Water

Water

"A safe and adequate drinking water supply is critical to the sustainability of existing communities and to the viability of future planned growth. Increasing demand from the 1.1 million additional people projected to live in Maryland over the next 25 years is expected to challenge local utilities' ability to provide safe drinking water and maintain good water quality. Some communities are already at or near current supply limitations.

"By 2030, the statewide demand for water for most uses, excluding self-supplied commercial and industrial uses, is expected to increase from 1,447 million gallons per day (mgd) in the year 2000 to 1,680 mgd, an increase of 233 mgd, or 16 percent. This total increase includes about 84 mgd of additional water for agricultural irrigation. Regional projections for 2030 demand are not available for irrigation uses.

"Maryland has faced a number of record drought periods in recent years that have necessitated the implementation of some difficult protective measures to enable the state to continue providing adequate water supplies. These stressors on water resources highlight the need to plan ahead to ensure adequate drinking water supplies at the local, comprehensive planning level.

"Existing regional and county water resource studies should be used to inform local planning efforts. Local government experience in obtaining permits for water appropriation should also be taken into account when assessing the reasonableness of future expectations.

"Decisions regarding growth and proposed land uses should consider planning-level assessments of the adequacy of drinking water resources for the planning time period under consideration. For the proposed number and location of homes, businesses and industrial facilities to be viable, the availability, costs and timeframes to provide an adequate water supply must be achievable. Local comprehensive plans must provide the vision and path needed to provide adequate water supplies for planned uses and needs within the planning timeframe.

"Limited water supplies can slow or stop planned development, resulting in the inability to fulfill the vision of local comprehensive plans and implement smart growth policies. Options for addressing these circumstances need to be explored, including, but not limited to, modifying the land use element to change the amount or location of growth, thereby capping growth where it cannot be supported. Local planning and zoning entities must be flexible enough to react to these changes.

"Protection of water supplies is a critical component of the vision for the comprehensive plan. Local land use and zoning decisions can have a profound impact on the risk of contamination to valuable drinking water supplies. Water supplies have varying degrees of vulnerability to contamination due to the nature of the aquifer being used, the size of the watershed, existing land uses and the potential sources of contamination within a recharge or watershed area." [*Source: Models & Guidelines No. 26, Managing Maryland's Growth, The Water Resources Element: Planning for Water Supply and Wastewater and Stormwater Management*]

8 Carroll County Hydrogeologic Setting

Carroll County lies entirely within the Piedmont physiographic province. This is an area of moderate relief and rounded hills, with relatively gentle slopes. This subdued topography is formed by the underlying, deeply weathered, lower Paleozoic to Precambrian-aged metamorphic rock (500 million to 1 billion years old).

The northwesternmost corner of Carroll County falls in the Triassic Uplands subprovince. This subprovince derives its name from the unique, Triassic-aged (250 million) sedimentary rocks found there. Topography in this area is more subdued than that found in the eastern portion of the County.

The most prominent physiographic feature in Carroll County is the Parrs Ridge/Dug Hill Ridge topographic high which trends northeast-southwest and bisects Carroll County, separating the Piedmont Uplands into east and west divisions. Low and often broad valleys are formed in the easily weathered carbonate rocks of Carroll County, lenses and stringers of which may be mixed with other metamorphic rock types. Stream segments, generally straight for short distances, follow closely the joints and fractures in the bedrock systems which represent zones of relative weakness.

Carroll County is underlain by rocks of the easternmost Appalachian Mountain system. Sedimentary, igneous, and metamorphic rocks of diverse lithology, complex structure, and ages ranging from Precambrian to Triassic are found here.

The majority of Carroll County is underlain by metamorphosed sedimentary and volcanic rocks overlain by a thick mantle of unconsolidated weathered material (saprolite). The general structural trend of Carroll County is northeast to southwest. The grade of metamorphism, that is the general grain size of the rocks, increase across the trend, from northwest to southeast. Slates and phyllites are exposed near the northwesternmost outcrop area of the Piedmont Uplands near the Pennsylvania state line and Blacks Corner. These phyllites and slates (very fine to fine-grained metamorphic rocks) grade gradually to phyllites and fine-graded schists in the central portion of Carroll County, and finally to coarser schists and gneisses in the southeastern portion of the county near Sykesville, as the core of the Ancient Appalachians is approached. The Precambrian Baltimore gneiss is the oldest rock type found in Carroll County, and is generally interpreted as representing the central core of the Appalachian system.

These rocks are tightly folded into anticlines and synclines, with beds ranging in dip from horizontal to vertical. Faults are very numerous, but the lack of outcrops limits their mapping. Joints and fractures are common throughout the metamorphic rocks of Carroll County.

The remainder of Carroll County, the northwesternmost corner, is underlain by much younger Triassic-aged sedimentary rocks which form the Triassic Uplands. These are consolidated alluvial deposits of the New Oxford Formation. They generally become coarser textured east and southeastward from the Carroll County/Frederick County line, grading from shale to siltstone, and sandstone, to the ancient metamorphic rocks. These Triassic rock strata have a gentle west and northwest dip, and generally trend northeast just north of Union Bridge, and gradually bend to the north as the Pennsylvania line is approached. These beds are cut by a few large and numerous small faults, and have well-developed joint and fracture systems.

The vast majority of groundwater in Carroll County occurs in the upper 500 feet of the earth's crust. Rocks in this zone are by no means totally solid. All rock types have been subjected to various earth stresses, which have created a network of fracture systems which often extend to great depths. This rock system in Carroll County has been subjected to a great amount of weathering and erosion, which has created an upper weathered zone referred to as saprolite. The deepest weathered zones are found in areas along pre-existing fractures. This combination of the weathered zone and underlying fractured rock system constitutes the geologic "environment" in which groundwater occurs.

There are three distinct aquifer types in Carroll County which may be delineated from a groundwater resource development standpoint. These are the saprolite aquifer, carbonate rock aquifer, and Triassic rock aquifer. Groundwater development strategy in these aquifers is unique, and must be addressed as such.

The saprolite aquifer underlies the majority of the County. It occurs over all of the non-carbonate rock in the county, and is the sole source aquifer for Mount Airy, Hampstead, and Manchester, and a partial source for New Windsor and Westminster. This is a hybrid aquifer from which high-yielding water supplies have not traditionally been developed. The carbonate rock aquifer underlies limited portions of New Windsor, Union Bridge, and Westminster, and is the most productive and environmentally sensitive aquifer type in Carroll County. It is the sole source for Union Bridge and a partial source for New Windsor and Westminster. The Triassic rock aquifer underlies the northwestern portion of the county and provides all the potable water needs for Taneytown.

Groundwater in the metamorphic rocks of the Maryland Piedmont is transmitted primarily in joints, fractures, and bedding planes in bedrock, and along the saprolite/bedrock interface. The size, number, and openness of fractures naturally determine the amount of groundwater transmitted through them. In soluble carbonate rocks, fractures may be greatly enlarged by solution, although they are characteristically filled with a significant amount of insoluble residual material, usually silts and clays. Carbonate rock well yields may be quite large, but may also be prone to creating sinkholes in the overlying soils. Therefore determining optimal well production to reduce the creation of sinkholes becomes necessary. This aquifer type is also susceptible to an increased risk of pollutants due to the rapid movement of groundwater.

In coarser grained schists and gneisses, which are often very competent, fractures are generally narrower, but remain open to relatively great depths. Water bearing fractures may occur to depths exceeding 500 feet. In finer grained phyllites, deep fracturing may occur less frequently due to the softness of these rocks. The discreteness of fracturing makes possible the development of very high yielding wells completely in fractured zones directly adjacent to “dry holes” not tapping such fractures.

Groundwater occurs in a somewhat different fashion in the Triassic rocks underlying the Taneytown region. Groundwater is primarily stored and transmitted along rock layers, joints, fractures, and faults. The weathered zone over these rocks is generally quite thin, and the water table is usually below this zone, in the fractured bedrock.

The layered nature of the Triassic rocks, with permeable sandstone sandwiched between less permeable shales, dipping at relatively low angles, creates a multi-aquifer system. Each competent, fractured sandstone/siltstone bed may respond as a single aquifer when it occurs between shale layers on local scale. Fracture zones often connect various beds vertically, creating the aquifer system.

9 Source Water Assessments

“Source water is water from rivers, streams, reservoirs, and aquifers that is treated and used for drinking water purposes. A source water assessment is a process for evaluating a public water system’s source water and assessing its vulnerability to contamination. The assessment does not address the treatment processes, or the storage and distribution aspects of the water system, which are covered under separate provisions of the Safe Drinking Water Act. A source water protection program is intended to add an extra layer of protection by ensuring that the water entering a public water system is as safe as possible. Preventing contamination at the drinking water source protects public health and makes good economic sense.

“Groundwater is the most commonly used source of water supply. In Maryland, groundwater is obtained from both unconfined and confined aquifers. Confined aquifers are more protected from contamination than are unconfined aquifers. In Central Maryland, the aquifers are unconfined.

“Source water assessments conducted in Maryland indicate that the most common potential sources of contamination for systems in unconfined aquifers are underground storage tanks, service stations, dry cleaners, onsite septic systems, and agriculture. Volatile organic compounds and nitrates were the most common contaminants found in these water supplies, although microbiological pathogens were found in some wells located in limestone areas of Central and Western Maryland. Some of the systems that are in deeper confined aquifers were found to be susceptible to naturally occurring contaminants like arsenic, fluoride and radium, but were not found to be susceptible to contaminants originating from local land use activity.

“In Maryland, about 10 percent of the community water systems (around 50 systems) rely on surface water, yet these surface water systems serve about 80 percent of the population using public water systems. Protecting a surface water source involves protecting the entire watershed, which can be relatively small (less than one square mile) to very large.

"Agricultural activities and urban development were the most prevalent sources of contaminants for surface water systems. Contaminants from agricultural land include nutrients and microbial pathogens. Excessive erosion (sediment) and de-icing compounds were contaminants of concern from runoff in developed areas. The discharge of treated wastewater and risks from overflowing sewage collection systems upstream of intakes were noted as a significant source of contaminants in some watersheds. Sources relying on river intakes are more susceptible to elevated levels of fecal contamination and turbidity following rain, while sources using reservoirs were more susceptible to eutrophication from phosphorus. Major roads, rail lines, and pipeline crossings presented the potential for spills above some intakes." *(Source: General source water assessment description excerpted from MDE website: http://www.mde.state.md.us/Programs/WaterPrograms/Water_Supply/sourcewaterassessment/factsheet.asp)*

■ Each Municipality

The MDE completed all Source Water Assessments (SWAs) described herein over the past ten years. Except as noted, SWAs were delineated by the Carroll County Bureau of Resource Management using US EPA-approved methodologies. Information on water sources has been updated to reflect current conditions.

Hampstead

The unconfined fractured rock aquifer in the Prettyboy Schist is the source of Hampstead's water supply, which is now comprised of 17 groundwater wells. All of Hampstead's wells are susceptible to contamination by nitrates, votatile organic compounds (VOCs), Synthetic Organic Compounds (SOCs), and radionuclides, but not to other inorganic compounds. Hampstead's wells were determined not to be susceptible to protozoans, but wells 19, 21, 23, and 24 are susceptible to total coliform.

The Town's inventory includes Wells 20 and 21. These two wells were used for over 20 years until the Town realized that it did not own the property where the wells are located. Both wells are high in nitrates and would require treatment or blending with lower nitrate water to meet the nitrate maximum contaminant level (MCL). The Town is attempting to acquire these wells.

Manchester

The unconfined fractured rock aquifer in the Marburg Formation is the source of water supply for the Town of Manchester. The system currently uses 14 wells and 1 spring to obtain its drinking water. All of Manchester's wells are susceptible to contamination by nitrates, VOCs, and radon (may be susceptible if currently proposed EPA standards are adopted), but not to SOCs, other radionuclides, or inorganic compounds. None of Manchester's water supply sources are susceptible to protozoan contamination except for the Walnut Street well and Crossroads Well 1. In addition, the Bachman Road, Patricia Court, and Walnut Street wells are susceptible to total coliform.

Mount Airy

The unconfined fractured rock aquifer within the Ijamsville Formation and Marburg Schist is the source of water supply for the Town of Mount Airy. The system uses 10 wells to obtain its drinking water. Well #11 is potentially being developed in the very near future and is approximately equal to Mount Airy's average size well. The Mount Airy water supply is susceptible to contamination by nitrates, VOCs (except well 8), SOCs, and radionuclides, but not susceptible to protozoans. Further, Wells 2 and 7 are susceptible to bacteria and viruses.

New Windsor

The Town of New Windsor relies upon both surface and groundwater for its potable supply. The unconfined fractured rock aquifer within the Wakefield Marble, Sam's Creek Formation, Marburg Formation, and Ijamsville Phyllite provide the source of water supply for two groundwater wells and one spring. The Hillside wellfield consists of two wells completely in the phyllite, while the Main Spring system is located near a contact of the Sam's Creek and Marburg Formations. The Hillside wells were determined to be susceptible to contamination from VOCs associated with commercial enterprises, as well as radionuclides. The Main Spring system was determined to be susceptible to contamination by nitrates, viruses, and bacteria associated with surface sources.

Taneytown

The unconfined fractured rock aquifer in the New Oxford Formation is the source of water supply for the City of Taneytown, which is comprised of 8 wells. The water supply for Taneytown is susceptible to contamination by nitrates, VOCs, and radionuclides, but is not susceptible to SOCs. Well 12 is also susceptible to bacteria, based on raw water sampling.

Union Bridge

The unconfined fractured rock aquifer in the Wakefield Marble is the source of water for the Town of Union Bridge. The system currently uses 2 wells to obtain its drinking water. All water supply sources for Union Bridge are susceptible to contamination by nitrates and protozoans. The water supply is not susceptible to organic compounds, radionuclides, or other inorganic compounds.

Westminster

The City of Westminster relies upon both ground and surface water for its potable supply. The unconfined fractured rock aquifer within the Wakefield Marble, Sam's Creek Formation, Marburg Formation, Ijamsville Phyllite, and Wissahickon Formation provide the source of water supply for 11 groundwater wells. Four of the City's wells (Wells 1, 2, 5, and 7) are in the Wakefield Marble. The remaining 7 wells are in the crystalline bedrock formations. The City also withdraws water from the Cranberry Run Reservoir. The SWA was delineated by a consultant in accordance with the 1999 MDE SWAP guidance document. Many of the wells are susceptible to natural contaminants such as radon, as well as anthropogenic contaminants like nitrates.

Freedom

Water is provided from both surface and groundwater sources in the Freedom District. The unconfined fractured rock aquifer in the Sykesville Formation is the source of groundwater supply for the Freedom District. This system is comprised of three groundwater supply wells. The Fairhaven well is located within the Piney Run Watershed and is drilled to approximately 600 feet. The Raincliffe well is approximately .5 mile south of the Fairhaven well and was drilled to approximately 500 feet. The Freedom District groundwater supply is susceptible to VOCs and radionuclides, but not susceptible to SOCs, nitrates, other regulated inorganic compounds, or microbiological contaminants.

Carroll County has a water treatment plant on the western shore of Liberty Reservoir. The reservoir was constructed in 1954 on the North Branch of the Patapsco River and is operated by Baltimore City. Carroll County, under agreement with Baltimore City, purchases raw water from this source. The treatment plant was expanded and now has a capacity greater than 3 mgd.

Potential sources of contamination for the Liberty Reservoir include point and non-point sources, including industrial sites, transportation (e.g., highways), a railroad, a petroleum product pipeline, agriculture, and septic tanks in rural portions of the watershed. The majority of point sources are located in the North Branch and Liberty subwatersheds.

The City of Baltimore maintains an extensive water quality monitoring program for Liberty Reservoir and its tributaries, as well as the Ashburton Water Filtration Plant. Routine sampling is performed at the City's water treatment plant, six tributaries of Liberty Reservoir, and four in-reservoir locations in an effort to monitor and improve the water quality conditions of the Liberty Reservoir water supply.

10 Future Additional Water Demand Based on Existing Planned Growth

Capacity Management Plan Worksheets – Methodology

To identify water supply and capacity needs, current service capacity must be determined. Recent guidelines published by MDE, Guidance Document: *Water Supply Capacity Management Plans* (WSCMP) (2006), provide a methodology for determining the net available capacity of existing water supplies. This available capacity, plus the estimated capacity from improving treatment of already existing sources or of obtaining water resources not yet permitted for withdrawal (to be determined using MDE recommended methodologies), can then be used to develop an estimate of the approximate number or range of additional households and associated commercial, institutional, and industrial water demand that can potentially be supported in a service area.

Data was collected for each of the public water systems owned or operated by Carroll County or a municipality. Appendix C: Water Supply Capacity Management Plan: Worksheets and Summary (Pg C-5) in MDE's Guidance Document: *Water Supply Capacity Management Plans* (2006) was used as a template and guide for collecting this data. A worksheet was prepared for each of these eight systems to capture a snapshot of the current capacity and projected demand, based on existing adopted land use plans, ordinances, and policies. (See the Appendices for copies of each individual worksheet, associated data, and any variations from the standard method.)

The Average Annual Daily Demand was based on data collected through calendar year 2007, as a consistent timeframe for reference between municipalities/systems and a point from which to move forward in the process to develop the plan. The appropriate data was collected for each system to determine the existing water demand. For efficiency and productivity, 2007 data was used for the capacity management plan worksheets and water supply information, so the process could continue without constant changing of data.

For a standard WSCMP submission, the worksheet requests information on potential additional water demand for approved (but undeveloped) subdivision lots and issued building permits. However, for the purposes of the WRE, the potential demand was based on all of the potential residential units (lots), regardless of development status.

Potential additional residential demand was estimated based on the County's BLI data. Within the W-1 Existing/Final Planning Water Service Area (WSA), the potential additional residential lots were based on the current zoning. Within the W-3 Priority and W-5 Future WSAs, the potential additional residential lots were based on the currently adopted land use designations, which would reflect the growth that is ultimately planned. These were the required categories shown on MDE's worksheet. Future demand for water from development in the No Planned Service areas that fall within the County's DGAs was also estimated for the WRE, although it does not show in the worksheets.

Future residential demand for water was estimated assuming the potential additional residential lots, as well as existing unserved residences, consume 250 gallons per day (gpd) per household/lot.

To arrive at future commercial and industrial demand, areas with adopted land use designations for commercial or industrial use were reviewed. Acreage was estimated for areas that are developed but not yet served. The buildable acreage of unimproved land was also estimated. Buildable acreage excludes streams, wetlands, and floodplains (see Appendix titled "Methodology to Estimate Future Commercial & Industrial Demand for Water & Sewer Service/Capacity" for more detailed methodology). Developed but not yet served acreage was added to buildable acreage to get a total acreage on which future demand was calculated. The combination of acreage from these two types of commercial land was multiplied by 700 gallons per acre per day. Industrial acreage was multiplied by 800 gallons per acre per day (based on MDE guidance and the Water and Sewerage Master Plan).

In Manchester's case, additional demand was added to the residential demand category to reflect projected demand from two new schools that were coming online during this process or shortly thereafter. In Freedom's case, additional demand beyond the BLI estimates used for residential demand was added to account for allocations and reservations. An additional 21,488 gpd in allocations was added, and an additional 27,765 gpd in reservations. For the Hampstead sewer system, additional demand beyond the BLI estimates used for residential demand also was added to account for 19,932 gpd in allocations.

For the Freedom water and sewer service areas, and for the Hampstead sewer service area, allocations represent capacity set aside to accommodate development that has already paid its area connection charges. These are typically sites for which building permits have already been issued, a site plan has been approved, or a minor subdivision has been approved. The capacity is "set aside" for two years after the area connection charges are paid. After two years, it is assumed that they are connected to the system.

Reservations represent a capacity that is unofficially 'reserved' for development that is in the pipeline, and represents a known quantity; area connection charges are unpaid. Both allocations and reservations are likely double-counting capacity demand. However, these numbers were included in the demand and capacity calculations knowing that it would provide very conservative numbers for the Freedom systems and for the Hampstead sewer system and would ensure the demand is accounted for.

For Hampstead and Westminster, numbers for residential, commercial, and industrial demand were modified or provided by the municipality rather than strictly using the BLI data.

Mount Airy demand and capacity numbers may not match the BLI estimates, as the County does not have BLI information for the portion of Mount Airy that lies within Frederick County. Therefore, where this is a factor in estimating figures used in these analyses, the Town used their own calculations to capture its entire area.

The MDE worksheets did not address demand that would be generated by areas within the GAB that are not currently within the planned WSA. This additional demand, however, was evaluated as part of Carroll County's WRE process.

To determine the capacity of the water supply system, the best available data were collected for each municipal system. The estimated excess water supply capacity available for allocation was determined through a series of formulas identified on MDE's worksheets.

Rural Areas

For the area of the county that lies outside the GABs of the DGAs, it is estimated that 15,038 additional residential lots could be developed, along with 95 acres of developable commercial land and 220 acres of developable industrial land. Based on this amount of future development, an estimated 3,759,500 gpd of additional of water demand would be generated by residential development, 66,500 gpd by commercial development, and 176,000 gpd by industrial development. In total, the county's rural areas are estimated to generate an average of 4,002,000 gpd of additional water usage.

While the Finksburg area is more urbanized than is typically found in rural areas, it is included in the analysis for rural areas given that it lacks community water and sewerage facilities.

[Note: These estimates were calculated using data based on land use designation only.]

■ Agricultural Use

Agriculture and its associated support businesses are the leading economic generator in Carroll County. The county ranks 9th in the State in total value of agricultural products sold. The county has approximately 142,000 acres in farmland, with an average farm size of 124 acres. Cropland comprises approximately 72 percent of total farmland. The county ranks within the top 5 in the state regarding the major livestock categories.

The latest data on estimated water use that is available from the U.S. Geological Survey (USGS) is for 2000. According to these data, agricultural operations in Carroll County devoted an estimated 390 acres to irrigation and consumed an estimated 310,000 gpd through irrigation withdrawals. An estimated 810,000 gpd were withdrawn for livestock operations. In total, agricultural uses consumed an estimated 1,120,000 gallons of water per day in 2000.

Comparable data from the 1995 Survey were not reported; data from the 1990 and 1985 Surveys were irretrievable from the USGS website.

Carroll County anticipates that growth in water use for agricultural purposes will be minimal, projecting an increase in the range of one to two percent.

■ Municipal Systems & Designated Growth Areas

The following table provides estimated future water demand, broken out by planned water service area, for each of the major community (public) water supply systems that operate in the County. "Current Demand" represents actual water usage by residents, businesses, and industries. Demand is measured as the average number of gallons consumed per day. "Planned Future Demand" and "Other Potential Demand" include both new, additional development as well as existing development that is currently unserved. For purposes of this plan document, properties that are currently designated in the "No Planned Water Service Area", which are represented under "Other Potential Demand," and are located within the DGA boundary, are assumed to be served in the long term.

"Infill Demand" is based on current zoning, while "Future Demand" and "Other Potential Demand" are based on current land use designation.

Future Water Demand by Service Category for Each Designated Growth Area
(Gallons per Day)

Community	Current Demand[1]	Planned Future Demand[2]		Other Potential Demand[3]	Total Demand
		Infill Demand	Future Demand		
Freedom/Sykesville	2,182,422	641,250	712,590	974,620	4,510,882
Hampstead[4]	459,680	22,500	0	959,200	1,441,380
Manchester	299,693	74,600	108,710	319,520	802,523
Mount Airy	765,000	87,500	221,750	114,750	1,189,000
New Windsor	159,600	35,850	248,940	3,800	448,190
Taneytown	509,143	60,300	1,215,630	750	1,785,823
Union Bridge	199,123	46,700	592,840	36,420	875,083
Westminster	2,960,000	732,050	956,400	689,850	5,338,300
Countywide Total	*7,534,661*	*1,700,750*	*4,056,860*	*3,098,910*	*16,391,181*

[1] These data are the greatest annual average daily demand for the 5-year period from 2003 through 2007.
[2] These data relate to areas located within the designated planned water service area. Infill demand is calculated for areas classified in the "Existing/Final Planning" service category; Future demand is calculated for the combined area classified in the "Priority" or "Future" service category.
[3] These data relate to areas designated in the "No Planned Water Service Area" but located within the Community GAB.
[4] Calculations for future water demand used the CMP data. This demand is reflected under "Infill Demand". However, the CMP data do not account for additional demand that would occur within the balance of the planned water service area, or the additional demand within the balance of the growth area that is designated in the "No Planned Water Service Area." To factor in this further demand, future development potential and existing development that would be served were estimated and calculated for water demand.

Source: Carroll County Department of Planning, December 2008

The following table presents the same water demand estimates as the preceding table, except that demand is indicated by type of land use – residential, commercial, and industrial.

Future Water Demand by Land Use for Each Designated Growth Area
(Gallons per Day)

Community	Current Demand[1]	Additional Demand by Land Use			Total Demand
		Residential	Commercial	Industrial	
Freedom/Sykesville	2,182,422	1,754,750	33,950	539,760	4,510,882
Hampstead	459,680	441,000	43,260	497,440	1,441,380
Manchester	299,693	452,500	50,330	0	802,523
Mount Airy	765,000	285,500	85,250	53,250	1,189,000
New Windsor	159,600	169,750	2,520	116,320	448,190
Taneytown	509,143	709,750	98,770	468,160	1,785,823
Union Bridge	199,123	345,750	43,890	286,320	875,083
Westminster	2,960,000	1,497,250	53,130	827,920	5,338,300
Countywide Total	*7,534,661*	*5,656,250*	*411,100*	*2,789,170*	*16,391,181*

[1] These data are the greatest annual average daily demand for the five-year period from 2003 through 2007.

Source: Carroll County Department of Planning, December 2008

■ Annexation Areas within the Municipal Growth Elements

Portions of several of the DGAs are predominantly located outside the corporate limits of the municipality. Many of these areas also are outside the area planned for public water service within the horizon of the Water and Sewer Plan. These areas are designated "No Planned Service" in the *Carroll County Water and Sewerage Master Plan*. Estimated future water demand for these areas is identified as "Other Potential Demand" in the table titled "Future Water Demand by Service Category for Each Designated Growth Area." While these areas are currently designated "No Planned Service" because service is not planned (or guaranteed) to occur within the 10-year horizon of the *Master Plan for Water & Sewerage*, ultimately, inclusion in the GAB infers the intention to annex these areas at some point in the future. They would be planned to be served upon annexation.

11 Water Balance – Supply Available for Consumption

A water balance assessment was completed to help identify 'untapped' water supplies that might be available for consumption. In assessing available water supply, both groundwater and surface water were evaluated and pertinent inputs and outputs to the hydrologic system were considered. Total estimated water availability for each watershed was determined.

The evaluations for these watersheds generally followed the methodology used for the report *An Evaluation of the Water Resources in the Catoctin Creek Watershed*, which was produced by MDE in May 2006. A few notable exceptions to the methodology were made. The recharge from septic systems, as well as water returned to the system from wastewater discharge, was counted toward the available water. In addition, the impact of agricultural water demand also was considered.

The water balance methodology is based on the approach outlined in Maryland's June 2007 Water Resources Element of the Comprehensive Plan – Guidance Document (M&G #26*)* and detailed in MDE's May 2006 *An Evaluation of the Water Resources in the Catoctin Creek Watershed*. MDE's Catoctin Creek report did not include a comprehensive discussion of all source data and methods used in the analyses. Therefore, specific assumptions and changes were made in developing methodology which may differ somewhat from MDE's approach. Also, newer and/or County-specific datasets are incorporated into this analysis. The list of noteworthy differences in methods (or more detailed method specifications) is as follows:

1. Self-supplied residential water demands are estimated based on the number of existing households (not served by public water) in the current address database provided by the County. It is assumed that the water demands for all households outside of the service areas are self-supplied by onsite individual groundwater wells and that each household consists of a single family with an average day water demand of 250 gpd. Households

from the County address database are used as the basis for self-supplied residential demands, because the Census 2000 data is nearly ten years old and may not be as representative of the current population.

2. The methodology incorporates septic returns to groundwater in order to determine the final groundwater availability. These returns are included because a significant portion of the groundwater demands are returned via septic systems. While some failures in septic systems may occur in the future, it is anticipated that the majority of systems will continue to operate and return significant quantities of water as the county grows. Based on published literature values, the average return rate for domestic use is approximately 80 percent; that is the default assumption. The County's intent to incorporate septic-based recharge of the aquifer system was discussed with MDE prior to moving forward.

3. Future demands for serviced and self-supplied residences are evaluated based on the number of additional households estimated at buildout in the County's BLI plus the number of self-supplied residences within the GABs. The BLI is considered to constitute the best source of available data representing potential population growth, while also providing the spatial resolution necessary for analyses at the subwatershed level.

4. The analysis of surface water availability included in this evaluation is generally based on MDE's approach in the Catoctin Creek analysis. However, MDE's report did not explicitly describe the methodology for determining the storage-safe yield curves. For this analysis, equivalent storage-safe yield curves are developed for each subwatershed by estimating required storage using the worst drought on record for the same gauges used in the groundwater availability calculations.

Malcolm Pirnie prepared a detailed report on methods and results for completing water balance assessments for 8-digit watersheds in Carroll County. More detailed information can be found in the July 30, 2009 report, titled *Carroll County Water Demands and Availability*.

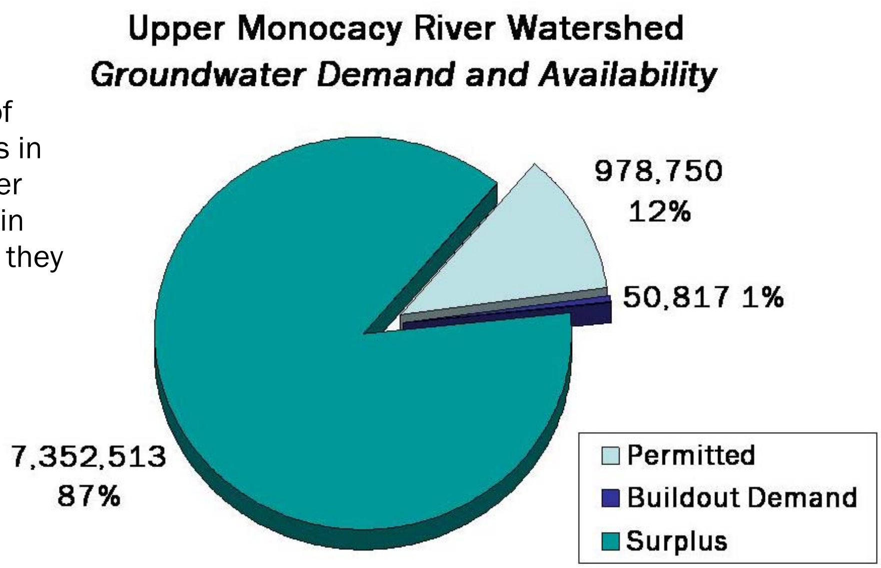
The following tables compare by watershed the reported, permitted, and buildout water demands, returns, and availability. "Reported" is based on existing water demands (for municipal supplies, 2007 average day withdrawals). "Permitted" refers to the maximum average day withdrawals permitted by MDE. "Buildout," for purposes of this particular analysis, was based on projected water demand (average day) for all areas within GABs on the adopted community comprehensive plans, but also includes buildout of areas outside DGAs that would be private wells. All data are reported in gallons per day, with the exception of the surface water storage figures. These figures represent total storage capacity in millions of gallons (MG).

The analysis focused on the two most significant aspects of returns – WWTPs and residential septic systems. The returns for each are reflected in the following tables. However, the total returns figure includes other categories factored into returns, such as industry, nonresidential septic systems, and quarries. Therefore, the total for returns is not the sum of the WWTPs and Septic figures shown in the tables.

In the following "Water Balance Assessment Results Summary" tables, the groundwater demand less septic returns equals the difference between the available groundwater and groundwater surplus. (GW Demands – Septic Returns = GW Availability – GW Surplus) In addition, it should be noted buildout demand was apportioned to the watershed in which the demand originates. Therefore, the buildout figure is less than the permitted figure for surface water. Many of the DGAs, however, are split between two or more watersheds. In this case, demand in a given watershed could be served by water that originated from another watershed.

Upper Monocacy River

Given the present level of analysis, water resources in the Upper Monocacy River watershed *are available* in sufficient quantities that they could be developed to meet projected buildout demands.



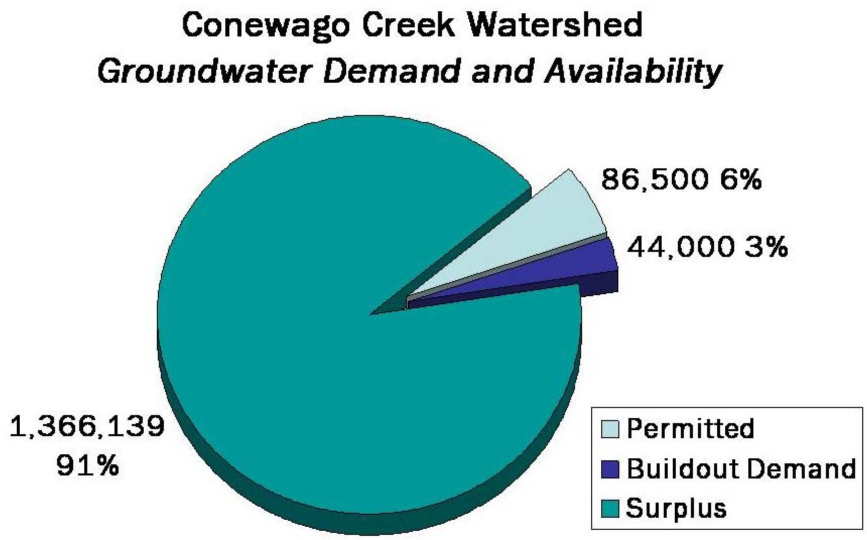
Upper Monocacy River Watershed
Water Balance Assessment Results Summary

		Reported	Permitted	Buildout
DEMANDS				
SW	Surface Water	707	10,000	707
GW	Groundwater	755,765	968,750	1,018,860
	Total	*756,472*	*978,750*	*1,019,567*
RETURNS				
	WWTP	407,055	466,400	1,390,885
	Residential Septic	238,800	238,800	364,000
	Other	6,000	121,200	149,165
	Total	*651,855*	*826,400*	*1,904,050*
WATER RESOURCES				
SW	Flowby	5,581,106	5,581,106	5,581,106
SW	Storage	683 MG	686 MG	683 MD
GW	Availability	7,919,973	7,919,973	7,919,973
GW	Surplus	7,409,009	7,206,023	7,352,513

Source: "Carroll County Water Demand and Availability," Malcolm Pirnie, July 30, 2009

Conewago Creek

Groundwater availability in the Carroll County portion of Conewago watershed was estimated to be approximately 1.4 mgd. Therefore, given the present level of analysis, water resources in the Conewago Creek watershed *are available* in sufficient quantities that they could be developed to meet projected buildout demands.



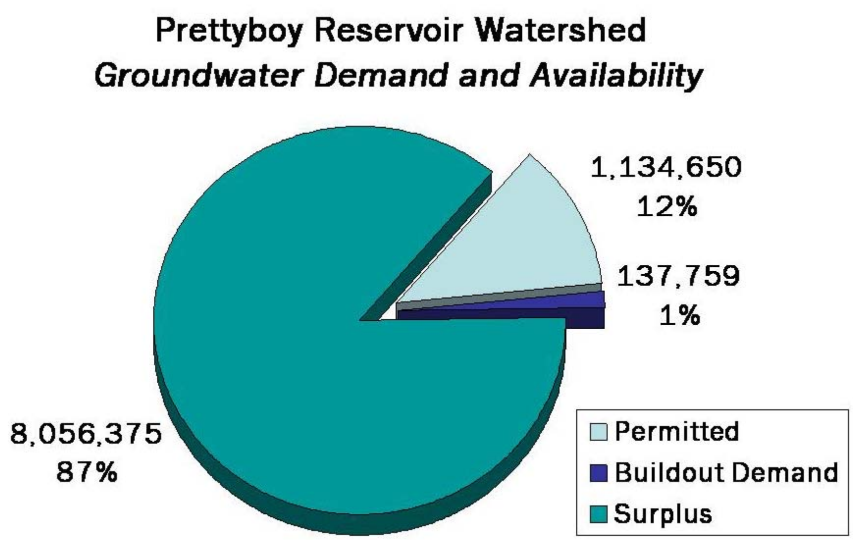
Conewago Creek Watershed
Water Balance Assessment Results Summary

		Reported	Permitted	Buildout
DEMANDS				
SW	Surface Water	0	0	0
GW	Groundwater	86,500	86,500	130,500
	Total	*86,500*	*86,500*	*130,500*
RETURNS				
	WWTP	0	0	0
	Residential Septic	71,000	71,000	91,800
	Other	0	0	12,600
	Total	*71,000*	*71,000*	*104,400*
WATER RESOURCES				
SW	Flowby	1,692,436	1,692,436	1,692,436
SW	Storage	NA	NA	NA
GW	Availability	1,392,239	1,392,239	1,392,239
GW	Surplus	1,376,739	1,376,739	1,366,139

Source: "Carroll County Water Demand and Availability," Malcolm Pirnie, July 30, 2009

■ Prettyboy Reservoir

Given the present level of analysis, water resources in the Prettyboy Reservoir watershed *are available* in sufficient quantities that they could be developed to meet projected buildout demands.



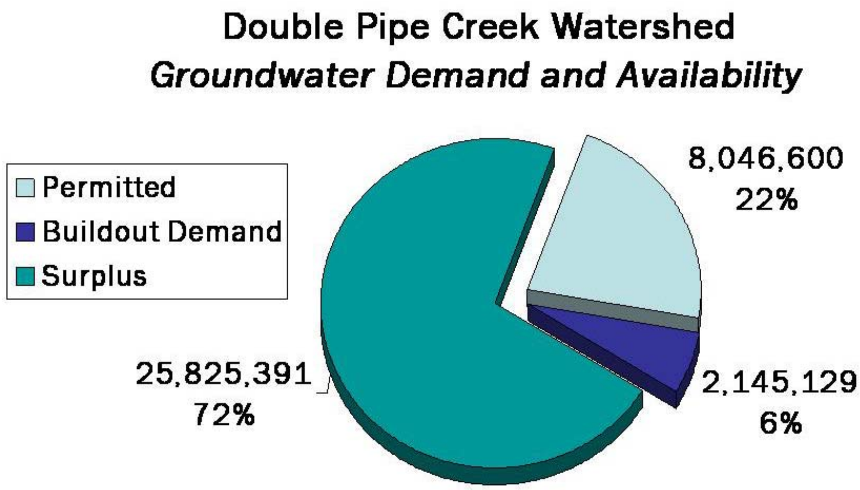
Prettyboy Reservoir Watershed
Water Balance Assessment Results Summary

		Reported	Permitted	Buildout
DEMANDS				
SW	Surface Water	12,268	22,000	12,268
GW	Groundwater	876,583	1,112,650	1,260,141
	Total	*888,851*	*1,134,650*	*1,272,409*
RETURNS				
	WWTP	240,661	457,360	375,293
	Residential Septic	587,600	587,600	804,800
	Other	11,800	11,800	100,200
	Total	*840,061*	*1,056,760*	*1,280,293*
WATER RESOURCES				
SW	Flowby	10,431,070	10,431,070	10,431,070
SW	Storage	720	721	720
GW	Availability	8,411,515	8,411,515	8,411,515
GW	Surplus	8,134,332	7,898,265	8,056,375

Source: "Carroll County Water Demand and Availability," Malcolm Pirnie, July 30, 2009

Double Pipe Creek

Water returns in the watershed are largely comprised of municipal WWTP returns (2.6 mgd, 44%), quarry discharges (1.7 mgd, 30%), and septic returns (1.5 mgd, 26%). Total returns are projected to increase from the existing rate of 5.8 mgd to a buildout rate of 9.5 mgd. Given the present level of analysis, water resources in the Double Pipe Creek watershed *are available* in sufficient quantities that they could be developed to meet projected buildout demands.

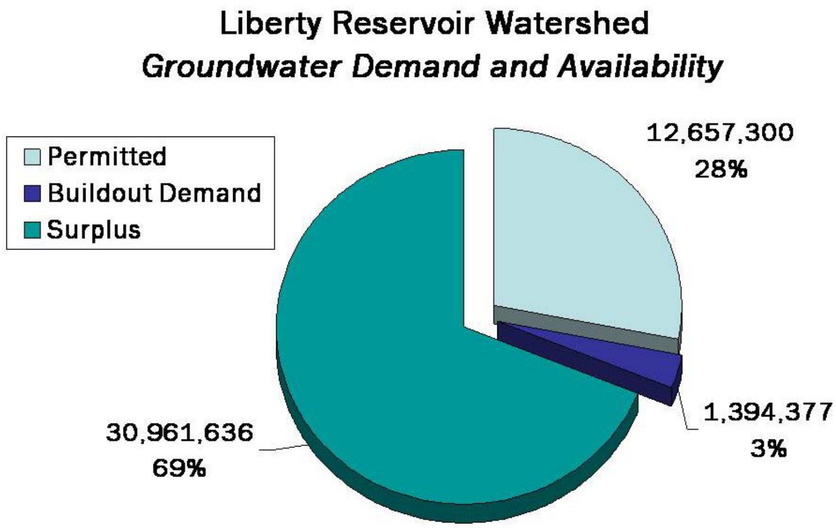


Double Pipe Creek Watershed
Water Balance Assessment Results Summary

		Reported	Permitted	Buildout
DEMANDS				
SW	Surface Water	139,907	792,300	1,352,061
GW	Groundwater	5,887,204	7,254,300	8,839,668
	Total	*6,027,111*	*8,046,600*	*10,191,729*
RETURNS				
	WWTP	2,553,821	3,327,290	4,017,641
	Residential Septic	1,491,200	1,491,200	2,157,600
	Other	1,740,800	1,845,600	3,288,122
	Total	*5,785,821*	*6,664,090*	*9,463,363*
WATER RESOURCES				
SW	Flowby	37,707,072	37,707,072	37,707,072
SW	Storage	5,029	5,254	5,447
GW	Availability	32,171,059	32,171,059	32,171,059
GW	Surplus	27,800,855	26,433,759	25,825,391

Source: "Carroll County Water Demand and Availability," Malcolm Pirnie, July 30, 2009

Liberty Reservoir



Water returns in the watershed are largely comprised of septic returns (2.8 mgd, 67%) and industry discharges (1.0 mgd, 25%). Municipal WWTP returns are largely returned to adjacent watersheds so that municipal returns only account for approximately 5.6 percent (0.23 mgd) of the total returns despite relatively large municipal demands in the watershed. Water returns are projected to increase to 5.8 mgd at buildout. Given the present level of analysis, water resources in the Liberty Reservoir watershed *are available* in sufficient quantities that they could be developed to meet projected buildout demands.

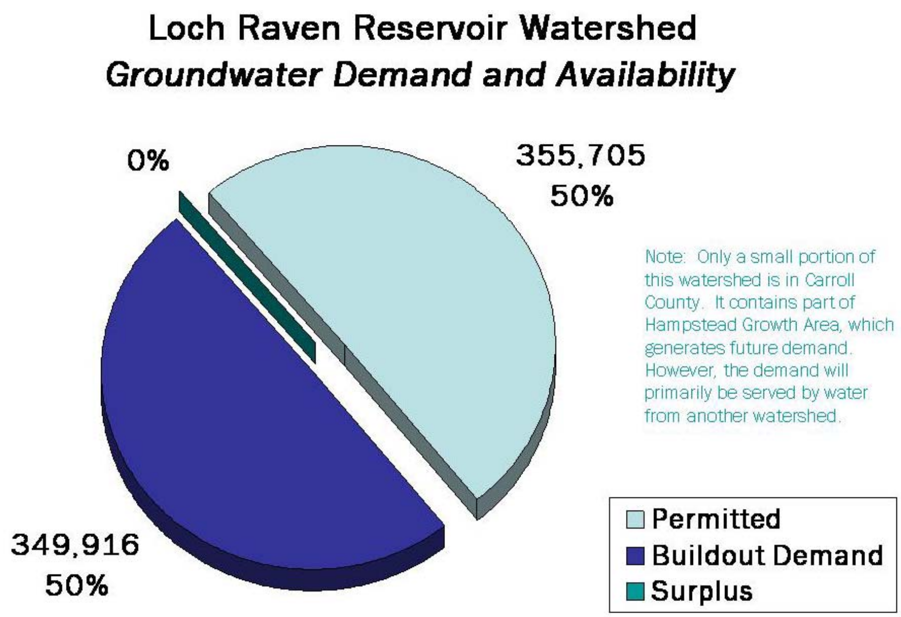
Liberty Reservoir Watershed
Water Balance Assessment Results Summary

		Reported	Permitted	Buildout
DEMANDS				
SW	Surface Water	4,318,319	6,764,900	5,977,392
GW	Groundwater	5,595,895	5,892,400	8,074,285
	Total	*9,914,214*	*12,657,300*	*14,051,677*
RETURNS				
	WWTP	231,770	296,310	262,554
	Residential Septic	2,770,600	2,770,600	3,664,400
	Other	1,151,303	1,336,760	1,865,126
	Total	*4,153,673*	*4,403,670*	*5,792,080*
WATER RESOURCES				
SW	Flowby	42,672,450	42,672,450	42,672,450
SW	Storage	3,534	3,868	3,760
GW	Availability	35,012,921	35,012,921	35,012,921
GW	Surplus	32,292,226	31,995,721	30,961,636

Source: "Carroll County Water Demand and Availability," Malcolm Pirnie, July 30, 2009

Loch Raven Reservoir

Without a more detailed evaluation or expansion of the analysis area, the water resources in the Carroll County portion of the Loch Raven watershed *would not be sufficient* to meet buildout groundwater demands. Future water demands in this watershed would have to be met using water from outside the small Carroll County portion of the watershed.



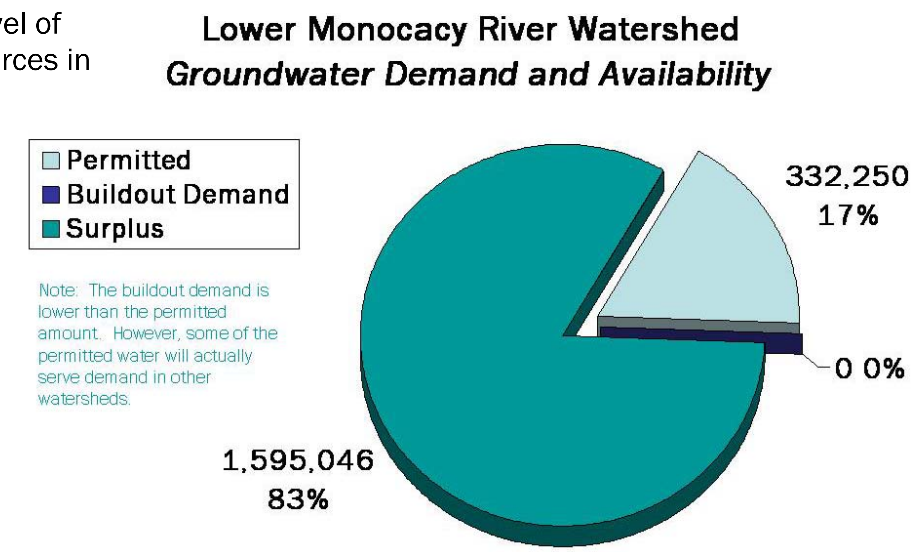
Loch Raven Reservoir Watershed
Water Balance Assessment Results Summary

		Reported	Permitted	Buildout
DEMANDS				
SW	Surface Water	0	0	0
GW	Groundwater	326,105	355,250	705,166
	Total	*326,105*	*355,250*	*705,166*
RETURNS				
	WWTP	367,719	464,000	592,550
	Residential Septic	3,400	3,400	45,600
	Other	200	200	2,800
	Total	*371,319*	*467,600*	*640,950*
WATER RESOURCES				
SW	Flowby	288,987	288,987	288,987
SW	Storage	NA	NA	NA
GW	Availability	237,727	237,727	237,727
GW	Surplus	-84,778	-113,923	-419,039

Source: "Carroll County Water Demand and Availability," Malcolm Pirnie, July 30, 2009

Lower Monocacy River

Given the present level of analysis, water resources in the Lower Monocacy River watershed *are available* in sufficient quantities that they could be developed to meet projected buildout demands.



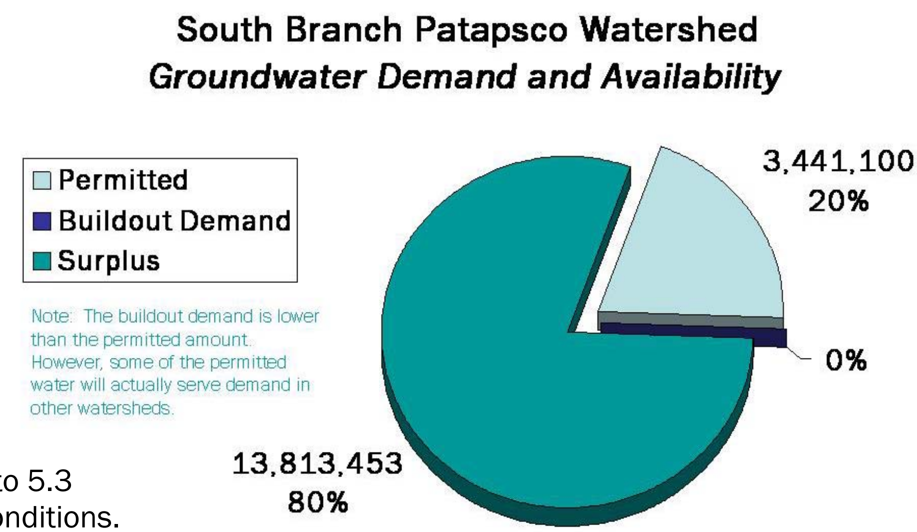
Lower Monocacy River Watershed
Water Balance Assessment Results Summary

		Reported	Permitted	Buildout
DEMANDS				
SW	Surface Water	0	0	0
GW	Groundwater	313,202	332,250	314,072
	Total	*313,202*	*332,250*	*314,072*
RETURNS				
	WWTP	0	0	0
	Residential Septic	192,200	192,200	222,600
	Other	4,600	4,600	21,400
	Total	*196,800*	*196,800*	*244,000*
WATER RESOURCES				
SW	Flowby	2,057,587	2,057,587	2,057,587
SW	Storage	NA	NA	NA
GW	Availability	1,665,118	1,665,118	1,665,118
GW	Surplus	1,548,717	1,529,668	1,595,046

Source: "Carroll County Water Demand and Availability," Malcolm Pirnie, July 30, 2009

South Branch Patapsco River

The majority of water returns in the watershed (3.1 mgd) currently consist of municipal WWTP returns (approximately 2.0 mgd, 65%) and septic returns (approximately 1.1 mgd, 35%). Future returns are projected to increase to 5.3 mgd under buildout conditions. Given the present level of analysis, water resources in the South Branch Patapsco River watershed *are available* in sufficient quantities that they could be developed to meet projected buildout demands.



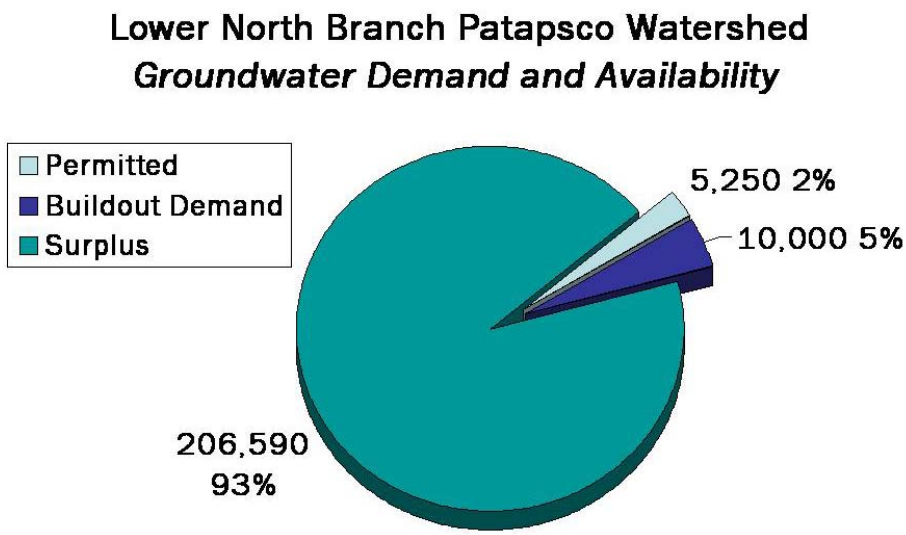
South Branch Patapsco Watershed
Water Balance Assessment Results Summary

		Reported	Permitted	Buildout
DEMANDS				
SW	Surface Water	53,660	3,441,100	635,530
GW	Groundwater	1,784,294	2,392,500	2,173,533
	Total	*1,837,954*	*5,833,600*	*2,809,063*
RETURNS				
	WWTP	1,988,161	6,745,000	3,683,066
	Residential Septic	1,071,600	1,071,600	1,440,400
	Other	20,402	86,242	172,112
	Total	*3,080,163*	*7,902,842*	*5,295,578*
WATER RESOURCES				
SW	Flowby	18,109,302	18,109,302	18,109,302
SW	Storage	1,497	2,232	1,610
GW	Availability	14,398,786	14,398,786	14,398,786
GW	Surplus	13,706,492	13,098,286	13,813,453

Source: "Carroll County Water Demand and Availability," Malcolm Pirnie, July 30, 2009

■ Lower North Branch Patapsco River

Given the present level of analysis, water resources in the Patapsco River Lower North Branch watershed *are available* in sufficient quantities that they could be developed to meet projected buildout demands.

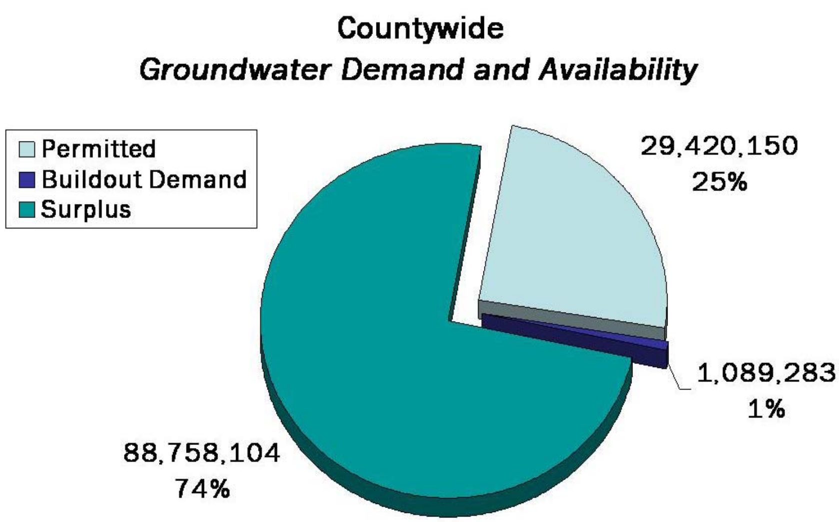


Lower North Branch Patapsco River Watershed
Water Balance Assessment Results Summary

		Reported	Permitted	Buildout
DEMANDS				
SW	Surface Water	0	0	0
GW	Groundwater	5,250	5,250	15,250
	Total	*5,250*	*5,250*	*15,250*
RETURNS				
	WWTP	0	0	0
	Residential Septic	3,200	3,200	10,600
	Other	0	0	1,600
	Total	*3,200*	*3,200*	*12,200*
WATER RESOURCES				
SW	Flowby	276,398	276,398	276,398
SW	Storage	NA	NA	NA
GW	Availability	209,640	209,640	209,640
GW	Surplus	207,590	207,590	206,590

Source: "Carroll County Water Demand and Availability," Malcolm Pirnie, July 30, 2009

Countywide



The majority of average water demands are mostly being met by groundwater wells (78%) compared to surface water sources (22%). A significant portion of the groundwater demand is from self-supplied domestic users (private residential wells) who do not require a water appropriation permit, given that their individual household demands are well below the current MDE permit requirement threshold. Current surface water withdrawals constitute a larger portion (4.1 mgd, 56%) of the total source supply (7.3 mgd) when only examining withdrawals subject to an MDE appropriation permit.

There are approximately 21 mgd of existing appropriations in the county, in addition to the approximate average of 8 mgd of self-supplied withdrawals for a total allocation of 29 mgd. The largest type of allocations in the county (40%) is municipal supply to the public water service areas.

Annual average buildout demands in the county are about 30.5 mgd. The majority of the existing demands are associated with residential uses, including 10.3 mgd (34%) for municipally supplied residential demands and 12.2 mgd (40%) for self-supplied residential demands.

With estimated existing and projected buildout groundwater demands of 15-23 mgd, and total projected demands of 30 mgd, groundwater resources in the county are theoretically more than adequate to meet existing and buildout demands. However, groundwater resources are not likely to be evenly distributed throughout the county.

Countywide Water Balance Assessment Results Summary

		Reported	Permitted	Buildout
DEMANDS				
SW	Surface Water	4,524,861	11,030,300	7,977,958
GW	Groundwater	15,630,797	18,389,850	22,531,475
	Total	*20,155,659*	*29,430,150*	*30,509,433*
RETURNS				
	WWTP	5,789,187	11,756,360	10,321,989
	Residential Septic	6,429,600	6,429,600	8,801,800
	Other	2,935,105	3,406,402	5,613,125
	Total	*15,153,892*	*21,592,362*	*24,736,914*
WATER RESOURCES				
SW	Flowby	118,816,408	118,816,408	118,816,408
SW	Storage	11,463 mgd	12,761 mgd	12,200 mgd
GW	Availability	101,418,978	101,418,978	101,418,978
GW	Surplus	92,391,182	89,632,128	88,758,104

Source: "Carroll County Water Demand and Availability," Malcolm Pirnie, July 30, 2009

■ Potential Effects Related to Climate Change

A rather dire climate picture was included in the Maryland Commission on Climate Change report, "Climate Action Plan - Interim Report to Governor and Maryland General Assembly" (2008). In this report it was stated that: "*The Chesapeake Bay has already warmed by about 2°F and continued warming will make our extensive efforts to restore its health that much more difficult. Examination of the detail of the global models used by the IPCC shows that, if GHG emissions continue to grow on the present trajectory, air temperatures will increase in Maryland more than the global average, resulting in average winter temperature increasing by about 8°F by the end of the century. While this might be welcomed by some, average summer temperature would also increase by about 7°F and the number of days with temperatures greater than 90°F is likely to quadruple, with 25 or more 100°F days…. Precipitation during the winter and spring is likely to increase 10-15%, coming mostly in heavy rainfall events, but the summers and falls are likely to be drier as increased evaporation depletes soil moisture.*" A future that looks like this would include longer growing seasons, higher evaporation rates and higher water demands for domestic, industrial, and agricultural users. Perhaps of more concern is the possibility of more severe drought and flooding events, both of which could significantly affect the quantity and quality of Carroll County's water resources.

Climate change research efforts and data analyses too numerous to list have been undertaken in recent years. However, an important publication was released earlier this year (2009) by the federal government, entitled *Climate Change and Water Resources Management: A Federal Perspective*. This interagency report was prepared by the USGS, U.S. Army Corps of Engineers (US ACE), Bureau of Reclamation, and National Oceanic and Atmospheric Administration. Two key points made in this report are as follows:

- *"Climate change could affect all sectors of water resources management, since it may require changed design and operational assumptions about resource supplies, system demands or performance requirements, and operational constraints. The assumption of temporal stationarity in hydroclimatic variables should be evaluated along with all other assumptions."*

- *"Current expectations about future climate may indicate a need to supplement historical climate information. Planning assumptions might instead be related to projections of future temperature and precipitation. This can be accomplished using a multitude of approaches; a best approach has yet to be determined."*

Considering that Carroll County is looking out decades into the future toward a buildout condition, and with the possibility of reduced safe yield when considering pre-20th century history and potential climate change effects, future water supply needs may be greater than currently anticipated. The science has not yet progressed to the point of being able to quantify how groundwater levels, streamflow patterns, or drought severity will change in the Mid-Atlantic region as a result of current climate change trends. However, a prudent approach is needed to be pro-active in planning for future water needs and to consider a diverse suite of water sources to improve supply reliability in the event of severe drought or other climate-induced changes in water availability. Carroll County may wish to consider moving more in the direction of integrated water resources planning to integrate and balance all possible water resources to sustain water demands into the future. Integrated water resources planning is gaining momentum and, as summarized below, offers a number of significant improvements over traditional water supply planning approaches:

- Comprehensive and diverse evaluation criteria (not just least-cost solution)
- Considers supply reliability (not just current capacity)
- Demand can be modified (not just supply options)
- Embraces uncertainty with planning for multiple possible future scenarios

The above information was excerpted from the *Carroll County Water Demands and Availability* report, dated July 30, 2009, and produced by Malcolm Pirnie. Please refer to this report for more detail on the water balance assessment.

12 Current Capacity and Existing Water Quantity Limitations

■ Capacity of Individual Municipal Systems

The municipal water supply systems serve the populations in the DGAs. Combined, existing usage (average daily demand) totaled 7,534,661 gpd countywide. Residential population served by these systems countywide was about 89,545. The following table indicates the existing usage in 2007 and the population estimated to be served, based on WSCMP worksheet data. Where population data were not provided in the WSCMP worksheet, data was taken from the *2007 Carroll County Master Plan for Water & Sewerage*.

2007 Existing Demands and Residential Population Served

Community/System	Existing Usage	Population Served
Freedom/Sykesville	2,182,422	23,580
Hampstead	459,680	6,400
Manchester	299,693	4,628
Mount Airy	765,000	*8,631
New Windsor	159,600	1,414
Taneytown	509,143	*6,200
Union Bridge	199,123	1,000
Westminster	2,960,000	37,692
Totals	*7,534,661*	*89,545*

Source: Water Supply Capacity Management Plan worksheets, 2007
*For population served - Carroll County Department of Planning, 2007 *Water and Sewerage Master Plan*

The following table is a snapshot in time of the capacity of each water supply system in the county, based on 2007 data in the CMP worksheets. The net average day capacity available at buildout indicates the amount of additional capacity that would be needed to meet projected demand at full buildout of the growth area. The growth areas used are those that were in effect on the comprehensive plans adopted as of 2008. Capacity gained from planned improvements included in either a municipality's capital improvement program or in the 2007 *Carroll County Water & Sewerage Master Plan* would not be reflected in this figure.

To arrive at the net average day capacity available at buildout, the combined total of existing flows plus the sum of the capacity needed for infill, future, and no planned service ("Unserved Demand") is subtracted from the remaining capacity. If the remaining capacity is a negative number, the total unserved demand is treated as a negative number, with two negative numbers added together to determine the net average day capacity available at buildout.

Water Supply Capacity *Currently* Available for Existing and Future Growth
for Each Designated Growth Area
(in Gallons per Day)

Community	Current			Remaining Capacity	Unserved Demand		Net Avg Day Capacity Available at Buildout
	Permitted	Avg Day Capacity Limitation	Avg Day Drought Demand[1]		Infill + Future	No Planned Service	
Freedom/ Sykesville	4,648,000	3,448,000	2,400,664	1,047,336	1,353,840	974,620	(1,281,124)
Hampstead	521,400	521,400	505,650	15,750	22,500	959,200	(965,950)
Manchester	581,000	388,800	329,662	59,138	193,610	319,520	(453,992)
Mount Airy	865,000	865,000	841,500	23,500	309,250	114,750	(400,500)
New Windsor	196,100	78,462	175,560	(97,098)	284,790	3,800	(385,688)
Taneytown	583,000	563,846	560,057	3,789	1,275,930	750	(1,272,891)
Union Bridge	208,300	49,846	219,035	(169,189)	639,540	40,980	(849,709)
Westminster	3,476,000	2,273,077	3,256,000	(982,923)	307,960	689,850	(1,980,733)
Totals	*11,078,800*	*8,028,098*	*8,288,128*	*(260,030)*	*4,579,940*	*2,989,720*	*(7,829,690)*

[1] Average Day Demand here includes an additional 10% for drought demand

Source: Carroll County Department of Planning, December 2008

■ Summary of Capacity and Limitations Countywide

Total water demand for the eight municipal water supply systems within their respective DGAs is estimated to be 16,474,511 gpd. Subtracting total "current demand," estimated at 7,534,661 gpd, from the total number leaves 8,939,850 gpd of projected additional demand.

The combined additional residential, commercial, and industrial water demand for the balance of the county (i.e., the rural area outside the various DGAs) that would be generated by future development is estimated to be 4,002,000 gpd.

For 2000, an estimated 1,120,000 gpd of water were used for agricultural purposes. Assuming a 2 percent increase per year and calculating water demand over a 20-year period, agricultural operations would use an estimated 1,664,261 gpd, or an additional 544,261 gpd, by 2020.

Given the above estimates for future water demand throughout the County, total additional water demand is estimated to be 13,486,111 gpd.

It is estimated that countywide 88,758,104 gallons of groundwater will be available after the county has fully developed (i.e., buildout) as currently planned. Based on groundwater resources alone, there appears to be ample water supplies available to accommodate future development. Combining available groundwater and surface water resources at buildout, the county has sufficient water supplies to accommodate future water demand.

When the county is examined in whole, even at buildout the total demand from all sources is approximately 25 percent of the theoretical resource, as determined by the water balance assessment (*Carroll County Water Demands and Availability*, July 30, 2009). The question becomes "Why are there apparent water shortages in some areas of the county?" First and foremost, abundant water resources are not evenly distributed across the region. Local hydrogeologic conditions and watershed or catchment area size are just some of the potential limiting factors. In addition, the ability to access the water resource, either directly due to land ownership issues or through expensive transmission methods, may be limiting factors. Those limiting factors and a host of additional ones are then evaluated for cost and administrative barriers. Therefore, the countywide results provide a more regional look at resources in the bigger picture of larger watersheds and ultimately the Chesapeake Bay.