CHARLES COUNTY WATER RESOURCE ADVISORY COMMITTEE

Report to the Charles County Commissioners

November 28, 2006

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Water Resources Advisory Committee
Report to the Charles County Commissioners

SECTION I: BACKGROUND

Since the early 1980's Charles County has been evaluating groundwater resources in an effort to understand the availability and quantity the County can safely utilize. Partnering with Federal and State agencies, Charles County Government (CCG) has undertaken or funded approximately fifteen (15) groundwater studies that have covered several different aquifers across the County, including the Aquia, the Magothy, the Upper and Lower Patapsco, and the Patuxent aquifers.

As the County has continued to grow in population, demand for water has increased. County population has increased 39% from 1990 to 2006, and is projected to grow another 40% by 2025. With an estimated use of 80 to100 gallons, per person, per day in the County, an estimated 11.5 million to 14 million gallons of water is withdrawn on a daily basis, by both citizens connected to public water and those using private individual wells. With the projected increase in population to 2025, groundwater withdrawals could increase to 19.6 million gallons per day county-wide.

In September of 2005, the Maryland Geological Survey (MGS) gave the Charles County Commissioners a briefing on the Southern Maryland Aquifer Study, which was evaluating the impact of future growth on groundwater aquifers in Charles, Calvert, and St. Mary's Counties. MGS reported that certain areas of Charles County may experience groundwater levels dropping below minimum acceptable levels, and causing certain wells to fail. Following this briefing, the Commissioners decided to explore various water alternatives through the help of County citizens and various water experts. The Water Resources Advisory Committee was appointed in the Spring of 2006, and was charged with providing the County Commissioners with an evaluation and recommendations of potential sustainable water resources for the County water systems[1].

The Water Resources Advisory Committee was comprised of county citizens interested in water resources, representatives from the Towns of Indian Head and La Plata, County staff, and groundwater experts from both the public and private sectors. The Committee first defined the issues that needed to be addressed, and outlined potential solutions to further investigate and evaluate. This report is the result of several months of discussion and assessment.

For the purposes of this report, the *public water system* is defined as any County owned and operated water system. The privately operated water systems are not included in this description of this term and are therefore referred to as *private water systems*. *Individual private well users* are the third entity described in this report and refer to individual homes or properties served by their own private well.

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[1]The Water Resources Advisory Committee was formed by the Charles County Commissioners based on the results of the Southern Maryland Aquifer Study of 2005-2006, by David Drummond, Geologist for the Maryland Geological Survey. This Report did not consider the Patuxent Aquifer in it's assumptions for future use and therefore should be noted when considering the content of the study.

Based on 2000 U.S. Census data, total groundwater withdrawals in Charles County equate to about 13.18 million gallons per day (mgd). The public water system makes up approximately 7.48 mgd, slightly under 60% of the total amount of groundwater withdrawals in the County. Although this report contains recommendations for both the public and private water users, the majority of implementation strategies pertain to the public water systems to create a greater and more immediate affect on reducing the impacts to area aquifers. The Committee also evaluated several implementation strategies for individual private well users to reduce the impacts of groundwater withdrawals outside of the public water system. These additional implementation strategies are also important to ensuring the longevity of the groundwater resources.

2.0 IMPLEMENTATION STRATEGIES - PUBLIC WATER

2.1 Options for Public Water Supply

The Committee evaluated a series of water supply alternatives, operational measures, and conservation measures for County action. Since groundwater is the existing *potable water* source for the entire County, the Committee first discussed the current concerns with groundwater and what changes could be made to the existing well network. This was followed by a discussion of alternatives to groundwater. The various alternatives are evaluated below and a series of recommendations is listed later in this report.

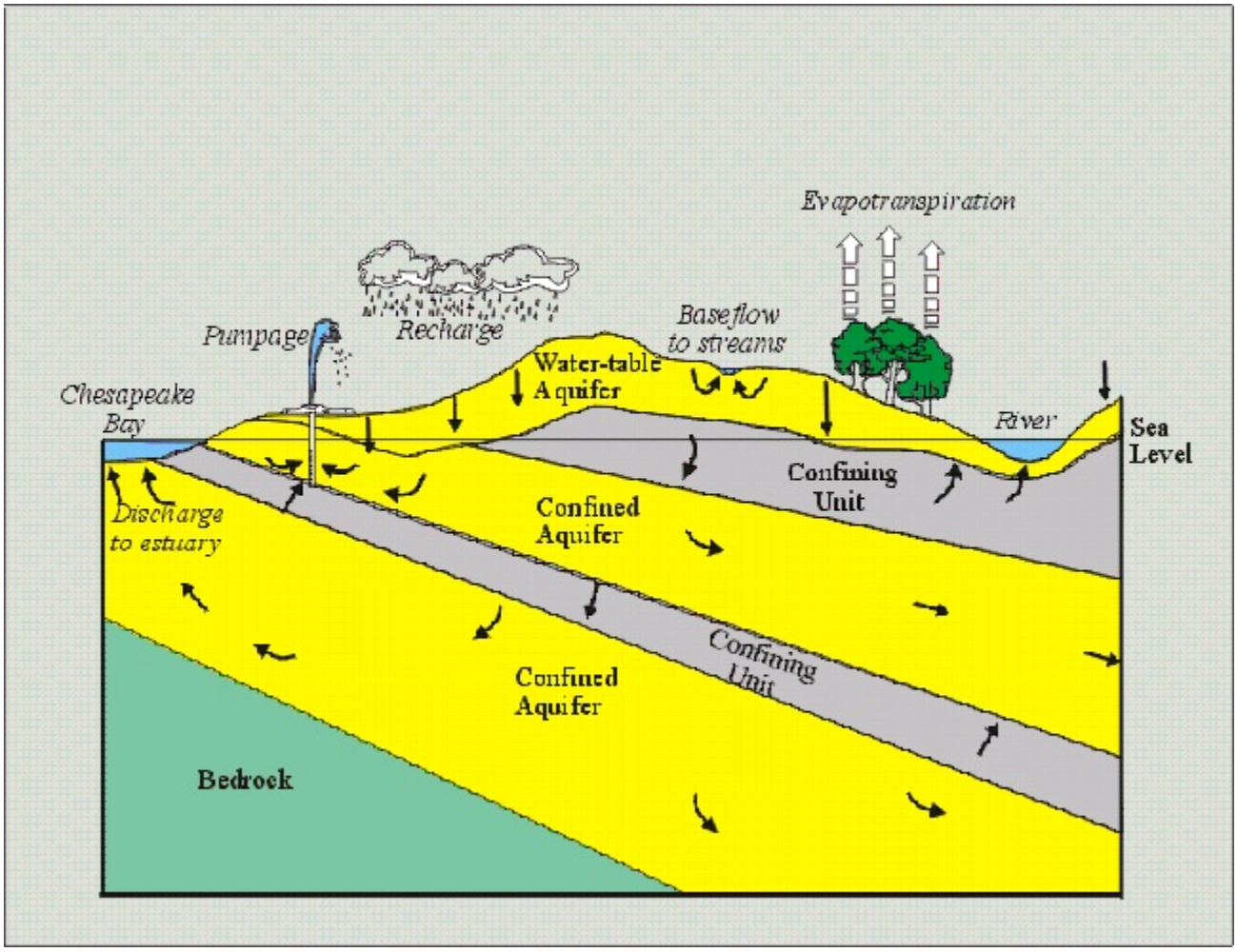
2.1.1 Groundwater

Groundwater is currently the primary source of potable water for Charles County Municipal Water Systems. The Maryland Geological Survey and the County staff have coordinated several studies over the last two decades that have determined that the local groundwater supply is limited and finite. The Water Resources Advisory Committee was appointed to consider and make recommendations on potential future water sources.

Charles County is located in the Coastal Plain of Maryland. The geology of the Coastal Plan is made up of sand, sediments and clays that were formed into sedimentary layers over millions of years on top of bedrock. As these layers formed over time, thick layers of clay confined layers of sands and sediments. Water naturally flows through these sediments, starting as rainwater on the land surface and permeates though the ground into the aquifers. The land surface area where rainwater or water from rivers or streams begin to permeate the ground is known as the "recharge area" *(See Figure 1).*

The water permeates through the soils layers and eventually accumulates in layers of sand and sediment, which are trapped between thick layers of clay. This layer is known as the aquifer. Within the aquifer, groundwater flows slowly through these sands and other sediments. Groundwater wells are drilled through the layers of clay

Figure 1 - Aquifers and Groundwater Hydrology[2]



Courtesy of the Maryland Geological Survey, 2005.

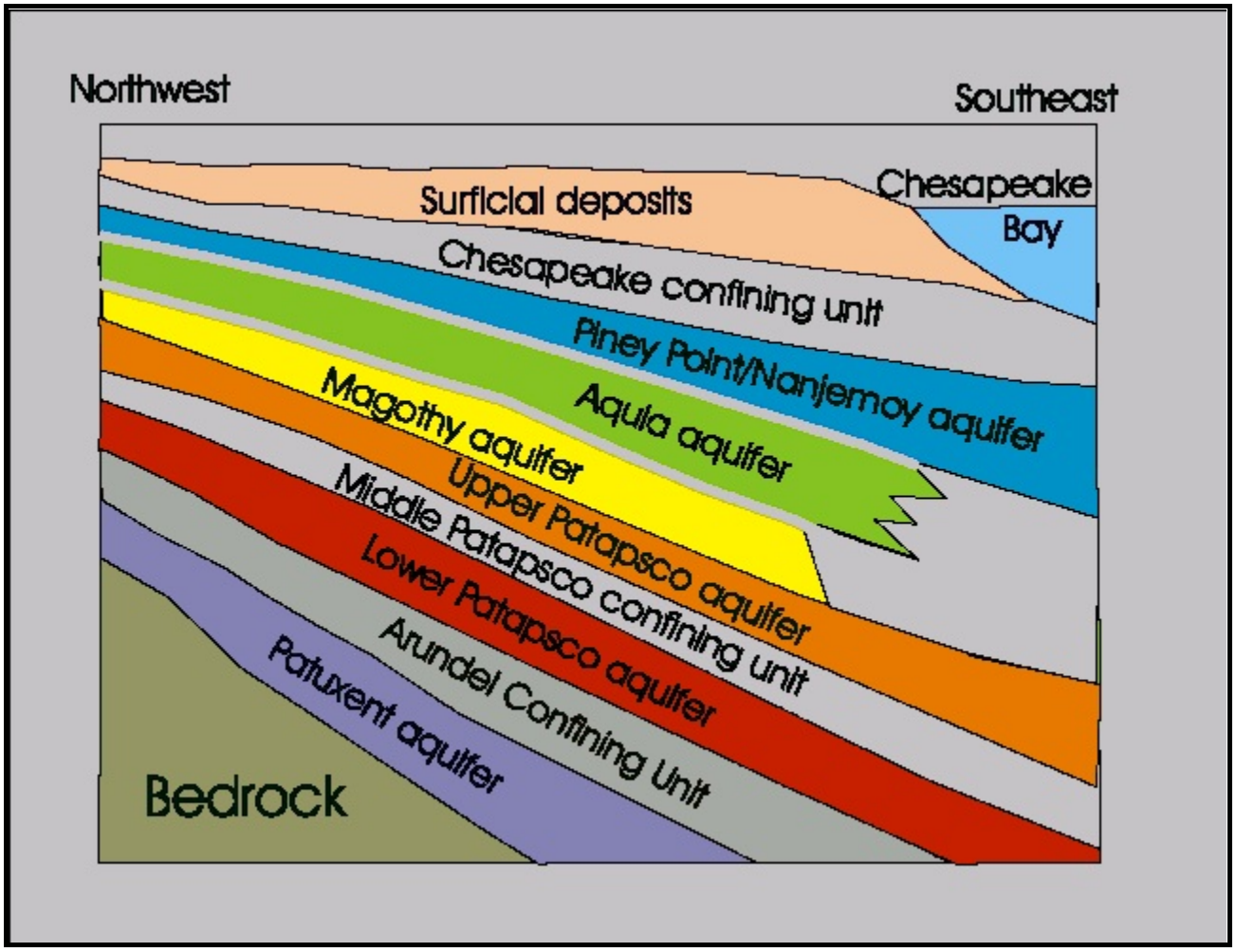
and sediments to reach the aquifers, where water can be drawn. A professional well driller will stop drilling when they find an aquifer that yields an adequate amount of water for the customer and that meets the minimum standards set by the State of Maryland. These standards vary based on the use of the well.

There are several aquifers in Charles County that vary in depth and water availability. These aquifers vary in depth from the Surficial aquifer, located just below the grounds surface, to the Patuxent aquifer which can exceed 1,000 feet in depth in

[2]Figure 1 is an example of the cross-section of the Coastal Plain Aquifers on the Eastern Shore of Maryland. This figure should not be used as a direct example of Charles County, MD. The figure is being used to illustrate the natural dynamics of groundwater flow and recharge.

various area of the County. These aquifers are described below in order of depth, starting with the most shallow *(See Figure 2)*.

Figure 2 - Aquifers and Confining Layers



Courtesy of the Maryland Geological Survey, 2005.

a. Surficial Aquifer

The Surficial aquifer is located just below the ground surface and is the only aquifer that is generally not confined. This aquifer mainly consists of shallow wells which are still permitted, but must be approved by the Charles County Department of Health.

b. Aquia Aquifer

In Charles County, the Aquia aquifer is primarily used by individual private wells. This aquifer is found to be productive in the eastern portion of the County, such as the Hughesville area. The Aquia aquifer becomes more productive to the east of the County, providing a greater water yield in St. Mary's County. Although the CCG does not have any production wells for the public water system in the Aquia aquifer, there is a small population of private wells for individual residents that are supplied with water from this aquifer.

c. Magothy Aquifer

The Magothy aquifer lies beneath the Aquia aquifer, separated by confining layers of clay and sediments. This aquifer was heavily used in the 1970's and into the mid 1980's as the primary source of water for the public water system. As total withdrawals approached three to four million gallons per day, the rate of decline of the aquifer began to increase dramatically. This caused the Maryland Department of Natural Resources (DNR) to require the County to shift pumpage to the deeper Patapsco aquifers. The County shifted 50% of its wells to the Patapsco aquifers in an effort to allow the Magothy to rebound. Groundwater monitoring wells have shown that this rate of decline has decreased. As of July 2006, the Charles County Government (CCG) withdraws an average of 2.7 million gallons per day (mgd) of water from the Magothy aquifer.

d. Lower Patapsco Aquifer

Through coordination with MDE and DNR, CCG began drilling major production wells into the Lower Patapsco aquifer in the mid-1980's and has continued this practice to date. The CCG pumps approximately 2.8 mgd from the Patapsco today and has been monitoring the groundwater levels with the assistance of the Maryland Geological Survey (MGS).

The CCG currently draws approximately half of the water for the public water system from the Lower Patapsco aquifer which has shown evidence of water level decline from increased use. As demand continues to increase, the CCG is seeking alternatives to the continual increase of pumpage from the Lower Patapsco aquifer. An additional concern is the impact this continual pumpage increase may have on area private individual wells (homeowners served by private individual wells). In order to reduce or eliminate the impacts on private well users, an alternative means of water management is needed.

e. Patuxent Aquifer

The Patuxent aquifer is the deepest aquifer in Charles County, lying below the Lower Patapsco Aquifer. This aquifer is relatively un-used in this geographic area, mainly due to it's great depth and the costs associated with drilling and operating wells to that depth. In Charles County, the average cost to a homeowner may be cost prohibitive from drilling to the Patuxent aquifer, in some cases greater than 1,000 feet. Since the aquifers are separated by confining layers of clay with limited leakage between them, it is likely that increased pumpage from the Patuxent aquifer will result in lesser effects in private individual wells.

Major water users such as the Town of La Plata, the Bryans Road Water System, and the Naval Surface Warfare Center at Indian Head have all drilled production wells in the recent past. The movement of these larger production wells into the Patuxent aquifer will reduce the impacts of large withdrawals on the smaller individual wells.

Recent studies by MGS have stated that there is limited information on the Patuxent aquifer and should be studied further to determine the suitability for a future water supply. Therefore, the Patuxent aquifer may be a viable resource for future use to reduce the *drawdown*[3] in the Lower Patapsco aquifer. A portion of the pumpage from the large public supply wells could be shifted from the Magothy and Patapsco wells into the Patuxent, thus potentially allowing the higher aquifer water levels to rebound. Additional investigation of the Patuxent aquifer and an overall Aquifer Management Plan will be necessary for long term use of the aquifers. Finally, further coordination will be necessary with the adjacent jurisdictions that share the same aquifers. The County should investigate the use of the Chapman State Park Wells through the State. These Patuxent aquifer wells were constructed, but never put into use for production.

The Chapman State Park property was purchased by the State of Maryland in an effort to preserve land in north-western Charles County in the late 1990's. Several discussions have occurred between the County and the State to potentially connect the two production wells on the Chapman property to the County's Bryans Road water system as a supplementary well source. This pair of wells draws from the Patuxent aquifer. The use of these wells would shift major withdrawals to the Patuxent aquifer and would reduce the stress on the Patapsco aquifers.

2.1.1.1 Well Locations

The location of wells in the coastal plain has a great bearing on the production capability of the well. According to many studies completed by the MGS, water

[3] Drawdown is defined as the distance between the static water level and the surface of the *cone of depression* (see pg. 9).

availability within the coastal plain aquifers of Southern Maryland becomes greater in the "down-dip" area. The aquifers become thicker and yield greater amounts of water to the south and east portions of the County's Development District. The aquifers have the least water availability in the Bryans Road/Indian Head Area. Wells in this area have to be drilled to great depths, in some cases exceeding 1,000 feet deep, in order have a sustainable water yield.

In order to comply with the recommendation of locating future production wells in the down-dip area, Waldorf Well 16 was located in an area recommended by MGS. Future wells for the public water system are also being planned to be located in the down-dip region.

Additional study may be needed to evaluate the location of wells outside of the Charles County Development District, where water is assumed to be more plentiful and likely to spread the impact of withdrawals out over a greater geographic area. As previously mentioned, MGS has indicated that the south-east portion of the Development District and beyond, is where the aquifers will likely yield a greater water supply while having a lesser effect on private individual wells. Should the County decide to pursue additional wells to support the public water system, a well field management plan may be necessary to plan and optimize water withdrawals. Further, this study will need to determine the exact location of these wells, and the associated costs to distribute the water back to the public water distribution system.

2.1.2 Surface Water

2.1.2.1 WSSC

The County currently has an agreement with the Washington Suburban Sanitary Commission (WSSC) to serve Charles County with up to 1.4 million gallons of water per day (mgd). The County has begun to consider a future allocation with WSSC to obtain an additional 5 mgd, thus meeting the current demand for the Public water system and reducing the demand on the confined aquifers.

WSSC withdraws water from the Potomac River and treats the water to drinking water standards. Several issues exist when considering the use of WSSC water. Charles County is currently on a unified rate system, meaning the that all residents receiving public water pay the same rate, regardless of the public water system they are connected to and the costs associated to supply that water to them. WSSC historically charges a higher rate to its users over those rates established for the users of the Charles County water system. Therefore, the increased cost of the WSSC water may increase the rates that County citizens currently pay. However, the rate that WSSC would charge Charles County is still to be negotiated.

An additional consideration is the effect to the consistency of water from the combination of ground water and surface water. Additional steps may be required to assure consistency of the water to the end-users with the public water system. Further investigation of the blending of water sources will be needed in order to determine the level of treatment needed in order to mix groundwater with surface drawn water. Once the necessary treatment or mixing techniques are identified, the alternatives for implementation must be considered. The cost and difficulties of these measures would need to be determined in order to make a fully informed decision.

An advantage to utilizing the additional connection to WSSC is the associated time frame for implementation. Once an Agreement is signed between the County Commissioners and WSSC, the County could begin design of needed infrastructure to make the connection to the WSSC water system. The distance necessary to make the connection is minimal, and would require little right-of-way. The associated cost of construction may be substantially less than many of the other alternatives being considered in this report. The WRAC has been informed that the Charles County Staff has begun discussions with WSSC to determine an acceptable rate for water consumption. The goal is to minimize rate increases to the County citizens.

A concern with this option are long term costs and guarantee of water availability. The WRAC has been informed by Charles County staff that the discussions between the County and WSSC have indicated that acceptable rates may be able to be negotiated. Requirements should be placed in the agreement to assure consistent billing rates over the long term. Additional assurances should be included with regard to a reliable supply of water in times of high demand or competition for the resource. This would also include an assurance of unchanged billing rates in times of high demand.

2.1.2.2 County-Operated Surface Water Source

The County may decide to further investigate the use of surface water from the Potomac River as a potable water supply. This would be an additional alternative source of water, which is also a surface water source. This would include the construction of a water intake station that would require the treatment of the water and associated transmission main and distribution lines. The location of such a plant would have a great bearing on the costs associated with this option. A plant located in close proximity to the existing distribution lines would be the most cost effective scenario.

A surface water production plant would enable the County to minimize groundwater withdrawals by switching a portion or all of the public water demand to surface

water. A plant could be located along the Potomac River, where water would be withdrawn and purified for distribution to the existing distribution system.

Some additional advantages to a surface water production plant is the control over the water source and the associated costs. Water security and quality assurance is an increasing concern for water operators to ensure health and safety of the clients of the water system. A County operated system would give greater assurance for the security of the water supply.

The greatest obstacle to overcome with a County operated surface water production plant is the cost associated with construction. Such a plant would take several years of design and construction. Several steps would need to be accomplished in order to implement a surface water plant. A feasibility study would need to be completed in order to determine if the plant is a prudent use of the County's resources. Design and construction costs will need to be estimated to determine feasibility as well as an estimation of the annual operation and maintenance costs.

Reverse Osmosis

Reverse Osmosis (RO) is a filtration process commonly used for making potable water from a surface water source, such as a river. Although it can be used for groundwater, RO is more commonly used for surface water resources.

Water quality holds equal importance to water quantity. Concerns with water quality vary based on the water source. To date, groundwater has been very high quality in most areas of Charles County. Groundwater is also a fairly secure source of water from contamination. In some cases certain methods of filtration have been necessary in the County to assure a high quality water supply. Although other sources of water, such as surface water from streams, rivers, and reservoirs have commonly required filtration, groundwater generally has not. Unacceptable levels of Arsenic and other naturally occurring elements have been found in neighboring County (St. Mary's & Anne Arundel Counties) wells. Charles County recently found levels of Polonium in the Chapel Point well, resulting in the installation of a Reverse Osmosis (RO) filtration system. This system is also used for filtering surface water sources.

RO is a process used to make drinking water potable through the use of an extremely fine filter. The filter or filtering membrane allows water to pass through extremely small pores, while trapping particles or contaminants. This filtration process is often used to de-salinate water to make it potable. The County currently uses the RO process on the Chapel Point Woods well.

Concerns with RO and other filtration processes for both ground and surface water sources, include the disposal of the waste materials, including wastewater, resulting from the filtration process. Currently, the County treats this waste material at the Mattawoman Treatment Plant. This is thought to be an acceptable method by MDE.

The cost associated with RO is high. Filtration of the water through the RO process requires equipment that is quite costly, as well as the filtration materials. However, when it comes to the assurance of a high quality water supply and the public health needs, the costs have been accepted. Consideration and evaluation should be given to the costs associated to each alternative reviewed in this report.

2.1.2.3 Watersheds/Reservoirs

The County previously conducted a study to determine if a reservoir could be created to sustain a potable water source. The water supply system report, prepared by Whitman, Requardt and Associates, identified five potential impoundment sites for the Waldorf service area. An executive summary of that report limited the supply sources to Mattawoman Creek, Port Tobacco Creek, and Zekiah Swamp. The summary indicated that surface water supplies are not feasible at this time due to low safe yields, environmental impacts, and high capital and operation and maintenance costs. However, because other more highly ranked alternatives for water supply may become impractical to develop, the report identified the Kerrick Run site as the most feasible of all the previously studied sites. The Kerrick Run site, however, is located within the St. Charles development. This site was not considered further due to the existing and proposed development around the Kerrick Run site.
Charles County is generally flat and inappropriate for a reservoir based water supply, similar to those used in the Piedmont areas of Maryland. Additionally, a reservoir is not recommended due to the associated vulnerability of the water for public consumption.

Although a reservoir would be another County-owned and operated water facility, the water consistency could not be guaranteed to be free from potential contaminants. Water security continues to be a great concern and a major issue when evaluating potential sustainable water resources for the County. Finally, the costs associated with the construction of a reservoir are believed to be prohibitive. The purchase of the land necessary to facilitate this reservoir in combination with the construction of the dam make this option unattractive.

2.2 Operational Measures

2.2.1 Well Field & Operational Optimization

Operational optimization can be completed through several venues. These include the construction of well fields, associated pumping strategy plans, and the automation of remote equipment to reduce labor and optimize the use of the well network. All of these implementation strategies combined result in greater efficiency of the system and increase the potential to properly manage water levels in the aquifers.

The Maryland Geological Survey (MGS) recently completed two reports for Charles County to determine the optimization of groundwater withdrawals in the Waldorf and Bryans Road water system. These reports analyzed several different well pumping scenarios to determine the greatest water yield from the wells while minimizing draw-down of the water levels in the aquifers. The County's capital project to interconnect the Bryans Road water system with the Waldorf water system provides additional help to reduce the pressure placed on the aquifers, specifically in the north-western portion of the County. The further expansion of the water system will provide support to areas that may have groundwater availability issues.

Building on this concept, the construction of a network of wells in various locations within the County, will allow for greater pumping optimization of groundwater. Through the use of monitoring wells to observe the effects of well pumping, the County will be able to rotate groundwater withdrawals to different wells and reduce the impact of draw-down. By minimizing the effect of draw-down, the County will be able to reduce the impacts in a given area on private well users.

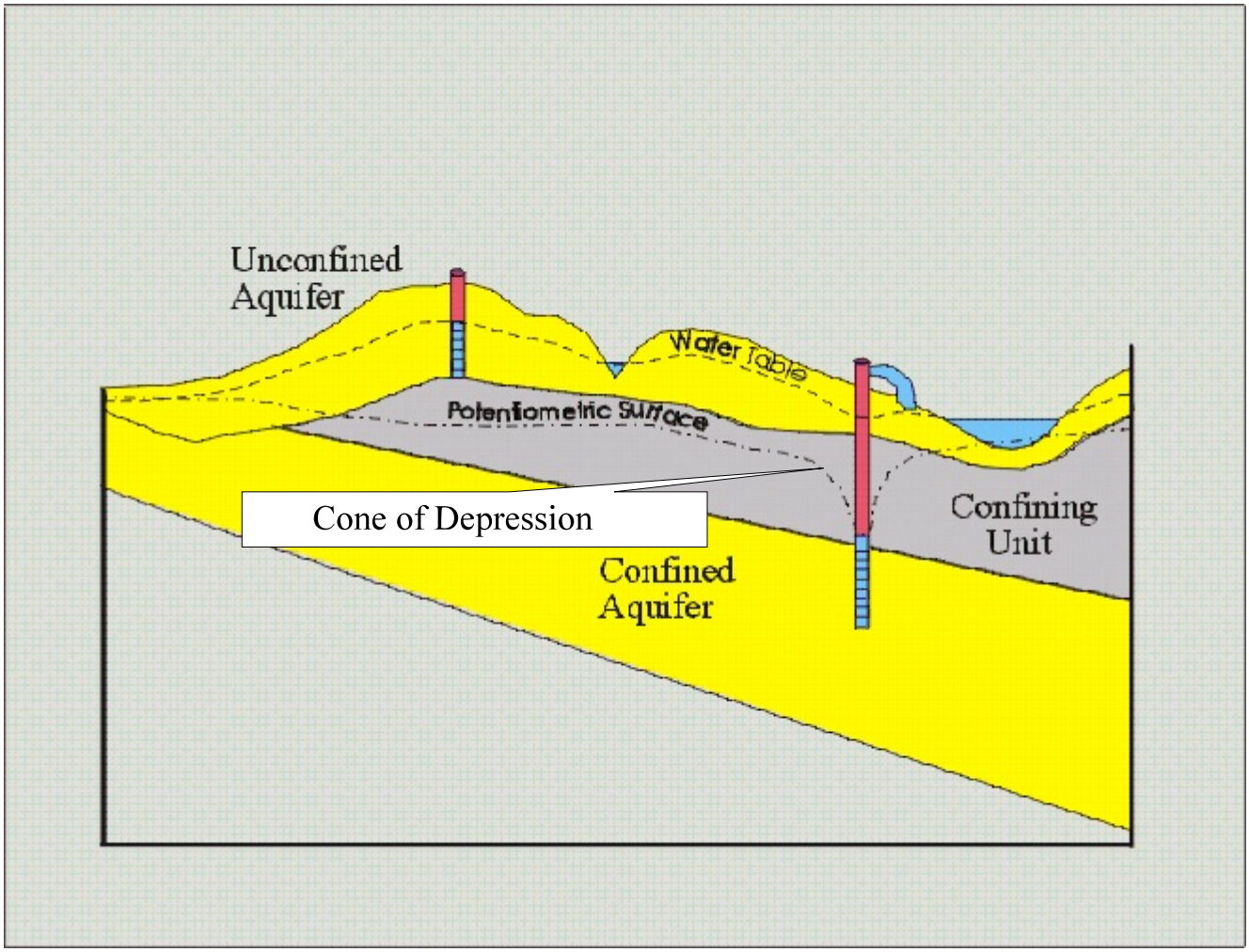
The advantages of a well field include management over the water source, both for cost and operations. In addition, the quality of water from the confined aquifers tends to be higher with little treatment cost as compared to other water sources.

Disadvantages may include the costs associated with the infrastructure needed to transmit water from the withdrawal location to the distribution network and or consumer. The well field area may consist of locations outside of the current Development District or County Water and Sewer Service Area. Potential pressures may arise from locating public water in an area of rural zoning. However, the presence of public water does not generally create development pressure, as compared to the presence of public sewer. In addition, the Maryland Department of Planning (MDP) under the Smart Growth Act of 1992, has allowed for such a scenario while prohibiting connections of the dwelling units outside of the development area. The term used is a "No Access Zone." Therefore, connections can be prohibited under Maryland State law if necessary. Development should only be dictated by the County's Comprehensive Plan and the associated zoning. However, policy provisions may need to allow the connection of private well users outside the

Development District if public health and safety is a concern. This would likely occur if a private well yields poor water quality or contamination.

An additional concern is the resulting effect of draw-down on the private individual wells surrounding the subject production wells. The large production wells tend to create a large cone of depression[4] possibly causing water levels to drop below the well pump *(See Figure 3)*. Additional monitoring wells may need to be installed to observe fluctuations in groundwater levels as the County continues to develop.

Figure 3 - Well Pumping and the Cone of Depression



Courtesy of the Maryland Geological Survey, 2005.

[4]Cone of Depression is defined as a depression in the groundwater table or potentiometric surface that has the shape of an inverted cone and develops around a well from which water is being withdrawn. It defines the area of influence of a well.

Further, liability issues may have to be explored to determine what responsibility the County has to these private wells if a problem occurs. A policy may be necessary to address this issue.

The implementation of such a strategy or plan would consist of further coordination with the Maryland Geological Survey (MGS) and the Maryland Department of the Environment (MDE) to determine the optimal locations for future wells in the down-dip area. With proper management, where the withdrawals do not exceed the recharge of the aquifers, the groundwater resource may last indefinitely.

2.2.2 Increase Storage (ground/elevated)

The elevated storage of water enables the citizens served by the public water system to continue to have water supply during power outages, have a back-up supply in times of high demand, maintain an adequate fire flow supply in an emergency, and reduce groundwater withdrawals when needed. Elevated storage creates pressurization of the water system through gravity. Ground storage tanks accomplish the same goals, but require mechanical pumps.

Other advantages to storage include the ability to rest the wells when needed through the use of the stored water to meed the demand. Additional storage is needed to keep pace with the demand from development and ensure an adequate supply. The County often works with developers to cooperatively construct the necessary infrastructure to meet the increasing demand.

Generally, the burden of the construction of the storage facilities falls on the County. In some instances, such as a satellite water system, the developer constructs the storage facility. The major disadvantage to water storage facilities is the cost associated with the facilities themselves and the associated infrastructure. The County's Adequate Public Facilities Ordinance calls for developers to mitigate for their impacts to the water infrastructure. However, many times the construction of a water storage facility greatly outweighs the individual developers impact. Therefore, the developer is generally required to make a fair share contribution to the construction or is required to make another system improvement that equates to their project's impact on the water system.

2.2.3 Aquifer Storage Recovery

Aquifer Storage Recovery (ASR) is defined as the storage of water in a suitable aquifer during times when water of good quality is available, and recovery of the water from the same well during times when it is needed[5].

[5] Source: Aquifer Storage Recovery: A Guide to Groundwater Recharge through Wells, Second Edition. Author: David G. Pyne, 1995.

ASR has not been used to any great degree in the State of Maryland. However, it has been used for decades in the state of New Jersey and several other states across the Country. This is done by pumping water back into the existing production well into the aquifer. Possible sources of water to be used for ASR are surface water, such as water from WSSC, or groundwater that was previously pumped from the aquifer. The most efficient source is groundwater. This form of water storage is likely the most affective way of regenerating the supply for potable water. The associated costs would be relatively low, since the water would pumped back down existing wells from above-ground water sources.

Implementation of this strategy may have a relatively short time-frame. A feasibility study would need to determine the impacts on the aquifers from this activity in the coastal plain sediments. Since this effort has not been widely used in this region, some assurances would have to be made that there would not be any negative impact on the groundwater aquifers and their ability to yield safe and drinkable water.

2.3 Conservation & Demand Reduction Measures

Demand for water continues to grow with the pace of development. The population in Southern Maryland has increased from 64,626 people in 1950 to 281,320 people in 2000. This growth has been the greatest in Charles County with an increase of nearly 100,000 people in this time frame. Population growth is expected to reach 205,000 people in Charles County by 2030.

Several options exist to reduce the demand that existing and proposed development create on the area water supply. These include various conservation measures and the re-use of treated wastewater for non-potable uses, like car-wash facilities.

2.3.1 Conservation Strategies

Water conservation strategies and demand management are small measures that can have a great impact on water consumption. Conservation of water resources can be accomplished in several different ways. In the mid-1980's, the State of Maryland mandated that all Counties implement and enforce the use of water reducing fixtures in all new construction. A retro-fit encouragement program was also put into place in this time period to encourage existing dwelling units to replace their water fixtures with the water conserving fixtures. A noticeable reduction in flows occurred from this implementation. Therefore, the use of these fixtures should be continued.

However, with the proposed future demand based on the volume of people for Charles County, additional measures must be taken to compensate for this growth. Water billing is currently a unified rate in Charles County, meaning that all users on the public water system pay the same rate per 1,000 gallons regardless of the gallons used, type of use, and location. Several jurisdictions base user rates on water consumption as a way of encouraging was conservation. Essentially, the higher the

water usage, the higher the billing rate. Thresholds would be established for billing rate structures. A higher water user, would likely be placed into a higher billing rate and pay a greater penalty for the higher use. In order to determine thresholds and associated rates, categories would have to be established for each rate type. Commercial users that are dependent on water use, would be billed at a higher rate per gallon than a typical residential user. The same basic scenario would be applied for a residential user that uses a significant amount of water over the typical user, such as filling a swimming pool or excessive lawn irrigation.

The benefits of demand management generally result in water conservation by the user and conservation of the resource. Patrons tend to change their habits when the cost is greater. Habits such as selecting landscape plants that do not require excess watering, retaining swimming pool water rather than refilling it with tap water each year, and promptly correcting leaking water fixtures within the home are all examples resulting from graduated billing.

There are few disadvantages to graduated billing. The greatest disadvantage is customer adjustments to the new rate structure. Adjusting habits of water use can result in customer complaints or perceived price gouging. However, after the adjustment period, it is expected to be an accepted measure of water conservation. Implementation of such a rate structure could be a short term implementation and have little cost to the County.

2.3.2 Water reuse

In many cases, water can be re-used for various purposes when the water does not have to be potable. Water reuse is considered a conservation measure because it takes the demand away from fresh water. In the case of Charles County, water reuse would take the demand away from the groundwater aquifers. Generally, the demand for non-potable water comes from industrial uses, such as water for cooling for power plants. Additional uses considered would be for landscape sprinkler systems for office complexes and shopping centers or golf course irrigation. These uses demand a high volume of water and have a great impact on the precious water resources.

The use of treated effluent from wastewater treatment plants, also known as "graywater," has been a widely used non-potable water resource. Treated wastewater has been used in near-by jurisdictions for many years for these purposes and been shown to greatly reduce the demand on groundwater withdrawals. Many environmental benefits also exist through the re-use of treated wastewater. In many cases, treated wastewater is discharged to a local river or stream. Depending on the demand for this treated wastewater, the surface water discharges may be dramatically reduced or eliminated completely. This reduction or elimination would improve the water quality of the water body. In addition, the treated effluent could also be used

as a revenue source for the County by charging a rate to the customer, similar to the current billing system used for the existing potable water system.

Implementation of such a program would require the construction of infrastructure to distribute the treated wastewater to the users. The cost of this implementation would consist of planning and design, acquisition of right-of-way, and construction of the water line and associated infrastructure. This construction would likely be completed through a government capital project or in conjunction with a major industrial user. In addition to costs, a distribution plan for end users would also have to be developed, including associated policies and regulations for use.

2.4 Water Security & Reliability

Following the events of the terrorist attacks on September 11, 2001, concerns have risen with regard to water security. The WRAC discussed issues regarding security of the County's drinking water supply and how they differ based on the source of supply. Consulting with the County's Department of Utilities and the County's Department of Health, it was decided that the wells serving the public water systems remain safe from contamination in most cases. Private individual wells were also considered to be a safe and secure source of drinking water.

Members of the WRAC also raised a concern that in the event of a power grid failure in the area or other loss of electrical service due to a terrorist attack or a natural event that the county could be without water for an extended period. It was the consensus of the group that the county should acquire generators for the pumping stations. The generators should have an adequate supply of fuel and should be regularly checked to assure their operational fitness. The county personnel who are well operators or otherwise directly involved in the treatment of our water supply should have the necessary security clearances for such operations.

3.0 IMPLEMENTATION STRATEGIES - PRIVATE WATER

Private residential wells and private water companies account for more than 40% of the water used in the county. The state has a responsibility to this sector that includes the issuing of drilling permits, establishing regulations to assure the quality of the water being used and protecting the supply. The County has the responsibility to ensure the health, safety, and welfare of the County citizens.

3.1 Private Individual Wells

Private individual wells share the same aquifers as the public water supply systems in many cases. Therefore, these wells are competing for the same water supply. In general, the deeper private wells last longer or indefinitely, depending

on the depth at which the public wells are drawing down water levels. In some cases the large withdrawals needed for the public supply can lower water levels below the pump for the private wells. In such cases, the owners of a private well have been responsible for the cost of either lowering the pump for their well or drilling a new well, depending on the well construction.

State law[6] requires local or county authorities to ensure that adequate water is available before approving a building permit and to ensure that adequate capacity will be available in time to serve a proposed development before approving a subdivision plat.

Through the state water and appropriation process, specific proposed water uses are reviewed to determine if the resource is adequate and whether the impacts of a withdrawal are reasonable. It is a reactive process addressing a specific request and does not assess the availability of water for future projected uses, or plan for their development. In this regard, the county should assign resources to plan for the orderly development of available water resources and to assure growth and development plans are commensurate with available resources. These functions will require County staff to implement this legislation and to coordinate water issues and projects.

In some areas, private residential wells have been adversely affected by growth in the county. The county's growth management responsibilities should include proactive measures to protect the many private residential users of our groundwater. It is important for the County to continue to work closely with the state in this regard. Problems may unfold if growth and demand continue without integrating water resources into comprehensive planning. It is critical that planning for water resources be integrated early in the planning process and that water resources for private residential wells be included in this process prior to issuance of building permits.

3.2 Private Water Companies

There are more than sixty private water companies providing water to several thousand citizens in the county. These water companies were formed to provide a needed service to citizens before the county had established its municipal water system and prior to the County's establishment of uniform standards for water distribution. Many of these water systems pre-date the state mandated requirements for testing and treatment of water. These requirements include employing a licensed well operator, the regular testing and treatment of the water, and maintaining the infrastructure. All of these requirements are costly.

[6] House Bill 1141 requires that all local jurisdictions have a plan in place by October of 2009 that ensures that adequate water supply be available to a property prior to approval of a Subdivision Plat.

Additional costs may include the replacement or lowering of the well pumps and/or the drilling of new wells due to dropping water levels. In many cases, the need to lower the pumps can be caused by an increase in water demand from growth in the County and adjacent jurisdictions. Today many of these water companies are struggling financially to survive. Many of the clients served by these water companies are senior citizens, single member households and individuals on a fixed income. Consideration should be given to establishing a policy of routinely meeting with representatives of these water companies to explore ways of assisting them and helping to find solutions to their problems.

3.3 Conservation Measures

Conservation measures for private individual well users are limited. These measures generally consist of the use of water conserving fixtures within the home. Additional measures generally consist of the users habits, pertaining to water use. Reductions in use may have a significant role on the life of the well and the associated impact to the water source. Additional steps can be made on the part of the private home-owner to reduce the demand on water resources, such as the use of rain barrels to catch run-off from roof-tops and other impervious surfaces.

The advantages to water conservation measures by private well users is the net reduction on water consumption. Finite resources such as groundwater will have greater longevity if withdrawals are reduced. A reduction of consumption by the major users, like the public water system wells will only partly reduce the consumption of the water resource. Therefore, a reduction of water consumption from each individual homeowner is also necessary to prolonging the life of the groundwater aquifers. As stated in the groundwater section, proper management of groundwater withdrawals, where the withdrawals do not exceed the recharge of the aquifers, may allow the resource to last indefinitely.

The use of rain barrels is a long-used form of retaining water, especially in areas where drought is common and water may be scarce. These devices retain the rainwater during storm events for later use, in gardens, landscape irrigation, and car washing. However, these retention barrels can be used to reduce the demand on the homeowners wells or conserve on the water bill for persons connected to the public water system. Other innovative water retention systems also exist for home-owners or businesses. The main obstacle is education to promote their use.

The disadvantages of this effort pertains to outreach and education to the homeowner. Currently, there is very little information presented to homeowners within Charles County. Information is available through the Maryland Department of the Environment and various environmental interest organizations. Additional information would need to be gathered and made available to County

citizens to educate them on how these retention devices work, how they can be installed, and how they can be maintained and used.

3.4 Conversion to Public System

Charles County has many private water systems that supply residential communities with their potable supply of water. These systems are generally run by a homeowners association and a private water operator. The Maryland Department of the Environment is responsible for regulating these private suppliers. Each water system requires a Groundwater Appropriation Permit (GAP), similar to those that the County obtains for each well for the public supply.

The extension of the public water system to individual wells users or community water systems is an ideal way of ensuring adequate water supply to County citizens and businesses, while being able to monitor and manage the groundwater resource. The management of groundwater withdraws is the primary advantage to connecting all county citizens to the public water system. In addition, the citizens on private wells would no longer have to contend with wells going dry and the associated costs of drilling a new well. Through the use of groundwater monitoring wells, the County officials would be able to make decisions of where water should be withdrawn at various times, and maintain an adequate water supply.

While the extension of public water to all County citizens is ideal, implementation will take a great amount of time. Costs of the extensions will need to be evaluated to determine the type of billing necessary. The County currently bills the public water users based on a unified rate system. All users pay the same rate for water regardless of the cost to supply any individual user. Therefore, the great costs of extensions of lines, new wells, and associated infrastructure will be passed on to all users of public water. Costs to all users would likely increase based on the increased capital expenditure by the County to extend this infrastructure to the un-served areas. Other options include special taxing districts, surcharges, or connection fees to the users. This works well for new home construction, but generally is not well accepted by homes currently using a functional private well. The subject wells were installed by the homeowner at a substantial cost. The costs associated with the extension of public water to the existing neighborhood and associated home would place an additional burden on the homeowner. This assessment, tax, or surcharge would likely receive great opposition, unless absorbed in the County rate structure for all users. The obvious disadvantage to this option would be the likely opposition of the existing water system users.

Aside from the obstacles of the costs associated with the extension of the public water system, the extensions are needed to various areas of the County. The

Charles County Comprehensive Water and Sewer Plan calls for the extension of the public water system, and includes the interconnection of independent public and private water systems.

While private water systems are no longer allowed by the policies in the Water and Sewer Plan, several private water systems are in need of replacement through the interconnections to the public system. These interconnection would alleviate the increased burden of system failures and improvements that are required to maintain a reliable source of water. In addition, regulations have become more stringent over time and costs to private community water systems have increased. Water treatment procedures and the requirement of a licensed operator or service have increased the costs further. Several community associations on private water systems have expressed interest in connecting to the public water system. However, the costs to interconnect these systems is generally cost prohibitive through the County's petition program, since income levels vary greatly. Most of the subject systems are 30 to 40 years in age and require a complete system replacement. Additionally, many of the households consist of senior citizens that rely on a fixed income and cannot afford the cost assessed for the interconnection.

A financing program would likely need to be developed on an income level basis to assess the opportunities for funding assistance to individuals that meet certain criteria for financial aide. Such a program would likely require local legislation.

3.5 Well Construction (Telescoped vs. Standard)

Many private wells have been constructed as a telescoped well. This construction technique uses a standard four-inch casing until it reaches a particular depth below the groundwater level, then reduces to a two-inch casing. The well pump can only be lowered through the four-inch casing, and is prohibited from being lowered below the small casing. When groundwater levels drop below the depth of the pump, the pump must be lowered. If the groundwater level drops below the four-inch section of pipe or casing, the pump cannot be lowered further and the well essentially becomes un-usable. The well must then be abandoned and a new well drilled.

In such a case, the reduction in water levels is generally related to water levels being reduced by a large user, such as a public supply well or a large commercial or industrial user. Many private well users are concerned with the costs of the new well and question the responsibility of the large user to compensate them for the impacts they may have caused. Therefore, questions have been posed to the administrators of the public systems or other large users as to the development of a program to assist or compensate the private homeowner for the construction of a new or improved well. Unfortunately, in most cases there is no direct way of attributing the drop in water levels to a particular large user. Liability issues have

raised concerns, but have not been solved to date. Therefore, the issued has remained as a cost to the individual homeowner. Suggestions from concerned citizens have included the institution of a government program, state or local.

The State of Maryland developed more stringent standards for the telescoping wells in the 1980's but this did not solve the problem that many homeowners face when the water levels drop below the maximum depth of the pump. A government program would require legislation to create a program to assist such homeowners with funding assistance. Such a program would likely be income based requiring the applicant to meet certain criteria in order to qualify for funds.

4.0. RECOMMENDATIONS

The following recommendations have been based on the short, mid, and long range feasibility of each option discussed in this report. Recommendations are broken down into these time frames for implementation.

4.1. Immediate (0 to 6 months)

1. Water Resource Coordinator - The CCG should hire a full-time employee to coordinate the public water management issues. This would include oversight of CCG water management plans and strategies, regular coordination with private water system operators, other municipalities, and federal and state water resource agencies. This position should also be responsible for public education and outreach of water resource related issues, including the development of greater public assistance to connect existing homes and neighborhoods to the public water systems.

4.2 Short Term (0 to 5 years)

1. Demand Management/Water Conservation - The County should implement the use of graduated billing and a new billing scale of categories to encourage the users to conserve water and prolong the use of the resource.

Graduated billing will encourage the average user to reduce or eliminate excess use of water and implement conservation efforts where possible. Homeowners will likely choose to reduce the water use on lawns, landscape areas, car washing, and correct malfunctioning fixtures in the home. This billing rate structure would also cause the larger users to conserve water where possible or generate revenue to support the operation and maintenance of the utilities infrastructure. Demand for the resource should be reduced while maintaining the source of revenue.

2. Connection to WSSC - An additional connection to WSSC at US 301 and the County Line. The County should pursue the allocation of 5.0 million gallons per day to offset the immediate demand for water in the Development District.

The additional WSSC connection at US 301 and the Charles County Line will create a quick shift for Charles County to an alternative water source and reduce the withdrawals from the aquifers. This reduction will allow the aquifers to rebound through natural groundwater recharge. The CCG should consider the financial impact on the rate payers while negotiating the billing rate with WSSC. Careful consideration should be given to the change in the current rate structure and how it will affect residents, including those on a fixed income. Another term of the agreement should include the assurance of water supply dependability.

Finally, the CCG should negotiate new terms with MDE regarding the current Groundwater Appropriation Permits (GAPs). MDE closely monitors groundwater withdrawals at each production well within the water systems and adjusts the GAPs based on use. If the County were to switch a large portion of it's water demand to WSSC water, MDE may dramatically lower the CCG's GAPs based on the drop in use. The CCG should discuss the changes in demand in case the situation arises where the County would need to resort back to groundwater use (e.g. a drought).

3. Chapman State Park Wells - The County should pursue the transfer of the easements through the State-owned Chapman Landing Property to gain access to the two production wells, which have been shown to have a substantial water yield from the Patuxent aquifer. These wells will assist the Bryans Road Water System, while reducing the impacts to local private well users.

The MDE has stated these wells produce a high volume of water while having good water quality in this relatively unused aquifer in the area. These wells are not currently being used since they were drilled as production wells for a development that did not come to fruition. The use of these wells would have very little, if any, impact on the wells of private individual homeowners, since they are deeper than the average well in the area. Based on the results of the pump test completed when the wells were drilled, the subject wells should yield a sustainable water supply for the Bryans Road Water System. Costs associated with infrastructure to connect these wells to the Bryans Road Water System should be investigated.

4. Aquifer Storage Recovery (ASR) - In coordination with MDE, CCG should conduct a study to determine the feasibility of groundwater recharge and the associated infrastructure necessary for it's implementation.

Groundwater recharge or ASR has been shown to be an affective way of creating artificial recharge of the groundwater aquifer. Further study should be given to determine how CCG can apply ASR to assist the rebound of groundwater levels in Charles County. An evaluation of the infrastructure, process, and resulting impacts should be determined in order to move forward with implementation of this strategy. Careful consideration should be given to determine the effects of this recharge method on the coastal plain aquifers, and to prevent any negative impacts to the groundwater supply.

5. Well Field Feasibility Study - Conduct a study on the construction of a well field in the down-dip portion of the County though the Maryland Geological Survey to determine the potential implementation of the well network and associated pumping strategy for long term water supply.

In concert with the recommendations of MGS, the CCG should further investigate the implementation of a production well field in the down-dip area. Again, this area has been recommended by MGS as the most productive groundwater area in Charles County. An evaluation of the infrastructure costs to transmit the water from the well field to the Development District will be necessary, along with an evaluation of the water quality in the area, the results of well pumpage on the wells of the surrounding homes, and the policy considerations for wells/public water outside the Development District (i.e. new development pressures). The study should determine if groundwater will be a sustainable water resource in the long term if managed properly.

6. Water System Interconnections - Investigate and develop a water system interconnection strategy for private water systems and individual well users, including a financial assistance program or capital funding.

Approximately sixty (60) private water systems exist within the County, which all draw water from the groundwater aquifers. Many of these systems are beginning to have infrastructure failures, which outweigh the budget of the rate payers. It is anticipated that many of the systems will require state or local assistance in the near future. The CCG should implement a plan to assist these private system to integrate them into the public water system. Funding assistance mechanisms will need to be created to complete this strategy, as well as policies and procedures for CCG staff. Integration of these private water systems will create greater efficiency over groundwater withdrawals in the area aquifers, as well as providing the necessary aide to these communities with public health concerns (e.g. safe and reliable drinking water).

7. Community Water System Assistance Program - The County should develop a program through the Water Resource Coordinator position to assist existing community water systems meet the growing demands from the state requirements.

Many of the private water systems are experiencing day-to-day increases in operating costs. The state in recent years has imposed more and more requirements such as chlorination, additional testing and the requirement that a licensed well operator monitor the system seven days a week. These requirements alone impose an excessive burden on the small company. Many of these companies due to their location are not in a position where they can be integrated in the near term into the public water system. The county therefore should work with these companies to explore ways to meet the state requirements within a reasonable cost structure so they can continue to provide this needed public service to their members.

8. Additional Monitoring Wells - The County should coordinate the installation of additional monitoring wells throughout the County as development continues in order to observe fluctuations in groundwater levels.

As development continues, groundwater levels should be closely monitored to determine trends in water levels and take action as needed to mitigate for potential impacts. These wells would be beneficial to the County as well as the state to ensure adequate groundwater monitoring is being completed.

9. Installation of Back-up Generators at Well Sites - The CCG should install back-up generators at all well locations in case of a power failure. These generators at each well location will ensure that a potable water supply is continued due to such a failure, until power is restored. This is especially important since the water tower in the Development District will only supply the service area with enough water to sustain the average public water use through a 24-hour period. The installation of back-up generators at each well will allow the well pumps to continue to operate and supply water to customers served by a public supply.

10. Water Conservation Program - The CCG should develop a program that would include the education and encouragement to the general public about water conservation measures and possibly provide incentives to implement these measures. These measures would include the use of rain barrels to collect rainwater for irrigation, the installation of "low-flow" fixtures within the homes or business, and limited use of water for irrigation and car washing.

4.3 Mid Term (5 to 10 years)

1. Well Field Implementation - If found feasible through the suggested MGS Study in Section II.A.2. of this report, the County should begin implementation of the construction of a well field and associated infrastructure in the down-dip area as indicated by the Waldorf and Bryans Road Optimization Studies. Create the necessary policies for proper implementation in the County Water and Sewer Plan and Comprehensive Plan.

The construction of the well field and associated infrastructure is considered a mid-term recommendation since the implementation requires the completion of several time consuming steps. These steps include: the completion of the feasibility study, the creation of several policies within the Charles County Comprehensive Plan and Water and Sewer Plan, the actual engineering and design of the infrastructure, the purchase of the necessary right-of-way for the infrastructure, and the construction of the infrastructure itself.

This recommendation would allow greater efficiency when using groundwater. A greater disbursement of the production wells in the down-dip area will cause less over-lap in the withdrawal areas and reduce the impacts to groundwater levels. Implementation of this

strategy would also likely require coordination with the St. Mary's and Calvert County governments to assure that each jurisdiction is in agreement to appropriately manage the groundwater resource and maintain a supply for each jurisdiction.

2. Aquifer Storage Recovery (ASR) Implmentation - If found feasible from recommendation A.4., CCG should begin the groundwater recharge program and construct the necessary infrastructure.

Pending the results of the feasibility study, the groundwater recharge program is anticipated to enhance the natural groundwater recharge and allow the groundwater aquifers to rebound. The study will have determined if both surface water (river water) and groundwater are able to be used to recharge the aquifer. This relatively simple process of pumping water back down into the aquifers will aid in the effort to preserve the groundwater resources for the long term for both public and private groundwater users. Infrastructure such as water towers, is presumed to be constructed on the site of CCG's existing wells, leaving little need for additional right-of-way. Infrastructure costs will mainly be associated with the construction of water towers or other storage facilities, where water is to be stored until it is dispensed to the users.

3. Water Reuse Feasibility Study - The County should conduct a study to determine the feasibility of a water reuse or effluent water line construction for re-distribution to non-potable water users.

The construction of an effluent water line will likely be built by private party, but be dedicated to CCG. The use of effluent water from the Wastewater Treatment Plants (WWTPs) will reduce the amount of treated wastewater being discharged into rivers and streams by re-using this "grey-water" for commercial or industrial purposes. Uses can consist of irrigation of landscaping or golf courses, and cooling uses for power plants or industrial manufacturing. The resulting reduction of wastewater to rivers or streams will also likley improve the water quality of those water bodies while generating revenue from the end users of this greywater.

4.4 Long Term (10 -15 years+)

1. Additional WSSC Allocation - Pursue an additional allocation of water capacity from WSSC beyond the 5 mgd.

The additional capacity from WSSC could sustain the CCG's public water system needs indefinitely, if the allocation is equal to the demand. A renegotiation of the agreement with WSSC would be necessary to initiate this recommendation.

2. Surface Water Treatment Plant Study - Investigate the implementation of a CCG-Operated Surface Water Treatment Plant along the Potomac River and associated infrastructure.

As discussed in Section II.A.4. of this report, a surface water treatment plant in the Bryans Road/Indian Head area would enable the CCG to have an additional water resource alternative. This strategy is recommended as a long term recommendation due to the anticipated high costs associated with the infrastructure, the necessary right-of-way, as well as high operation and maintenance costs.

5.0 REFERENCES

MGS Studies (4)

Bryans Road Lower Potapsco Aquifer Study, 1999
Bryans Road Aquifer Optimization Study, 2003
Waldorf Aquifer Optimization Study, 2004
Southern Maryland Aquifer Study, 2006

WSSC Agreements (2)

Agreement with WSSC - dated October 22, 1980
Agreement with WSSC - dated March 10, 1987

Watershed/Reservoir Study - by Whitman, Requardt & Associates

Aquifer Storage Recovery: A Guide to Groundwater Recharge through Wells, Second Edition. Author: David G. Pyne, 1995.

2006 Charles County Comprehensive Water and Sewer Plan, County Commissioners of Charles County, Maryland.