead of the shallower Magothy aquifer.

- Annapolis is currently drilling a new well in the Lower Patapsco aquifer that will replace a similar, recently retired well. When this well becomes operational, the City's total capacity with all wells running at the same time will be 11.80 mgd. Well field capacity with the highest producing well off-line ("firm capacity") will be 9.26 mgd.

- Actual water uses recorded during the single driest annual summer month between 2003 and 2007 ranged from 4.7 mgd to 5.9 mgd. While 5.9 mgd exceeds the average daily allocation, it is well below the permitted allocation during the month of maximum use and the City's firm capacity.

- The City's MDE water allocation permit allows for an annual average daily withdrawal of 5.70 mgd. Actual use recorded between 2003 and 2007 has ranged between 74.1 and 83.6 percent of the allocation, as shown in Figure 9.1. The 2008 WSCMP states that the long-term safe yield of the water supply wells will be 8.2 mgd when the new well begins production. The safe yield takes into account water level trends in the water supply aquifers as well as individual well capacities.

Figure 9-1 City of Annapolis Daily Water Use and Allocation

City of Annapolis Daily Use & Allocation					
Year	Average Daily Water Use (mgd)	Allocation (mgd)	Percent of Allocation	Surplus Allocation	
				Daily Use (mgd)	Population Equivalent*
2007	4.53	5.70	79.4	1.17	4,690
2006	4.77		83.6	0.93	3,739
2005	4.65		81.6	1.05	4,198
2004	4.57		80.2	1.13	4,515
2003	4.22		74.1	1.48	5,912

* Population equivalent assumes per capita consumption of 100 gallons per day.
Source: Mark Schultz Associates and Kendig Keast Collaborative.

- Assuming that Annapolis grows by an additional 2,320 households and accommodates new commercial development (representing pipeline development and projected growth), by 2030 it is possible that average daily water use could grow from 4.77 mgd to 5.46 mgd. Figure 9-2 shows the impact of the residential and commercial growth discussed in *Ch. 5- Municipal Growth and Community Facilities* on the demand for water. The water demand figures in Figure 9-2 show the net increase in demand as a result of added development. If average daily water use exceeds the permitted allocation of 5.70 mgd, then the City will need to submit an application for an increase to the MDE.

Figure 9-2 Impact of Growth on Water Demand

Impact of Growth on Water Demand			
	Residential Units	***Commercial Space (sf)***	***Estimated New Water Demand (gpd)****
Projected Net Increase: Pipeline Development	470	200,000	144,500
Projected Net Increase: Projected Development 2009-2030 **	1,850	604,750	544,141
Total	**2,320**	**804,750**	**688,641**

*The Estimated New Water Demand is the sum of the demand created by new residential units (assuming 250 gallons per day/unit) and the demand created by new commercial space. For commercial space a demand factor of 0.18 gallons per day (gpd) per square foot (sf) is applied to one-half of the projected commercial space and a demand factor of 0.09 gpd/sf is applied to the other half. These flow calculation rates apply to general shopping centers and office buildings, respectively (Source: MDE).

**The projection of net new commercial development was arrived at through a build-out analysis of the planned Opportunity Areas (see Chapter 3). Actual commercial development through 2030 may exceed that shown in this table; only the net increase expected in the City through 2030 is shown, reflecting the fact that much commercial development occurs through the redevelopment of existing space which is presently provided with public water and sewer service and counted as part of the "existing use".

Water Treatment

The water treatment plant, which was designed for 10 MGD capacity, continues to have adequate capacity to meet the City's current and projected future demands. Treatment consists mainly of iron removal via injection of chemicals that cause the iron and other minerals in the raw water to coagulate and settle out, followed by filtration and chlorination/floridation.

The water treatment plant is over 60 years old and, while it was well constructed, it is in need of modernization and is slated for replacement. The Public Works Department is currently implementing or planning numerous improvements to enhance security, enclose and expand clearwell storage volume, update treatment processes, and replace aging equipment and control systems. These are included in the City's current capital improvements budget.

Storage

Water storage is provided by four water towers and one standpipe located throughout the City. Recently, the Public Works Department was considering the addition of another water tower but was experiencing difficulty in finding a location that was both functionally suitable and publicly acceptable. The need for this additional storage has been addressed with the 2009 project to enclose and expand clearwell storage volume at the Water Treatment Plant with two 1 MG- storage tanks. The City is also in the process of updating its water computer model to gain a better understanding of system needs.

Canoeing

Service Area and Distribution

The Annapolis water system serves all areas within the city limits and also extends outside the city to supply Loretta Heights to the west, Lindamoor and Dreams Landing north of Weems Creek, and the Chesapeake Harbor complex to the southeast of city limits (Figure 9.3). The water distribution system is reported to be generally in adequate condition, with ongoing repairs and replacement of aging components.

The City is completing a Water and Sewer Systems Study to update its water distribution system model and establish a foundation for identifying system deficiencies and developing a prioritized list of improvements. Improvement recommendations will be developed to address sections of the water system that may need to be cleaned and lined or replaced. This Study is expected to be completed in 2009.

Interconnection with other Water Systems

Excluding the out-of-city developments noted above, Anne Arundel County is responsible for supplying water to the remainder of the Annapolis Neck. A significant number of households in the Lower Neck area continue to rely on private wells of poor quality, and the County is formulating plans to extend service to these areas.

The U.S. Naval Academy operates its own wells, water treatment plant, and distribution system that serve most of the Campus. It is interconnected with the City's system at one tie-in location.

Back Creek Boatyard

Wastewater Collection and Treatment

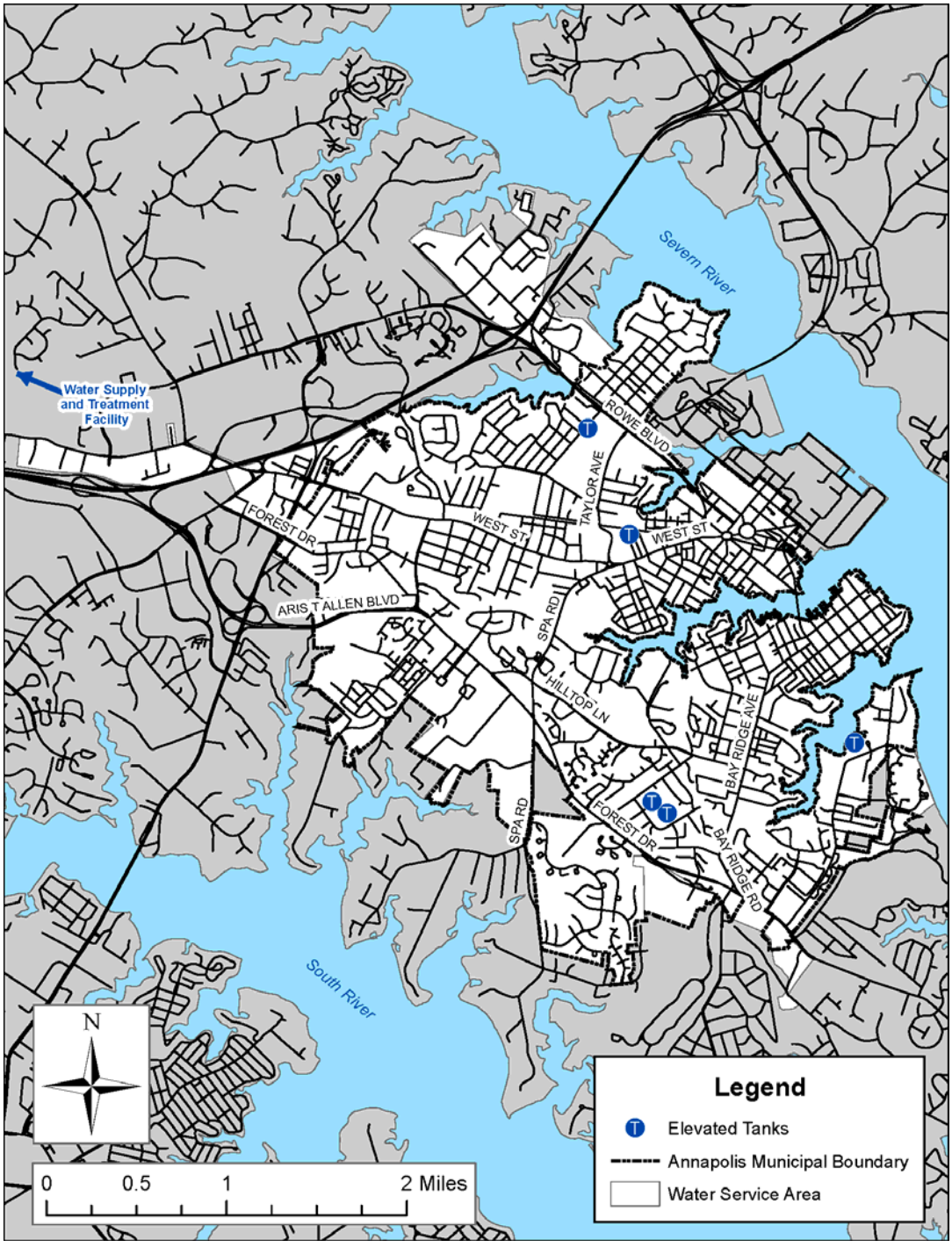

Figure 9-3 Water Service Area Map

Collection

Annapolis maintains a sanitary sewer system that serves all areas of the city and the Naval Academy. Based on the topography, the city is split into multiple pump station sub-systems to convey wastes to the treatment plant on Edgewood Road. A map indicating the existing sewer system and pump stations and siphon is shown in Figure 9.5. The City's sewer system serves all areas within the city boundary, although in some areas, service is subject to private connections to the system being made.

The City is completing a Water and Sewer Systems Study. This Study will update the City's wastewater model and establish a foundation for identifying system deficiencies and developing a prioritized list of improvements.

Inflow and Infiltration

Inflow and infiltration (I & I) can be a problem especially for older municipal sewer systems. Inflow is stormwater that enters the wastewater collection system as a result of insufficient stormwater management on lots (e.g., downspouts that direct water into sewer collection pipes). Infiltration is flow from groundwater that enters the system through cracks in pipes, for example. I & I add to the amount of wastewater that needs to be treated and discharged, which reduces available capacity for households and businesses. The Annapolis Water Reclamation Facility is operating under capacity and I&I has not be identified as a problem, but the City should undertake I&I studies of possible problems on a regular schedule.

Treatment

The Annapolis Water Reclamation Facility (WRF) is a plant that is jointly owned and supported by the City and Anne Arundel County, but is operated by the County. As a joint facility, it treats sanitary sewage collected from the City, County, and USNA. The plant is located off of Edgewood Road within the City's limits. The plant's capacity is 13 mgd, of which the City (with the USNA) has been allotted 6.7 mgd. The effluent from the WRF is discharged to the Severn River.

The City currently generates a little under 5 mgd of wastewater flow. Assuming that Annapolis grows by an additional 2,320 households and accommodates new commercial development (representing pipeline development and projected growth), by 2030 it is possible that wastewater flows could grow from 5 million gallons per day (mgd) to approximately 5.72 mgd. Figure 9-4 shows the impact of the residential and commercial growth discussed in *Ch. 5- Municipal Growth and Community Facilities* on the demand for sewer. The demand figures show the net increase in demand as a result of added development. While this remains within the City's allocation, it differs from an estimate calculated by the County in 2006.[20] The projection of 5.72 mgd should be factored into the City's Agreement with the County governing the WRF, which will be renewed in 2010.

20 The 2007-2010 Master Plan for Water Supply and Sewerage Systems by Anne Arundel County calculated that the City would generate only 5.48 of wastewater flow by 2030. However, the City's calculation is based on updated conditions and projections.

Figure 9-4 Impact of Growth on Sewer Demand

Impact of Growth on Sewer Demand			
	Residential Units	***Commercial Space (sf)***	***Estimated New Sewer Demand* (gpd)***
Projected Net Increase: Pipeline Development	470	200,000	151,725
Projected net Increase: Projected Development 2009-2030**	1,850	604,750	571,348
Total	**2,320**	**804,750**	**723,073**

*

Estimated New Water Demand is the sum of the demand created by new residential units (assuming 250 gallons per day/unit) and the demand created by new commercial space. For commercial space a demand factor of 0.18 gallons per day (gpd) per square foot (sf) is applied to one-half of the projected commercial space and a demand factor of 0.09 gpd/sf is applied to the other half. These flow calculation rates apply to general shopping centers and office buildings, respectively (Source: MDE).

**The projection of net new commercial development was arrived at through a build-out analysis of the planned Opportunity Areas (see Chapter 3). Actual commercial development through 2030 may exceed that shown in this table; only the net increase expected in the City through 2030 is shown, reflecting the fact that much commercial development occurs through the redevelopment of existing space which is presently provided with public water and sewer service and counted as part of the "existing use".

The County/City is in the process of completing a design of an Enhanced Nutrient Removal upgrade to reduce nitrogen to 3 mg/l and phosphorous below 0.3 mg/l. Construction on the project is scheduled to begin in 2009. The ENR upgrade would allow the plant's permitted capacity to reach 17.2 million gallons per day. There is sufficient space on the site of the WRF to expand to this capacity if needed. The Annapolis WRF currently uses Biological Nutrient Removal (BNR) technology and meets its permit requirements for total nitrogen and phosphorus concentrations in the effluent.

Wastewater Pretreatment

The Department of Neighborhood & Environmental Programs manages the City's Wastewater Pretreatment Program. This state regulated program, regulates the discharge of difficult to treat sanitary waste, having the potential to cause harm to the collection system, treatment plant, utility workers or the environment.

Septic Tank/On Site Waste Treatment Standards

The City's sewer system serves the full incorporated area. Septic tanks and onsite waste treatment are not a factor in Annapolis since there are no independent systems in the city.

Marine and Industrial Waste Management

Maritime and industrial waste discharges are subject to Maryland and U.S. Coast Guard regulation, as are recreational boating waste handling. Collection and conveyance to the City sewer system are the responsibility of boaters and individual marina operators. There are no commercial port or ship maintenance facilities in the City that require commercial disposal provisions.

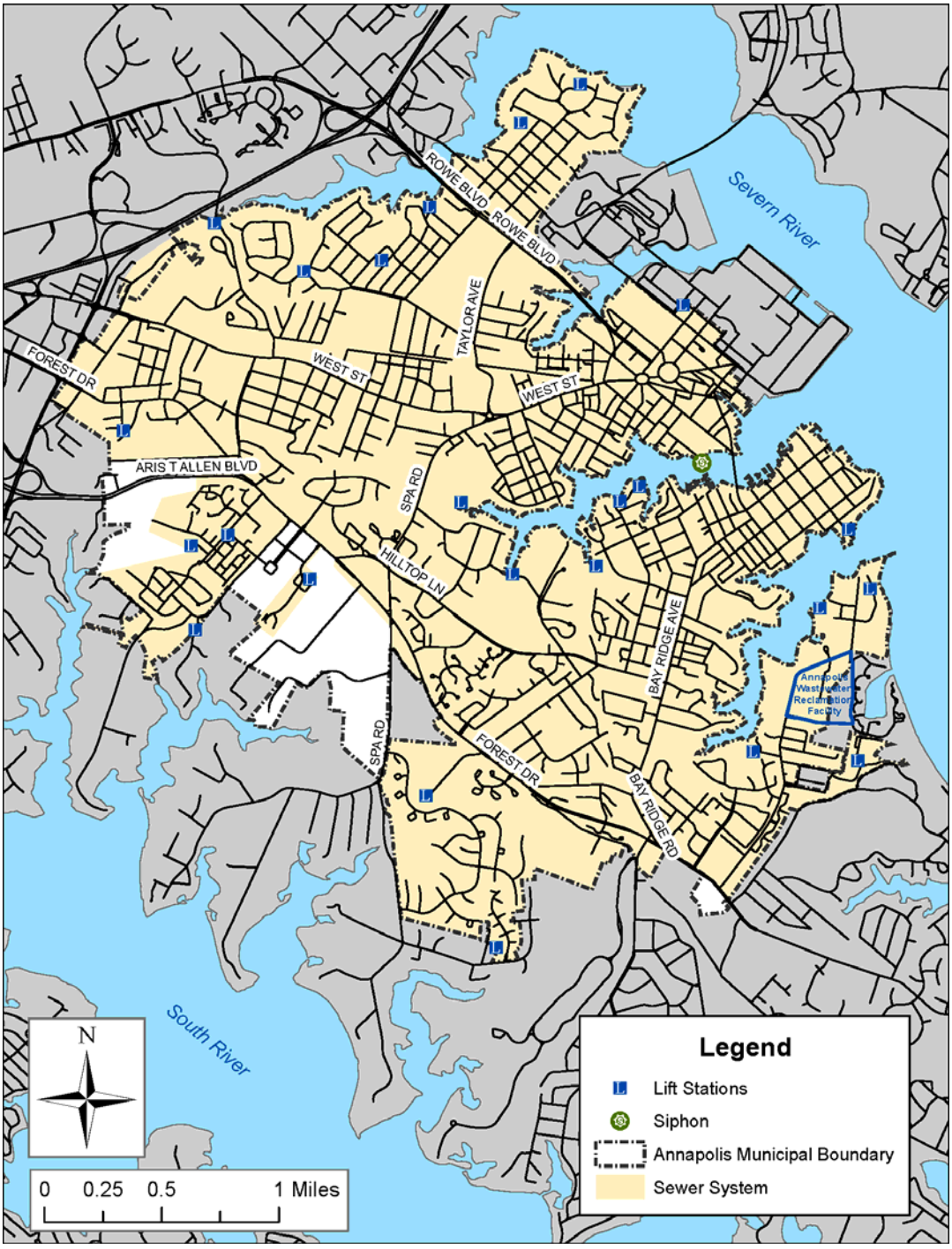

Figure 9-5 Sewer System Map

Drainage and Stormwater Management

Facilities

Generally, the City is served by a combination of storm sewers in the downtown urban areas and surface drainage into streams and creeks in the outlying areas. The storm sewers were separated from the sanitary sewer system during the 1960s and 70s. While there are no large retention/detention facilities integrated with the City's drainage system, such facilities are routinely required for all developments with large buildings or extensive paved areas.

Stormwater Management Sections of the City Code[21]

Chapter 17.10 is the stormwater management section of the City Code. It provides that all development and redevelopment activity in the City address water quality. In particular, it establishes that all site development plans with disturbances of more than 5,000 square feet (and 2,000 square feet for waterfront sites) shall reduce existing impervious area by at least 50 percent. If site conditions prevent this from being accomplished then the development plan must provide for enhanced control of the quality of runoff from the site. This improvement is most often accomplished through structural Best Management Practices, (BMPs) (such as rain gardens and infiltration trenches) but can also be done though such techniques as conservation easements, buffers, and greenroofs. Beyond regulation of development, the volunteer and individual efforts of property owners and businesses can meaningfully help improve stormwater quality in the City and help reduce the loads on stormwater facilities.

Erosion and Sedimentation

The Maryland Department of Environment (MDE) has established erosion and sediment control standards, implementation and maintenance techniques, and specifications associated with various best management practices during construction. The permitting requirements and monitoring are administered by the City of Annapolis. Techniques deal with appropriate means of soil stockpiling, surface grading, and the application sedimentation skirting and fencing. Grading, soil erosion, and sedimentation control permitting requirements are administered by the City as part of the building and grading permitting process. Sediments entering storm sewers and surface waterways are also managed through a regular street sweeping program.

Chemical and Fertilizer Usage

Introduction of organic chemicals and fertilizers into storm sewers and waterways can be destructive to the biological balance of receiving streams, waterways, and rivers. The excess nutrients cause algae blooms in the waterways. Algae blooms can block sunlight and also deplete oxygen, causing harm to both aquatic plants and wildlife. Best management practices are normally associated with public education on appropriate ways to dispose of household substances and the proper application of lawn chemicals. The use of fertilizers in City Parks is extremely limited. Fertilizers containing phosphates may only be used in the city under limited conditions or upon the completion of a soil test.

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21 Updates to State of Maryland stormwater design regulations automatically update the City's regulations in this area. The State Stormwater Design Manual is expected to become more stringent as it is updated in 2010 and with it, the principles of Low Impact Development may be expected to become increasingly relevant and applied in Annapolis.

Water Resource Management Areas

Wellhead Protection

Because Annapolis' raw water supply is drawn from wells ranging from 300' to over 1,000' in depth, special measures for protection from seepages into the aquifer at and around the locations of its wellheads is not a planning consideration. Additionally, the plant and all wells are located in Waterworks Park, shown in Figure 9.6. Approximately 30 acres of the 650-acre Waterworks Park are maintained as a secure water supply zone.

Aquifer Protection

The primary recharge areas of the aquifers supplying Annapolis are subject to significant urban and suburban development pressures in the Baltimore-Washington corridor. Quantity of aquifer recharge and the adequacy of aquifers to serve Annapolis over the long-term future is a regional issue that was evaluated in a 2007 study by the Maryland Geological Survey, *Optimization of Ground-Water Withdrawals in Anne Arundel County from the Upper Patapsco, Lower Patapsco, and Patuxent Aquifers projected through 2044.*

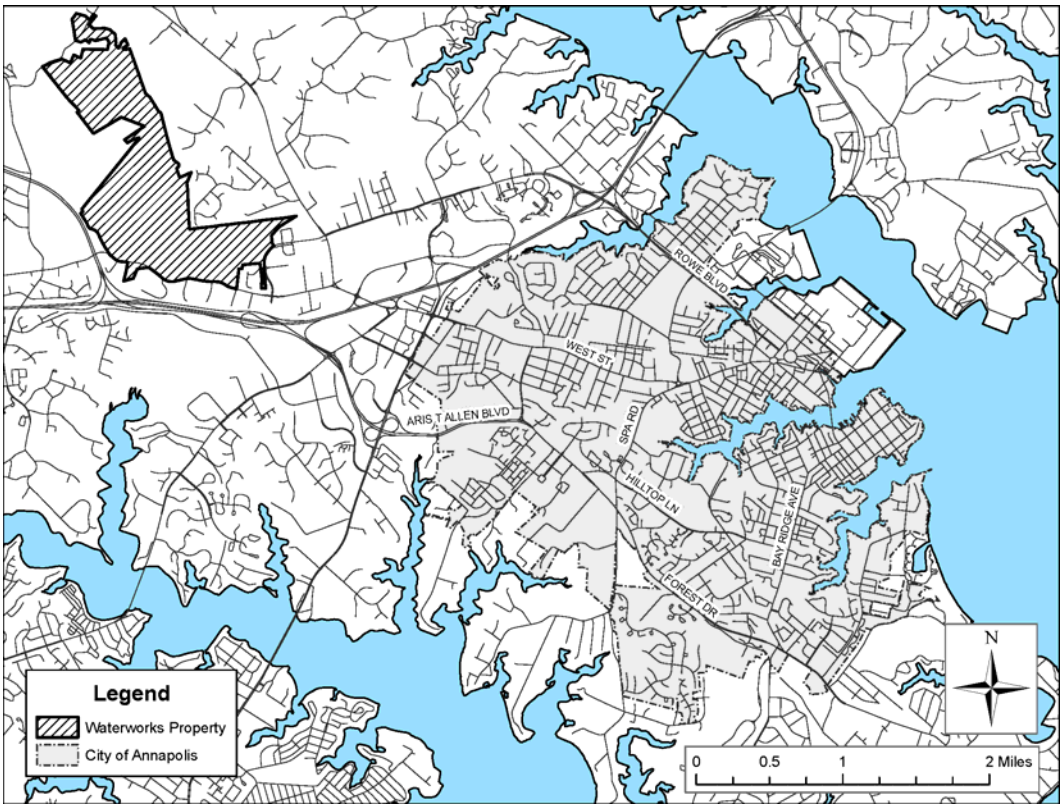

Figure 9-6 Waterworks Property in relation to the City corporate boundary

Surface Watershed Areas

Annapolis is situated in the "Lower Western Shore" tributary to the Chesapeake Bay watershed. The Annapolis Neck, in general, is drained by the Severn and South Rivers. More specifically, the City is drained by Weems Creek, College Creek, Spa Creek, and Back Creek, which are tributary to the Severn River and by Crab, Harness and Aberdeen creeks, which drain to the South River. Sub-watersheds are shown in Figure 9.7.

The City has completed an Action Plan for Annapolis Watersheds. The Action Plan measures impervious coverage for four sub-watersheds in the city (the Weems, College, Spa, and Back Creek sub-watersheds), and other indicators of ecological health. The analysis and recommendations from the Action Plan will inform the City's future actions in regards to watershed management. However, the comprehensive water resource planning that the City will conduct in coordination with Anne Arundel County, in compliance with Article 66B, is focused at the Severn and South River water levels and not to any individual stream, creek, or other "receiving water".

Annapolis' surface waterways also create challenges to the City in the form of infrastructure costs: bridges, culverts, water line and sewer crossings and the need for sewage lift stations for 14 sanitary sewer drainage basins for areas at the northern and western peripheries of the city.

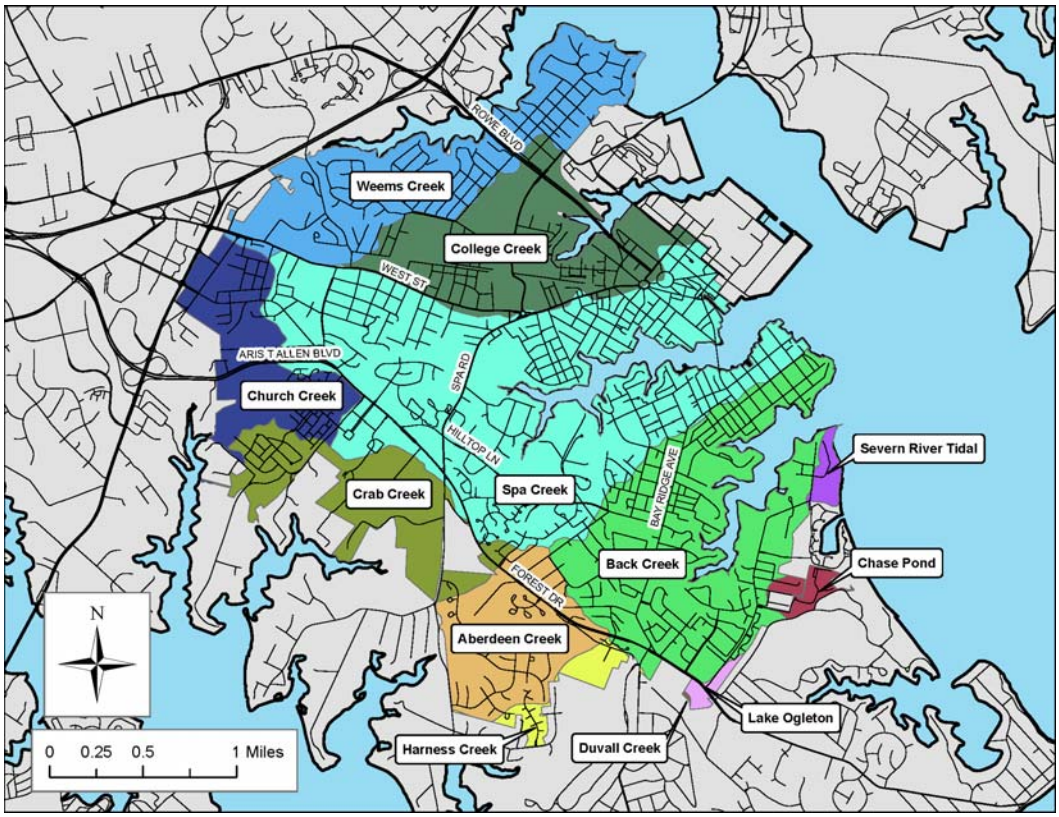

Figure 9-7 Sub-Watersheds Map

Stream Buffers

Most parts of Annapolis are drained by the freshwater and tidal tributaries to the Severn River. The City has recognized the importance of maintaining the integrity of these watercourses and has adopted Critical Area Overlay provisions to its land use regulations, which require a 100-foot minimum vegetated stream and wetland buffer.

These protected buffer areas generally correspond to the 100-year floodplains for the respective streams. Proposed development in these areas is subject to intensive review to ensure that impacts are minimized or entirely avoided.

Coastal and Shoreline Protection

With the possible exception of the far southern bank of the Severn River at Sparrows Beach and Horn Point, most of the City's shoreline is naturally sheltered from local storms and strong northeastern winds. A jetty has been constructed along the shore immediately south of the mouth of Back Creek, just south of the City Limits, to capture sand and provide erosion protection to the waterfronts of residences.

Waterfront Painting

Exposed shoreline development at the foot of Eastern Avenue and east of Horn Point Road is protected by a combination of submerged groins, riprap deposited on the bank, gabions, and sheetpile walls. Remaining areas of the City are less exposed and rely on sheetpiling with occasional riprap protection at the foot of the walls and "living shorelines" wherever appropriate. Major portions of the downtown area and the Naval Academy that are exposed to the Severn River are heavily protected by seawalls.

Hardened shorelines such as these are considered to be unsustainable, but are appropriate in built out urban areas that experience high energy wave activity. The use of groins tends to starve other down-drift beaches from natural sand accumulation, thereby depriving adjacent property owners' natural protection. These concerns have been recognized for decades, and the Coastal Zone Management Act of 1972, combined with Maryland's Coastal Program, has placed regulation of all coastal structures in the hands of the Maryland Department of the Environment, usually in conjunction with U.S. Army Corps of Engineers permitting requirements.

Impervious Cover

As noted in Ch. 7 - *Environment*, impervious cover in Annapolis is currently calculated to be approximately 42 percent. The City is currently completing an Action Plan for Annapolis Watersheds, which will refine the calculation of impervious coverage specific to each watershed. Given that the majority of proposed growth is located in currently developed areas, little of the tree canopy is expected to be impacted by growth. Refer to Chapter 7, for policy recommendations related to reducing pollutant loading to Annapolis waterways, increasing the tree canopy, and green building practices.

Adjustments to the Land Use Plan

No adjustments are needed to Future Land Use proposed in Ch. 3 - *Land Use & Economic Development*. This Plan's focus on environmental goals, in particular the reduction of polluting effects of stormwater runoff, Low Impact Development, the retrofit of stormwater management facilities and environmental site design in general, will contribute to water quality improvements as development and redevelopment occur. (See Chapter 7 – *Environment*, and Policy 3.4 of this chapter.) For the reasons mentioned below changes to the Annapolis comprehensive land use plan cannot be looked to for meaningful improvements in area water quality. Instead future growth will continue to be subject to strict stormwater management best management practices. When correctly implemented, development should have no significant impact on area water quality. In the case of redevelopment, pollutant impacts should be reduced especially in areas where existing development has substandard retention.

Annapolis is located within the Severn and South River watershed. The Maryland Department of Environment (MDE) has determined that both watersheds are impaired with respect to nutrients (nitrogen and phosphorous) metals, and bacteria. However, MDE has not yet established nutrient TMDLs for the watersheds as it is empowered to do under the federal Clean Water Act[22]. TMDLs stand for Total Maximum Daily Loads and reflect the total daily pollution that water bodies can absorb and still meet federal water quality standards. In the future MDE may promulgate TMDL's for nitrogen and phosphorous. When and if it is does, the City will endeavor to coordinate with Anne Arundel County to meet these established pollutant caps within the Severn and South River watersheds.

As part of its Water Resources planning, Anne Arundel County has completed watershed analyses for both the Severn and South watersheds and in the absence of TMDL's, calculated nutrient loading assimilative capacities for nitrogen and phosphorous[23]. Like TMDL's, the assimilative capacities establish a maximum value

22 MDE has established bacteria TMDLs for the watersheds. The Annapolis contribution in this regard is minimal because development in the City is served by the municipal sanitary sewer system, rather than by individual on-site septic systems.

23 The County calculated the non-point source (stormwater) pollutant loadings using its Watershed Management Tool and data on existing land cover, stormwater management coverage, impervious coverage, soil infiltration rates, rainfall, pollutant event mean concentrations and other pertinent data. The assimilative capacities are based on data on bacteria and other stressors in the watershed and established quantitative relationships between certain land cover characteristics and concentration of nitrogen and phosphorous in stormwater runoff.

for acceptable nutrient loading. Where pollutant loadings are found to exceed assimilative capacities, the land use condition is determined to be unable the support biological health of the watershed's receiving waters.

The County's calculated assimilative capacities for nitrogen and phosphorous (in both watersheds) is 2.7 lbs/acre/year and 0.38 lbs/acre/year, respectively. The County study shows that both values are well exceeded in the watersheds under current conditions and under the County's future land use plan conditions. Assimilative capacities are much like TMDL's except that they are planning targets without the regulatory authority associated with MDE required TMDLs. In the absence of MDE promulgated TMDL's, Annapolis will use the County's assimilative capacities and coordinate with the County to study the contributions it can make toward achieving assimilative capacities.

The County's analysis showed nutrient loading in the Severn and South River watershed will experience little change between the existing conditions and future County land use plan. The City's Comprehensive Plan also recognizes that it is not possible for Annapolis alone to attain the assimilative capacities. While Annapolis is a major part of the Severn River Watershed in particular, it is an established city and nearly completely developed and the City's land use cannot be looked to for meaningful contributions to water quality improvements. That being said, as part of a continuing and coordinated water resource planning effort, the City will coordinate with the County to compare the City's Land Use Plan (see Chapter 3) with existing conditions data used by the County and quantify any possible impacts to area water quality. No adjustments to the City land use plan are envisioned at this time.

This Plan's focus on ecologically sound re-development and environmental site design in particular will contribute to long term improvements in water quality, however. The City will coordinate with the County to study the potential reductions in nutrient loading that can be achieved using a variety of measures such as implementation of enhanced stormwater management BMPs. These are discussed in this Chapter and in Chapter 7 - *Environment*.

Policy Recommendations

Policy 1. Protect and Conserve the Existing Water Supply and Distribution Systems

1.1 Utilize the findings of the Water and Sewer Systems Study (completion anticipated in 2009) to prioritize and implement improvements to the water supply and distribution systems. Provide reliable water service to all City residents.

1.2 Undertake measures to reduce water system losses and per capita consumption rates. Actions that support this policy include:

- Implement a strong public information campaign to promote increased residential and commercial water conservation.

- Improve record keeping and analysis of water use. Increase the frequency of public water use reports.
- Consider the adjustment of residential water rate structures to reward domestic water conservation.
- Review existing building codes to determine opportunities to require water conserving fixtures and appliances.
- Promote (or require) landscaping practices that minimize watering requirements, particularly during the drier seasons.

Policy 2. Enhance the Wastewater Collection and Treatment Systems

The city's wastewater treatment system does not appear to be at risk in the near future, in part due to coordination between the City and Anne Arundel County. Improved nitrogen removal at the wastewater treatment facility (in continued coordination with the county) will continue. Emphasis on development and redevelopment opportunities within municipal limits reduces the need to expand the number of existing lift stations.

2.1 Utilize the findings of the Water and Sewer Systems Study (completion anticipated in 2009) to prioritize and implement improvements recommended for the wastewater collection and treatment systems. Using the sewer model being developed as part of the Study, evaluate system capacity frequently and consistently.

2.2 In the 2010 renewal of the City's Agreement with the County for the Water Reclamation Facility (WRF), factor in changes detailed in this Plan to the City's allocation of the WRF capacity.

Policy 3. Maintain Water Resource Management Areas

3.1 Maintain best management practices (BMP's)—frequent street sweeping, planting of street trees, enhanced streetscapes, and catch basin cleaning—to reduce the introduction of pollutants into waterways and storm sewers. Identify opportunities for additional BMPs, such as pet waste cleanup requirements, limited fertilizer use, disconnection of downspouts and capturing of rainwater onsite, and publication of violations. (City policy regarding stormwater management is detailed in Chapter 7 – *Environment*, and complements this policy.)

3.2 Maintain the portions of Waterworks Park dedicated to a secure water supply service area. This area should be inaccessible to public recreational use.

3.3 Coordinate with Anne Arundel County to continue to refine its analysis of nonpoint source nutrient loading to the Severn and South River Watersheds and monitor improvements to area water quality.

3.4 In order to meet higher standards for environmental quality, water quality in particular. the City should promote Low Impact Development (LID). LID is an approach to land use that works with natural processes and ecologically engineered systems to manage stormwater as close to its generating source as possible. Basic principles include preserving and recreating natural landscape features and functions to provide water quantity control and water quality improvements that benefit nature and society. Treating stormwater as a resource as opposed to a waste product, LID strives to minimize the effective impervious area of a site by creating or retrofitting drainage features on a small scale close to the source of runoff. LID can significantly reduce the adverse cumulative impacts of stormwater on the physical, chemical and biological quality of receiving waters.

This policy will be implemented in coordination with the policies in Ch. 7 – *Environment*. LID can be addressed through development of a Site Design Manual and by making changes to subdivision regulations, the zoning ordinance, and stormwater management regulations. These efforts should be coordinated with the City's Green Building Standards. This level of attention will be needed as the City seeks to reduce pollutant loadings to area waterways to levels comparable to a 32-percent impervious coverage, see Ch. 7 – *Environment*, policy 1.