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Background

Frederick County is roughly 665 square miles, and is Maryland's largest County. According to the U.S. Census Bureau, Frederick County had 195,277 people in the year 2000. Frederick County is developing rapidly, and is predicted to grow at a faster rate between 1995 and 2015 than any other Maryland County in the Washington/Baltimore region. By 2020, the population is predicted to be 281,710 people (Frederick County DPZ, 1998b).

Frederick County borders Pennsylvania to the north and Virginia to the south. Neighboring Maryland Counties include Washington to the west, Carroll to the east, a small portion of Howard County to the southeast, and Montgomery County to the south. The eastern part of Frederick County is in the Piedmont Province and the western part is in the BlueRidge Province. Limestone is present under the Frederick Valley: from the Town of Woodsboro, south through Frederick City, to the confluence of the Monocacy and Potomac Rivers (Versar, 2001a). This limestone area is especially susceptible to sinkholes and direct pollution of the groundwater, and therefore requires special management consideration (MGS, 2003). Catoctin Mountain and South Mountain are west of these limestone areas.

Over half of the land use in this County is dominated by agriculture (64% in 1997). Roughly a quarter of the land is covered in forest, having the lowest percent forest cover of all Maryland Counties. Forest generally occurs in areas of steep slopes, or along streams, rivers, and roads (Shanks, 2003). Over a quarter of the soil is designated as

prime farmland. This soil is mostly in Frederick and Middletown Valleys (Frederick County, 2000), but is located throughout the County (based on NRCS SSURGO GIS data). In order to preserve agriculture in the County, wetland restoration/creation should attempt to avoid areas classified as prime farmland. There are currently eight active mining sites for limestone, shale, and stone aggregate. County zoning in 1997 designated 60% of the land as agriculture, 22% Resource Conservation, 13% residential, 4% commercial/industrial, and 1% mineral extraction (Frederick County DPZ, 1998b).

Frederick County drains into four different State-designated 6-digit watersheds: The Middle Potomac River (021403), Patapsco River (021309), Patuxent River (021311), and Washington Metropolitan (021402). The vast majority of the County drains into the Middle Potomac River Watershed. The 8-digit watersheds within the Frederick portion of this Middle Potomac River watershed include: Potomac River (02140301), Lower Monocacy River (02140302), Upper Monocacy River (02140303), Double Pipe Creek (02140304), and Catoctin Creek (02140305). Only about 500 acres of Frederick County land does not drain into the Middle Potomac River watershed. This land instead drains three other 8-digit watersheds that drain into three different 6-digit watersheds. These include: Potomac River Montgomery County (02140202) draining to the Washington Metropolitan watershed, Brighton Dam (02131108) draining to Patuxent River watershed, and South Branch Patapsco (02130908) draining to the Patapsco River watershed.

County-designated watershed boundaries are different than State-designated watershed boundaries. Frederick County contains 20 County-designated watersheds.

Streams

Streams in the BlueRidge Province have steep slopes in the mountains and moderate grades in the valleys. Valley streams consist of gravel to boulder-sized material. Most streams in the Piedmont Plateau Province have moderate slopes with some bedrock at the surface. Generally stream bottoms are composed of gravel and sand. The Monocacy and its tributaries provide the water supply for three municipalities and receive effluent from 28 sewage treatment plants.

The following information is based on the Maryland Tributary Strategies 2004 document entitled *Maryland Upper Potomac River: Final Version for 1985-2002 Data*. Maryland's Upper Potomac River basin includes all of Allegany and Washington Counties, and part of Frederick, Carroll, Montgomery, and Garrett Counties. This report describes water quality in the Upper Potomac River Basin as being variable, with some waterways being healthy trout streams while others are nearly lifeless due to acid mine drainage. The eastern portion of the basin (Piedmont and Great Valley areas east of Allegany County) contribute high amounts of nutrients and sediment from development and agriculture. The middle portion of the basin is moderately forested, so does not contribute excessive pollutants. The western portion of the basin (the Appalachian Plateau) contributes pollution from agriculture and development, but also contributes acid mine drainage. In 2002, the main nitrogen, phosphorus, and sediment sources within the Upper Potomac

River basin were agriculture (56%, 59%, and 80% respectively). There are six major wastewater treatment plants in this County (Frederick, Ballenger Creek, Brunswick, Emmitsburg, Fort Detrick, and Thurmont) contributing roughly 31% of the total nitrogen and 34% of the total phosphorus load in the Upper Potomac River basin. Frederick WWTP contributed the most. Tributary stations sampled within Frederick County (along the Potomac River, Catoctin Creek, and Monocacy River) had total nitrogen status of poor to good, with most levels having a decreasing trend. The highest nitrogen was along the Monocacy River, with the two lower Monocacy sites ranked poor (Reel's Mill and MD 28) and the two upper Monocacy sites ranked fair. Total phosphorus was ranked poor at all sites except the Potomac River station (ranked fair), and was actually increasing at one of the lower Monocacy River stations (Reel's Mill). Total suspended solids were ranked fair at all stations except one of the Catoctin Creek stations (Middletown) which was ranked good. This document describes the success of BMPs in the Upper Potomac River Watershed like this:

A series of Best Management Practices (BMPs) have been planned in the basin to help reduce non-point source pollution. As of 1998, the implementation of these practices varies from having exceeded the goal to not having made any progress. Implementation of BMPs for animal waste management, conservation tillage, cover crops, and stream buffers have made good progress towards Tributary Strategy goals. Unfortunately, there has been no progress in forest harvesting BMPs, which consist of regulatory and voluntary measures applied to timber harvests, including erosion and sediment control and streamside management. Others, such as nutrient management and stream protections have exceeded the goals.

MBSS sampling of nitrate/nitrite found levels ranging from 0.10 to >10 mg/L. Lowest values (0.10 to 0.99 mg/L) are in the northwest portion of the County (northern part of Catoctin Creek watershed and western and northern parts of Upper Monocacy watershed). All other areas had higher values (>1 mg/L). High values (5-9.99 mg/L) are in the eastern part of the County (Double Pipe Creek and northeastern and southern part of Lower Monocacy watershed). The highest sample (>10 mg/L) was found on Little Catoctin Creek, just north of Middletown.

Wetlands

Mapped wetlands (based on DNR and NWI GIS data) are scattered throughout the County. They occur in floodplains of streams, at the heads of drainageways, and in isolated depressions. The supporting hydrology of nontidal wetlands is primarily through groundwater or a combination of groundwater and overbank flooding. Wetlands may also occur at the bases of slopes, where they are supported by seepage from the hillside. Wetlands have also developed at mined sites.

Wetland Classification

According to Tiner and Burke (1995), in 1981-1982, there were 7,325 acres of wetlands in the County (1.2% of the State's wetlands). The wetland types were Palustrine (7,243

acres), Riverine (33 acres), and Lacustrine (49 acres). The majority of these wetlands were associated with low-lying areas around streams, with a few isolated depressional wetlands. Comparisons of this 1981-1982 wetland acreage with historic wetland acreage (based on hydric soils) represents a 57%, or 9,655 acre, loss (MDE, 2002a).

The following wetland plant community descriptions are based on Tiner and Burke (1995).

- Palustrine wetlands can be classified into four major groups depending on the dominant vegetation type: forested, scrub-shrub, emergent, and aquatic. These wetlands were described for the Piedmont Province.
 - Palustrine forested wetlands are often found in stream floodplains. They can be categorized into two main types.
 - Seasonally flooded palustrine forested wetlands: These wetlands are flooded for some period (e.g. greater than two weeks) during the spring. Common tree species include Red maple, Black willow, and Green ash. There is often a dense understory of shrubs (e.g. Spicebush and Southern arrowwood) and herbaceous species (e.g. Skunk cabbage). Tiner and Burke gave an example of a seasonally flooded forested wetland community within Frederick County. The example was a Silver maple-Black willow dominated community. Associate tree species were Red maple, shrub species were Alder and Dogwood, and herbaceous species were Jewelweed, Joe-Pye weed, Blue vervain, Lurid sedge, and Big arrowhead.
 - Temporarily flooded palustrine forested wetlands: These wetlands are flooded for some period (e.g. a week or less) during the spring, less than that in the seasonally flooded forested wetlands. These systems may contain Red maple, Sycamore, Green ash, Silver maple, Pin oak, Tulip poplar, Black walnut, Black locust, or Box elder. The shrub layer may be less dense than in the seasonally flooded system. Temporarily flooded forested wetlands along the Potomac River floodplain are often dominated by Eastern cottonwood and Silver maple, with some Sycamore and Black willow. Tiner and Burke give two examples of wetland communities found within Frederick County. The first system, a Green ash-Sycamore-Box elder dominance, was found along Bennett Branch. Associate tree species were Pawpaw, Ironwood, Beech, Hackberry, and Tulip poplar. Associate shrubs species were spicebush and elderberry, herbaceous species were wood nettle, garlic mustard, wood sorrel, Lady's thumb, False nettle, and clearweed. Other associate vine-like species were Virginia creeper and poison ivy. The second example was a Red Maple dominance. Associates tree species were Sycamore, Box elder, and Silver maple. Shrub species were Multiflora rose, herbaceous species were Jewelweed and Goldenrod, and other species were Japanese honeysuckle and Blackberry.

- Palustrine shrub wetlands contain shrubs and tree saplings. The wetter systems are often dominated by Buttonbush, while the drier seasonally flooded systems may be dominated by a number of different species. Herbaceous species may form an understory.
- Palustrine emergent wetlands:
 - Semipermanently flooded marsh
 - Seasonally flooded marsh: These systems may be dominated by cattail, rice cutgrass, arrow arum, and rush.
 - Seasonally flooded meadow: This is the most common wetland type in the region. These systems would naturally be forested wetlands, but were cleared. Many have high plant diversity.
 - Temporarily flooded wet meadow: These systems may be adjacent to the seasonally flooded meadows, but they are flooded less often and for shorter durations.
- Palustrine aquatic beds are small ponds with partial or total vegetative cover.
- Riverine wetlands are found within the channel and include nonpersistent vegetation.
- Lacustrine wetlands are associated with deepwater habitat (e.g. freshwater lakes, deep ponds, and reservoirs). They can be classified into lacustrine aquatic beds (wetlands are located in the shallow water) and lacustrine emergent wetlands (wetlands are located along the shoreline).

As part of an ongoing project to classify the vegetative communities in Maryland, DNR Heritage Program described circumneutral seepage wetlands within the Blue Ridge and Northern Piedmont Province. These near-neutral pH systems are important since they “serve valuable ecosystem functions, furnish habitat to numerous taxonomic groups, are generally rare, and are often habitat for numerous rare, threatened, and endangered plant and animal species.” These wetlands are restricted in Maryland to areas with specific geology (e.g. greenstone, limestone, ultramafic bedrock), many of which often are at high risk of urban sprawl.

Wetland Functions

Stormwater and Flood Control

Wetlands are often credited with providing natural stormwater and flood control benefits. Inland wetlands adjacent to rivers, streams and creeks hold excess discharge and runoff during periods of increased precipitation such as tropical storms and hurricanes and during periods of rapid snow-melt in mountainous regions.

Several factors influence the effectiveness of a wetland in reducing adverse effects of stormwater and floods. Factors include the characteristics of the wetland, local land conditions, and landscape features in the surrounding larger watershed, as well as the type of storm itself. The physical structure of many wetlands, with dense vegetation, fallen trees, topography (hummocks, depressions), and complexity of stream channel

systems serve as resistance features to slow flow of surface water from floods and surface runoff, reduce the height of peak floods, and delay the timing of the flood crest. Wetlands are typically in a topographically low position, which provides a natural basin for water storage. The depth of the basin and soil characteristics affect the wetland's storage capacity at surface and subsurface levels. Water is released more slowly from the wetlands, thereby reducing both erosion and damage to property and structures farther downstream. In the surrounding areas, the ability of the land to also reduce runoff may aid the wetland in its flow retention/reduction function. At the landscape level, the position of the wetland in the watershed and the ratio of size of the wetland to the size of the watershed also affect the function. Wetlands higher in the landscape and of large in size in relation to the watershed are most effective. While wetlands retain surface flows that enter the wetlands at a gradual rate, they are considered to be more effective at reducing damages from short duration storms.

Also, some water will be removed from the wetland through ground water recharge, soil retention and evapotranspiration.

Land use changes have likely caused some alteration in Frederick County wetlands' capacity and opportunity for providing flood attenuation. Development and increases in impervious surfaces have resulted in stream channel erosion and downcutting of stream channels. This has in some instances resulted in less out of bank flooding for low intensity storm events, thus less opportunity for adjacent wetlands to provide the flood attenuation function. The downcutting of the stream also results in a lower elevation of the base flow, which is often paralleled by a lowering of groundwater levels in adjacent wetlands. In other instances, increased development that caused additional flashiness and higher peak flows may result in additional flooding and more opportunity for adjacent wetlands to reduce flood damages to property. Some floodplain wetlands are also found in pasture land with little natural vegetation. Lack of dense vegetation reduces the ability of a wetland to slow velocities of floodwaters, further reducing the flood attenuation function. Floodplains are relatively narrow, which is another limitation to the storage capacity of wetlands in the floodplain. In areas of less development, headwater streams still may provide some flood attenuation functions.

Groundwater Recharge and Discharge

Functions

Wetlands facilitate the flow of water between the ground water system and surface water system. Wetlands periodically perform different functions, depending on the gradient of the groundwater table and the topography of the land surface. The relationship of the groundwater table and the land surface dictates which function - groundwater recharge or discharge - a wetland performs.

Nearly all of Maryland's wetlands are ground water discharge areas, at least for some portion of the year (Fugro East, Inc., 1995). Variations in the depth of the ground water table, resulting from seasonal changes in climate, dictate which of these functions - discharge or recharge - a wetland will perform at a given time.

Areas underlain with limestone support some streams that “disappear” underground and may re-emerge as springs.

Values

Ground water discharge helps maintain a wetland's water balance and water chemistry. This wetland function is also critical to the formation of hydric soils and the maintenance of ecosystem habitats in different types of wetlands.

Ground water recharge is the primary mechanism for aquifer replenishment which ensures future sources of groundwater for commercial and residential use.

Many Frederick County wetlands exist in association with springs that provide baseflow to streams or are developed in water sources for livestock.

Modification of Water Quality

Water Quality Improvement

Wetlands are valued for their ability to maintain or improve quality of adjacent surface waters. This ability is primarily accomplished by the following processes:

- Nutrient removal, transformation, and retention
- Retention of toxic materials
- Storage of the sediment transported by runoff or floods.

Hydrophytic vegetation (adapted to live in water) and microbial activity in soils help remove toxic substances and excess nutrients from surface water. Dissolved solids and other constituents may be removed or degraded, such that they become inactive, or incorporated into biomass. This occurs through adsorption and absorption by soil particles, uptake by vegetation and loss to the atmosphere through decomposition and exchange between atmosphere and water.

Nutrient Cycling: Addition, Removal and Transformation

Nutrients are carried into wetlands by hydrologic pathways of precipitation, river flooding, tides, and surface and ground water inflows. Outflows of nutrients are controlled primarily by outflow pathways of waters. The inflow and outflow of water and nutrients are important processes that effect wetland productivity.

Wetland biological and chemical processes remove suspended and dissolved solids and nutrients from surface and ground water and convert them into other forms, such as plant or animal biomass or gases. Debris and suspended solids (fine sediment or organic matter) may be removed by physical processes, such as filtering and sedimentation.

Soil characteristics, landscape position, and hydrology all contribute to the relative ability of a wetland to perform nutrient removal and transformation. Sufficient organic matter must be present for microorganisms in the soil to consume or transform the nutrients. Wetlands are often depressions in the landscape that hold water, transported sediment, and attached or dissolved nutrients for a longer period of time than a sloping area or areas with relatively higher elevations. A longer retention time allows for chemical interactions and plant uptake to occur.

Nitrogen undergoes some chemical transformations and may be taken up in soluble form, absorbed by plants through their roots, or consumed by anaerobic microorganisms that convert the nitrogen to organic matter (Mitsch and Gosselink, 2000). Anaerobic microbes may also convert the nitrogen from a nitrate form to nitrogen gas. Phosphorus is often bound to clay particles, and these fine sediments are transported into wetlands by riparian flooding and tidal action. Phosphorus may be stored in a wetland attached to the clay particles, however, phosphorus becomes available for plant uptake in its soluble form after flooding, saturation and anaerobic conditions typical of a wetland occur. Nutrient processes vary seasonally. Cooler temperatures slow microbial activity and plant uptake while higher flows of water transport more materials out of non-isolated wetland systems. The transported organic material is critical for downstream food chain support.

Wetlands are most effective at nutrient transformation and uptake when there are seasonal fluctuations in water levels (Tiner and Burke, 1995). Wetlands that are temporarily flooded (saturated or inundated for brief periods early in the growing season) and those that are permanently inundated would generally be less effective than seasonally wet areas (saturated or inundated for longer periods during the early-mid growing season but are drier by the end of the growing season).

Toxics Retention

Retention of heavy metals has been reported most often in studies of tidal wetlands, though most wetlands are believed to serve as sinks for heavy metals. Accumulation is primarily in soils, with plants playing a more limited role (Mitsch and Gosselink, 2000). Plants such as cattails, bulrushes, and *Phragmites* are among the more effective and commonly used plants for uptake of toxic materials such as metals. As is the case for nutrient transformation and sediment retention, soil characteristics, landscape position, vegetation, and hydrology all contribute the relative ability of a wetland to retain toxic materials. The longer the duration that water and transported materials remain in the wetland, the greater the likelihood that the materials will be retained. Many wetlands have been constructed as part of stormwater management facilities to treat surface runoff.

Sediment Reduction

Wetlands along rivers, streams and coastal areas are important for removing sediment from surface and tidal waters. During large flood events, rivers frequently overtop their banks and water flows through adjacent floodplains and wetlands. Flood waters carry large volumes of suspended sediment, mostly fine sand, silt and clay. Because floodplains and wetlands provide resistance to flow - from dense vegetation, microtopography, and woody debris - the flow of water is slowed and sediment is deposited and stored in these areas. Similarly, coastal marshes and estuaries retain sediment brought in by tides and residual suspended sediment from rivers.

Lack of dense vegetation in some floodplains, and narrow width of floodplains, would reduce the ability of wetlands to slow velocities of floodwaters and allow settling of transported sediments.

Wildlife Habitat/Diversity

Wetlands provide important habitat for fish, wildlife, and plant species, including rare species. Wetlands adjacent to coldwater streams in Frederick County also aid in providing shade to maintain cool temperatures for aquatic species such as trout.

Nontidal Wetlands of Special State Concern

Nontidal Wetlands of Special State Concern are most common in the western part of the Upper Monocacy River watershed, along the Catoctin Mountains. Specific locations, descriptions, and management plans for these wetlands are described in the section for each individual watershed.

Wetland Restoration Considerations

Identifying areas of hydric soils suggest where wetlands are located presently or were located historically. In the 2002 Frederick County Soil Survey, two dominant soils were often combined into one soil map unit classification. In many cases, one of these soils was hydric and occurred along the lower elevations and the other soil was non-hydric and occurred in the higher elevations. Calling this entire soil map unit hydric may be overestimating the true amount of hydric soil. Additionally, non-hydric soil map units may contain other dissimilar soils that are in areas too small to map. These soil map units, although largely non-hydric, may contain some “pockets” of hydric soils. In this case, the amount of hydric soil may be underrepresented. Keeping this in mind, soil map units designated as having one of the dominant soils being hydric are distributed throughout the County. Not surprising, large areas occur along streams. Wetlands are present in a relatively small portion of the area containing hydric soil.

Hydric soils in Frederick County can also be estimated from the Natural Soil Groups of Maryland (1973). However, these soil groupings are also highly generalized and the definition of hydric soil may have changed since the classification.

Vegetated stream buffers have the potential to intercept and remove nutrients, sediments, and other pollutants. Peterson et al. (2001) found that the smallest headwater streams, which are often found in association with springs and groundwater discharge wetlands, have the most rapid uptake and transformation of inorganic nitrogen (ammonium and nitrate) in comparison with other surface waters. The authors believed that the large surface to volume ratio in small streams resulted in rapid nitrogen uptake and processing. An excess of discharges to overload these systems would result in nitrogen being transported farther down the drainage systems to rivers and estuaries. Forested stream buffers can also improve down stream biodiversity by contributing organic matter to the food web, providing woody debris which increases diversity of physical habitat, and reducing stream temperature. Headwater streams are thought to be the most beneficial at these processes. Therefore, wetlands adjacent to streams should be high priority for restoration/preservation, with emphasis on headwater stream systems. Wetlands adjacent to Scenic Rivers and around all tributaries of waterways used for drinking water (COMAR Use P) should also be ranked higher.

DNR assessed the development risk for all land within Maryland. Wetlands within areas of high development risk should be higher priority for preservation.

In order to maintain water quality of surface water reservoirs, wetlands within the watersheds of surface water reservoirs should be higher priority for preservation.

Wetland restoration may be more desirable in land uses that contribute high pollution, currently provide relatively low amounts of biodiversity, and are easy to convert to wetlands. As a general rule, agriculture fits these criteria more than other land use types. Forested land is generally not as high of a pollutant source and it also provides better habitat for plants and wildlife. For these reasons, converting upland forest to wetland may provide fewer benefits than converting agriculture to wetlands. However, projects that have converted artificially drained forest to wetland have resulted in beautiful wetlands with diverse ecology. Additionally, wetlands may be built in urban land use, but they are generally much smaller and sometimes more costly. Urban areas may provide good potential for wetlands designed for storm water management.

Sensitive Resources

Sensitive areas requiring special consideration according to the 1992 Planning Act include: streams and their buffers, 100-year floodplain, threatened and endangered species habitats, and steep slopes. Additionally, in the Comprehensive Plan, Frederick County has designated other elements as “sensitive areas” including: Scenic Monocacy River, areas of prime agricultural soils not in planned community growth boundaries, groundwater (especially around wellhead protection areas), wetlands, limestone conglomerate/carbonate rock areas, and historic/archaeological resources. Restoring forest buffers along the streams is a high priority in this County.

The DNR Natural Heritage Program has 16 animal species and 82 plant species listed as being rare, threatened, and endangered in the County. They maintain data on locations of these species, which may be important in selecting preservation areas. Rare species in Frederick County are most likely to be located in healthy forests and wetlands (Frederick County DPZ, 1997). There are no State-designated Natural Heritage Areas within this County.

The Federal Emergency Management Agency (FEMA)-designated 100-year floodplain is widest in areas adjacent to the Monocacy and Potomac Rivers. Some areas along the Monocacy River near Frederick City have 100-year floodplain widths of over 2,000 feet. This high flooding danger in Frederick City resulted in the building of an extensive flood control structure for Carroll Creek, diverting overflow water into an underground pipe to be transported away from the city. Frederick County also restricts development on the historic floodplain (if known) and the annual floodplain (based on soil surveys that may include floodplains of small streams missed by FEMA).

According to the 2004 NPDES Annual Report, Frederick County plans to prioritize subwatersheds as follows (with highest priority first): Lower Bush Creek, Ballenger Creek, Lower Linganore Creek, Upper Linganore Creek, Bennett Creek, Tuscarora Creek, Catoctin Creek, Israel Creek, Fishing Creek, Glade Creek, Upper Bush Creek,

Potomac Direct, Monocacy Direct Southwest, Little Catocin Creek South, Hunting Creek, Toms Creek, Middle Creek, Owens Creek, Little Pipe Creek, and Carroll Creek. A WRAS has been completed for the 8-digit watersheds Lower Monocacy River and Upper Monocacy River watershed. As a result of these WRASs, the Monocacy and Catocin Watershed Alliance was formed, an entity designed to continue initiatives established during the WRAS. County watershed assessments have been conducted by Versar, Inc. for the County's three highest priority subwatersheds: Lower Bush Creek, Ballenger Creek, and Lower Linganore Creek (all within the Lower Monocacy River watershed). More detailed information on these assessments can be found in the individual watershed sections.

Other Relevant Programs

Green Infrastructure and Green Space

The largest Green Infrastructure hub is in the northwest portion of the County, on steep terrain. Other small hubs exist throughout the County. These hubs still contain some significant portions of unprotected land. Areas within the Green Infrastructure network that are currently unprotected should be protected. A few Green Infrastructure corridors, mainly in agriculture, run through the County. Much of this Green Infrastructure land is along waterways. It is desirable to restore these areas back to natural vegetation, as they can provide a wildlife corridor, a protective buffer, and may be especially important along the waterways. For more detailed information, refer to section on the individual watershed.

A goal of the City of Frederick is to have a greenway along the streams to act as open space in this otherwise rapidly developing area (DNR, 2000a). The Frederick County Comprehensive Plan suggested that a Development Setback/Buffer along the Monocacy be enlarged to 500 feet. Additionally, it proposed that more parks and water access points be established around the Monocacy and Potomac Rivers. Waterways should be targeted for park development and portions of the creeks near proposed development should be evaluated for open space and linear park options. Frederick County would also like to develop bike and pedestrian trails along corridors and rail right-of-ways. The County Comprehensive Plan also encourages developing a 2,000 foot wide greenbelt around Municipal Growth Areas and Unincorporated Growth Areas, to provide a boundary between the developed areas and agricultural/rural areas.

The document entitled *Recommended Model Development Principles for Frederick County, MD* suggests using vegetated channels to transport and treat stormwater runoff. This document also suggests having protected green space within the community open space areas.

Ecologically Significant Areas

DNR designates areas that contain habitat for rare, threatened and endangered species and rare natural community types. These areas are buffered to create the "sensitive species project review areas" GIS layer, intended to assist in assessing environmental impacts and reviewing potential development changes. This layer generally includes

designated Natural Heritage Areas, Wetlands of Special State Concern, Colonial Waterbird Colonies, and Habitat Protection Areas.

Rural Legacy

Designated Rural Legacy land is located west of Middletown (encompassing Burkettsville and Myersville) in the watersheds Catoctin Creek and Potomac River (02140301). Wetland preservation in these areas may be compatible with the goals of the Rural Legacy Program. For detailed information about the program, refer to the individual watershed section.

Priority Funding Areas

Priority Funding Areas (PFAs) are mainly focused around Frederick City. PFAs connect Frederick City with Walkersville to the north, and New Market and Lake Linganore to the east. There are many smaller PFAs including the towns of Emmitsburg, Thurmont, Middletown, Brunswick, Mount Airy, Myersville, Urbana, and Woodsboro. The northwestern part of the County has the fewest PFAs. Wetland restoration may not be as desirable in areas slated for development.

Stakeholders in wetland management may have conflicting goals for wetlands in Priority Funding Areas. Some may advocate preserving wetlands in these areas as greenways, for aesthetics, or as unique communities in a developing area. Other interests may seek flexibility and expedited review of proposals to impact wetlands due to other goals for growth and economic development in a designated area. There may be benefits to protecting and restoring wetlands for water quality in a growth area, particularly as an offset against future or existing TMDLs. Preservation of biodiversity may be more of a challenge due to possible increases in nonpoint source pollution and fragmentation. Stormwater management associated with growth may also reduce certain nonpoint source impacts to wetlands in PFAs.

Zoning

County regulations limit subdivision in areas zoned agricultural and resource conservation. For agricultural zoned areas, property may be subdivided into three lots and a remainder. Large agricultural lots may also do a limited amount of cluster development. For new development, areas zoned resource conservation must maintain a minimum five-acre residential lot size with no new residential roads.

Protected Areas

Estimates of protected land in the County, based on Maryland Department of Natural Resources GIS data, are as follows: 10,237 acres Federal, 12,628 acres DNR, 10,367 acres County, 3,718 acres MET easements, 2,525 acres private conservation, and 26,212 acres agricultural easements. It is estimated that of the 131,000 acres of forest, roughly 90% is privately owned (Frederick County, 2000). This suggests that much of this valuable forest is not protected and may be vulnerable to logging.

Some properties are within agricultural easements. Some are permanent and some are shorter-term. There is some controversy about conducting wetland restoration within

agricultural easements. Most would agree that it is desirable to preserve good farmland. However, properties within these easements may also contain spots of soil with lower productivity due to wetness. These low productivity spots may be a hassle to the farmer and may be good areas for wetland restoration. First, the property owner may be able to benefit from an additional program for that low productivity area, resulting in the owner getting more money for the land and utilizing the land to its full extent. Since these property owners are already involved in a preservation program, they may be more likely to consider additional programs. Second, since some of these agricultural easements are temporary, after the agricultural easement expires, the land owner may decide to get out of agriculture, and a wetland program could help to preserve some of the land from development.

Watershed information

Information on individual State-designated 8-digit watershed basins is as follows. Detailed information on the watersheds South Branch Patapsco, Brighton Dam, and Potomac River (Montgomery County region) was not included in the following section, due to small size of those watersheds within Frederick County. For more information on these watersheds, please see the section for the main County where they are located.

Potomac River – Monocacy to Shenandoah River (02140301)

Background

While the majority of this watershed is located within Frederick County, a small portion is within Washington County. There are 31,448 land acres in the Frederick County portion of this watershed. Nearly half of this land is agriculture (49%), a third is forested (33%), and a smaller amount is developed (18%) (MDP, 2002). This watershed is located within two physiographic provinces, the Piedmont Province and the Blue Ridge Province. Within the Piedmont region, many of the streams have moderate slopes with rock or bedrock bottoms. The Blue Ridge Province has mainly rocky streams, which are steep in the mountains and meandering in the valleys.

The geologic formation called Frederick Limestone is present in the eastern portion of this watershed. This limestone is susceptible to sinkhole formation and groundwater contamination. Designs for wetland restoration/creation in these areas should take this into account.

The Potomac River, a State-designated Scenic River (DNR, 2003d), is the largest waterway. Main tributaries to the Potomac include Little Catoctin Creek in the Western section and Tuscarora Creek in the eastern section.

The 188-acres Islands of Potomac Wildlands (partially located in Montgomery County) is part of the Maryland Wildland Preservation System. To be in this program, the Maryland General Assembly must designate this area as a Wildland, land that retained its wilderness character, and it must be owned by DNR.

Estimates of wetland acreage for the entire Maryland portion of the watershed, based on DNR mapped wetlands, are as follows:

- Palustrine
 - Emergent: 191 acres
 - Scrub shrub: 102 acres
 - Forested: 715 acres
 - Unconsolidated bottom: 89 acres
 - Farmed: 86 acres
- Riverine unconsolidated shore: 2 acres
- Total: 1,185 acres

MDE tracks all regulated nontidal wetland activity in Maryland, including regulated wetland impacts and gains. Based on data for the time period of January 1, 1991 through December 31, 2004, for this watershed, there has been a slight loss in wetlands (Walbeck, 2005).

Basin code	Permanent Impacts (acres)	Permittee Mitigation (acres)	Programmatic Gains (acres)	Other Gains (acres)	Net Change (acres)
02140301	-0.33	0	0	0	-0.33

Code of Maryland Regulations

All Maryland stream segments are categorized by Sub-Basin and are given a “designated use” in the Code of Maryland Regulations 26.08.02.08. This watershed is designated as follows:

- All of Potomac River and tributaries from Montgomery County line to Shenandoah River, except those stream segments designated below: Use I-P, water contact recreation, protection of aquatic life, and public water supply.
- Israel Creek and tributaries: Use IV-P, recreational trout waters and public water supply.

Water quality

There are two surface water community water supplies withdrawing from the Potomac: one for the City of Brunswick and one in Southern Frederick County (called New Design). Eastalco Aluminum is a major industrial point source in the upper reaches of this watershed.

There are small State-designated wellhead protection areas around Point of Rocks. Source Water Assessments have been completed for some water systems. The water system and associated susceptibility to contaminants is summarized as follows:

- *Point of Rocks*: radionuclides and some microbiological contaminants.
- *City of Brunswick and New Design (Potomac River)*: natural organic matter, disinfection byproduct precursors, Cyptospridium oocyts, Giardia cysts, taste and odor problems, ammonia, sediment/turbidity, algae, fecal coliform, and dieldrin. Main recommendations include reducing the pathogens from agriculture (there is

a large livestock population in the source water assessment area) and urban wastewater treatment plants. Efforts to reduce erosion and sediment pollution are also necessary. Phosphorus is the limiting nutrient in this waterway.

The 1998 Clean Water Action Plan classified the watershed as Category 1, a watershed not meeting clean water and other natural resource goals and therefore needing restoration. Failing indicators include poor non-tidal Benthic Index of Biotic Integrity (BIBI) and high percentage unforested stream buffer (79%). There is one drinking water intake.

Although the *2002 Maryland Section 305(b) Water Quality Report* suggests the portion of the Potomac River between the Monocacy River and the Shenandoah River supports all designated uses. The 2002 Maryland Section 305(b) Water Quality Report States that wadeable streams (stream order ≤ 4) do not support all designated uses due to a poor biological community. The 2000 Maryland Section 305(b) Water Quality Report States that Israel Creek (in Washington County) and Tuscarora Creek do not support all designated uses. Possible pollutant sources include habitat degradation from siltation, poor bank stability, and channelization.

The 2004 303(d) List contains basins and subbasins that have measured water quality impairment and may require a Total Maximum Daily Load (TMDL). The basin/subbasin name, subbasin number (if applicable), and type of impairment are as follows:

- *Israel Creek* (021403010207 – in Washington County); poor biological community.
- *Unknown tributary to Little Catoctin Creek* (021403010208); poor biological community.
- *Tuscarora Creek* (021403010211); sedimentation.
- *Unknown tributary to Tuscarora Creek* (021403010211); sedimentation.

MBSS found BIBI of poor and very poor and FIBI of fair to very poor (Boward, 1995-1997, 2000-2001).

Restoration/Preservation

There is a long Green Infrastructure hub on the Washington-Frederick border, mostly protected by the South Mountain Natural Environmental Area. There is a smaller hub just north of Point of Rocks, which is unprotected. The C&O Canal National Historical Park is also part of a narrow hub in the southern portion of the County (DNR, 2000-2003). Although this park does occupy much of this hub, there are some unprotected zones that should be high priority for protection. According to the Maryland Greenways Commission, existing greenways include the Appalachian Trail/South Mountain Greenway and the C&O Canal National Historical Park. There are several agricultural easements and Maryland Environmental Trust Easements throughout.

The following information is based on the document *Rural Legacy FY 2003: Applications and State Agency Review*. Approximately 26,351 acres in the southwestern corner of

Frederick, including Myersville and Burkittsville, are designated as Rural Legacy area. This area is largely undeveloped (89%). This area was chosen in order to protect productive agriculture, including many dairy and livestock farms, the Appalachian Trail and viewshed, the town of Burkittsville, and Civil War battlefields in and around South Mountain Battlefield State Park. The goal is to protect 17,267 acres (66%). Currently, 8,189 acres (31%) of this land is protected through various methods. The sponsors are Frederick County Department of Planning and Zoning and Mid-Maryland Land Trust Association, Inc. The report also includes a list of property owners who are interested in selling an easement and the priority of acquiring these easements. Generally the intent of the Rural Legacy Program is to focus preservation efforts around historic and scenic roads, develop greenbelts, and add to large areas of already-protected lands. In this case, Priority 1 sites are located mainly around Burkittsville and near the U.S. Rte. 17/U.S. Rte. 340 interchange. Since the Rural Legacy Program funds are not adequate enough to support all of these requests, other programs should consider preservation of these sites.

There are several Nontidal Wetlands of Special State Concern along the Potomac River, all protected by the C&O Canal National Historic Park. The following information was summarized from the 2003 document entitled *Nontidal Wetlands of Special State Concern of Five Central Maryland Counties and Coastal Bay Area of Worcester County, Maryland*. General management recommendations include limiting hydrological changes including draining/filling/excavating, increased impervious surface, and groundwater drawdown by surrounding wells. Sediment and other pollutants from agriculture and development should be controlled. Best Management Practices should be established for any new development. Spraying of pesticides should be avoided within the wetland. Avoid livestock grazing within the site. Nearby road maintenance should be performed with caution. Heavy recreation should be directed away from the sensitive species. Non-native species invasion and excessive deer browsing should be controlled. A forested buffer should be maintained and logging should be prohibited in the buffer area and within the site itself. Any site recreational use should be directed away from the sensitive species. Restrictions on all-terrain vehicle (ATVs) use should be strictly enforced.

- *Brunswick Riverside (DNR name: Brunswick Floodplain)*. This area has five endangered plant species (the presence of two of these species is based on historical records) and five additional uncommon plant species. Notable habitats in this system include scour/depositional bars and maturing floodplain forest. Recreation within this site includes fishing, hiking, and unauthorized camping and ATV use. Nearby there is picnicking, parking, a boat launch, and railroad operations. One of the sensitive species occurs mainly in the vegetative canopy gaps. Succession of woody vegetation may reduce these light gaps. Invasive non-native plant species and deer browse are a large problem at this site. Increased human activity within the site is also a major threat to the system. This site is within the C&O Canal National Historical Park.
- *Lock 28 Floodplain*. This is a linear wetland following the C&O Canal and the Potomac River. Notable habitat within this site includes alluvial vernal pools and maturing floodplain forest. It also contains two State rare threatened or endangered plant species and three uncommon plant species. Lightly-used trails cross the wetland. Invasive non-native plant species and deer browse are a large

problem at this site. Increased human activity within the site is also a major threat to the system.

- *Lock 29 Floodplain*. Catoctin Creek Mouth, Catoctin Station, and Lock 29 Floodplain comprise a continuous wetland floodplain system between the C& O Canal and the Potomac River. Past land use impacts have included agriculture, logging, and home and railroad/canal construction. Main threats include invasion by non-native plant species, excessive deer browse, and human recreational use.
 - *Catoctin Creek Mouth*. This site is located at the mouth of Catoctin Creek. Significant habitats include alluvial vernal pools, maturing floodplain and forest, and scour/deposition bars. This site contains seven plant species on the State rare threatened or endangered species list. It also contains five uncommon plant species and six plant species of local significance. Two rare or endangered mollusks have been documented. Some of these species are especially sensitive to sedimentation and deterioration of water quality. Since one endangered plant species occurs in the canopy gaps, these gaps should be monitored to determine if suppression of maturing woody vegetation is required.
 - *Catoctin Station*. This site is located east of Catoctin Creek. Significant habitats include alluvial vernal pools, maturing floodplain and forest, and scour/deposition bars. This site contains four State rare threatened or endangered species, three uncommon plant species, and three locally significant plant species. There is moderate recreational use in the area, including hiking, fishing, and a nearby boat launch.
 - *Lock 29 Floodplain*. This is the southernmost section of the wetland complex. Significant habitats include alluvial vernal pools and maturing floodplain forest. This site contains two rare threatened or endangered species, two uncommon plant species, and two locally significant plant species. A powerline crossing and Eagle Island Campground maintain canopy gaps in a portion of the wetland, into which invasive non-native plant species have spread. There is also a trail for fishing access along the river.

Specific recommendations for restoration:

- Restore the Scenic Potomac River.
- Restore wetlands and streams within the headwaters.
- Restore “gaps” within the Green Infrastructure to natural vegetation, especially along the Potomac River and tributaries.
- Wetland restoration design should consider effects of possible underlying limestone.

Specific recommendations for protection:

- Protect the Scenic Potomac River.
- Protect portions of Green Infrastructure that are not currently protected, especially along waterways.
- Protect additional wetlands within the DNR-designated Ecologically Significant Areas.

- Protect wetlands and streams within the headwaters.

Lower Monocacy River (02140302)

Background

Of the total 194,700 acres in this watershed, most is in Frederick County (87%), with smaller amounts in the Counties Montgomery (10%) and Carroll (3%) (Shanks, 2003). There are 168,262 land acres in the Frederick County portion of this watershed. Nearly half of this watershed is agriculture (47%), and the other half is divided nearly equally between forest (29%) and developed area (24%) (MDP, 2002). Within Frederick County, this watershed has the highest percentage developed land because it includes the majority of Frederick City and because development is highest in the southeastern part of the County due to proximity to Washington and Baltimore. Nearly a quarter of this watershed is highly erodible land (Shanks, 2003). The 1995 Walkersville Region Plan identifies wet soils mainly along streams and floodplains, but also north and south of Maryland 31 (east of Libertytown at Old Fields).

The Carroll County portion of this watershed includes the outskirts of Mt. Airy, a community planned area where future growth is being focused. The remaining Carroll County portion land use is agriculture and forest. The Montgomery County portion of this watershed is mainly agriculture and forest, including Little Bennett Regional Park. For more detailed descriptions of the watershed portions within these Counties, please refer to the section for that County.

The majority of this watershed is located in the Piedmont Province, with only the far western edge in the Blue Ridge Province. Within the Piedmont Region, many of the streams have moderate slopes with rock or bedrock bottoms. The Appalachian Plateau has mainly rocky streams of which may have steep slopes along mountains or may meander in the valleys. The geologic formations called Frederick Limestone and Grove Limestone are present in the western portion of this watershed, running from Woodsboro/Walkersville south through Frederick and then to the Potomac River. This limestone is susceptible to sinkhole formation and groundwater contamination. For this reason, designs for wetland restoration/creation in these areas should take this into account.

The major waterway is the Monocacy, with large tributaries to the Monocacy including Bennett, Bush, Linganore, Israel, Carroll, and Ballenger Creeks. The Monocacy River is the largest tributary of the Potomac River (Frederick County, 2000) and has a fairly low stream gradient for the Piedmont region. Of the Monocacy River watershed, 56% is located in Frederick County (Frederick County, 2000). The Monocacy River was designated a State Scenic River partially in order to restore the water quality (Monocacy Scenic River Local Advisory Board, 1992). Within this watershed, two tributaries to the Monocacy were also listed as candidates for State Scenic Rivers: Bennett Creek and Linganore Creek.

Lake Linganore is the largest impoundment in the County, holding roughly 883 million gallons of water. This lake is privately owned and is used for recreation and for water supply.

The Monocacy Natural Resource Management Area, located within this watershed, was identified by Audubon Maryland-DC as important bird area. A high population of waterfowl are located on the Monocacy River from Michael’s Mill Dam to the confluence with the Potomac River (Monocacy Scenic River Local Advisory Board, 1992). Native brook trout are on Bear Branch and naturalized brown trout are located on the headwaters of Ballenger Creek (Shanks, 2003).

Estimates of wetland acreage for the entire watershed, based on DNR mapped wetlands, are as follows:

- Lacustrine unconsolidated shore: 1 acre
- Palustrine
 - Aquatic bed: 1 acres
 - Emergent: 1,009 acres
 - Scrub shrub: 639 acres
 - Forested: 2,483 acres
 - Unconsolidated bottom: 757 acres
 - Unconsolidated shore: 2 acres
 - Farmed: 219 acres
- Riverine unconsolidated shore: 2 acres
- Total: 5,114 acres

MDE tracks all regulated nontidal wetland activity in Maryland, including regulated wetland impacts and gains. Based on data for the time period of January 1, 1991 through December 31, 2004, for this watershed, there has been a gain in wetlands (Walbeck, 2005).

Basin code	Permanent Impacts (acres)	Permittee Mitigation (acres)	Programmatic Gains (acres)	Other Gains (acres)	Net Change (acres)
02140302	-6.06	5.91	37.50	0.11	37.46

Code of Maryland Regulations

All Maryland stream segments are categorized by Sub-Basin and are given a “designated use” in the Code of Maryland Regulations 26.08.02.08. This watershed is designated as follows:

- All of Potomac River and tributaries from Montgomery County line to Shenandoah River, except those stream segments designated below: Use I-P, water contact recreation, protection of aquatic life, and public water supply.
- Carroll Creek and all tributaries (above U.S. Rte. 15), Rocky Fountain Run and all tributaries, Little Bennett Creek and all tributaries (above MD Rte. 355), Furnace Branch and all tributaries, Ballenger Creek and all tributaries: Use III-P, natural trout waters and public water supply

- Monocacy River and tributaries (above Rte. 40) except those listed as Use III-P above: IV-P, recreational trout waters and public water supply.

The Monocacy River Study and Management Plan

The following information was summarized from *The Monocacy River Study and Management Plan* (1990). Since much of the land adjacent to the Monocacy and its tributaries had fairly low topographic gradients, development and agriculture were possible next to the water. As discussed later, this proximity increases pollutant entry into the waterways.

There are many springs and seeps, often being wetlands. The majority of these areas produce little water, with the exception of Fountain Rock Spring. Since these springs and seeps may provide important conditions required for certain species (e.g. brook trout and pearl dace), these sites may provide good opportunities for protection. The wetlands located in the mountain region, often getting water from seeps, contain rare plant species.

Trout streams include the following: Furnace Branch, Glade Branch, Bear Branch, Friends, Ballenger, Owens, Hunting Tuscarora, and Fishing Creek. Trout populations are higher in the northern waterways, suggesting that water quality in general is better in the north. Waterfowl densities are highest on the Monocacy near Michael's Dam, through the Monocacy Natural Resource Management Area to the Potomac. There are some wetlands in this area that could be protected to maintain wildlife habitat.

During the period of this 1990 study, the most dominant land use along the river was agriculture and old fields, with some residential development and light industry. The forest buffer width along the Monocacy River was generally poor, with only about half of the streambanks having adequate buffers (with good buffers being found within park property).

Water impacts include: three major developed areas withdrawing water from the Monocacy River (Frederick, Westminster, and Gettysburg), sewage disposal, and agricultural and residential land use. An important issue in this waterway is suspended sediment, which inhibits aquatic species. This watershed discharges over two times the amount of sediment per acre than any other Potomac River watershed upstream of Point of Rocks. Other pollutants of concern in the Monocacy are nutrients and pathogens. Conversion of the natural buffers and creation of structures within the floodplain increases pollution entering the waterways and increases flash flooding.

Water Quality

There are four surface water community water supply systems, two withdrawing from the Monocacy River (City of Frederick and Fort Detrick), one from Linganore Creek (City of Frederick), and one from Lake Linganore. Some of the major municipal point sources include Fort Detrick, Frederick, and Ballenger Creek WWTPs flowing into the Monocacy River.

There are several State-designated wellhead protection areas in this watershed, with the largest being around Mt. Airy. The Source Water Assessments completed for the wellhead protection areas found sites being susceptible to the following:

- *Bradford Estates* (between New Market and Mt. Airy): nitrate, radon, and synthetic organic compounds.
- *Gilberts Mobile Home Park* (South of Frederick City): nitrate, radon, volatile organic compounds (VOCs), and synthetic organic compounds (SOCs).
- *Libertytown Apartments*: nitrate, radon, VOCs, and viruses.
- *Libertytown East*: some microbiological contamination.
- *Mill Bottom* (near Mt. Airy): nitrate and some microbiological contamination.
- *Polings Mobile Home Estates* (west of Frederick City): radon and nitrate.
- *Urbana High School*: nitrate, radon, and some microbiological contaminants.
- *Windsor Knolls*: nitrate and some microbiological contamination.
- *Woodspring* (near New Market): nitrate, VOCs, SOCs, and microbiological contaminants.

The 1998 Clean Water Action Plan classified this watershed as “Priority” Category 1, a watershed not meeting clean water and other natural resource goals and therefore needing restoration. Since it is a “Priority” Category 1 watershed, this watershed was selected as being one of the most in need of restoration within the next two years since it failed to meet at least half of the goals. It is also classified as a “Selected” Category 3, a pristine or sensitive watershed most in need of protection. Failing indicators include high levels of the nutrients phosphorus and nitrogen, poor benthic index of biotic integrity (BIBI), high percent unforested stream buffer (63%), and high soil erodibility (0.28). Wetland loss was estimated to be 11,799 acres. This watershed was ranked among the worst 25% of the State watersheds for having high levels of total nitrogen and total phosphorus. Indicators for Category 3 include high fish index of biotic integrity (FIBI), high imperiled aquatic species indicator, and the presence of five drinking water intakes.

According to the *2002 Maryland Section 305(b) Water Quality Report*, some portions of the Lower Monocacy River and larger tributaries do not support all designated uses. There are elevated levels of bacteria in the Monocacy River just above the Potomac River and in the Monocacy River near Reich’s Ford Road (DNR, 2000b). The Monocacy River between the Potomac River and MD Route 26 partially supports all designated uses, with pollutant sources including agriculture, development, and natural sources (DNR, 2000b). However, this pollutant is not severe enough to put this basin on the 303(d) List for impaired waters due to bacterial impairment. The majority of streams (stream order ≤ 4) fail to fully support all designated uses (DNR, 2002). Wadeable streams in the sub-watersheds Carroll Creek and Cabbage Run do not support all designated aquatic life uses due to poor fish and benthic communities (DNR, 2000b). This may be due to channelization and poor habitat from bank instability and high rates of sedimentation. Lake Linganore fails to support all designated uses due to siltation and nutrients from sources including upstream, natural, and unknown (DNR, 2002).

The 2004 303(d) List contains basins and subbasins that have measured water quality impairment and may need a TMDL. The basin/subbasin name, subbasin number (if applicable), and type of impairment are as follows:

- *Lower Monocacy River*; fecal coliform. While this watershed is also impaired by nutrients and sediments, a TMDL has been completed for these contaminant.
- *Lake Linganore*; While this waterway is impaired by nutrients and suspended sediments, a TMDL has been completed for these pollutants.
- *Bear Creek* (021403020224 in Frederick); poor biological community.
- *Bennett Creek* (021403020224 in Frederick); poor biological community.
- *Horsehead Run* (021403020227 in Frederick); poor biological community.
- *Carroll Creek* (021403020233 in Frederick); poor biological community.
- *Ballenger Creek* (021403020230 in Frederick); poor biological community.
- *Unnamed tributary to Ballenger Creek* (021403020230 in Frederick); poor biological community.
- *Unnamed tributary to Carroll Creek* (021403020233 in Frederick); poor biological community.
- *Addison Run* (021403020233 in Frederick); sedimentation.
- *Rock Creek* (021403020233 in Frederick); poor biological community.
- *Laurel Run* (021403020237 in Frederick); poor biological community.
- *Laurel Run Unnamed Tributary* (021403020237 in Frederick); poor biological community.
- *Dollyhide Creek Unnamed Tributary* (021403020236 in Frederick); poor biological community.
- *Unnamed tributary to the Monocacy River* (021403020233 in Frederick); sedimentation.
- *Cabbage Run* (021403020237 in Frederick); poor biological community.
- *Unnamed tributary to Israel Creek* (021403020237 in Frederick); poor biological community.

A Total Maximum Daily Load (TMDL) was approved for Lake Linganore in 2003. In this TMDL, MDE recommends a 90% reduction in phosphorus loads and a 45% reduction in sediment loads to this lake. Lake Linganore has been closed to swimmers several times due to high fecal coliform. Reductions in sediment and nutrient pollution from upstream will improve the water quality of the lake and prolong the water storage capacity in the lake before a costly dredging project is required (Frederick County DPZ, 1995b).

Some water quality concerns for this river include inadequate riparian buffer (in many sections), sediments, nutrients, and pathogens. The Monocacy River is the largest source of sediment to the Potomac (Shanks, 2003). Linganore Creek is a State-priority watershed due to the high amount of land that is both agricultural and highly erodible soil (Frederick County DPZ, 1995b).

MBSS found FIBI of generally good to fair in most areas except around Frederick and Walkersville, which had some sites ranked very poor. BIBI were ranked lower, and did

not show any clear pattern, as the very poor sites were scattered throughout the watershed.

Stream Corridor Assessment for Rock and Carroll Creeks

Maryland Department of Natural Resources completed a Stream Corridor Assessment (SCA) for Rock and Carroll Creeks. These watersheds are 20 square miles and include most of Frederick City. The SCA was funded in response to the document *Rock Creek and Carroll Creek Forest Master Plan*, which suggested that there were high amounts of sediment entering these waterways through nearby construction and stream bank erosion. The SCA surveyed 19 stream miles and concluded that the most common problem was inadequate stream buffer, followed by pipe outfalls and stream erosion. Other problems included: barriers to fish migration, stream channel alterations, exposed pipes, unrestricted livestock access, and new construction adjacent to the waterways. Although inadequate stream buffers were located throughout the watershed, stream erosion was the worst in Rock Creek. This survey also included a list of prioritized stream restoration sites, based on severity of the problem, ease of correctability, and site accessibility. Based on this report, DNR and the City of Frederick Department of Public Works have designed or completed at least three stream restoration projects including: stream stabilization and revegetating the stream below Baughman's Lane, erosion control and improving fish passage at and above Baughman's Lane, and improving aquatic habitat in Baker Park.

Stream Corridor Assessment for Ballenger Creek

Maryland Department of Natural Resources was hired by Frederick County Division of Public Works to conduct a Stream Corridor Assessment of Ballenger Creek (completed in 2004). Roughly 33 stream miles were walked, finding 192 potential environmental problems. Problems included pipe outfalls (50 sites), inadequately forested stream buffers (42 sites), fish passage barriers (38 sites), erosion (34 sites), unusual conditions (10 sites), channel alteration (8 sites), trash dumping (6 sites), and exposed pipes (4 sites). Some of these sites may be conducive to wetland restoration.

Stream Corridor Assessment for Lower Linganore Creek

Maryland Department of Natural Resources was hired by Frederick County Division of Public Works to conduct a Stream Corridor Assessment of Lower Linganore Creek (completed in 2004). Roughly 95 stream miles were walked, finding 114 potential environmental problems. Problems included inadequately forested stream buffers (63 sites or ~32 miles), erosion (20 sites), fish passage barriers (11 sites), pipe outfalls (7 sites), channel alteration (5 sites), unusual conditions (3 sites), trash dumping (3 sites), and exposed pipes (2 sites). Some of these sites may be conducive to wetland restoration.

Stream Corridor Assessment for Upper Linganore Creek

Maryland Department of Natural Resources was hired by Frederick County Division of Public Works to conduct a Stream Corridor Assessment of Upper Linganore Creek. The survey found 247 potential environmental problems. The most common problem was inadequately forested stream buffers (80 sites or ~36 miles), with many ranked as severe or very severe. Largest amounts were along tributaries of South Fork Linganore Creek and tributaries of Linganore Creek. Some of these sites may be conducive to wetland

restoration. Other problems included erosion (72 sites or ~23 miles), fish passage barriers (56 sites), pipe outfalls (17 sites), channel alteration (4 sites), unusual conditions (8 sites), trash dumping (6 sites), and exposed pipes (4 sites).

Stream Corridor Assessment for Lower Monocacy River Watershed

Maryland Department of Natural Resources conducted a Stream Corridor Assessment for the Lower Monocacy watershed in 2003. The most common problem reported was inadequate buffers (115 sites). Many of the inadequate buffers were rated severe to very severe, with roughly half surrounded by agriculture. Many sites also had livestock access to the stream (29 sites). The next most common problem was stream erosion (81 sites), many ranked severe to very severe. There were numerous total fish barriers, nearly half on Woodville Branch. Other problems included pipe outfalls (45 sites), channel alterations (35 sites), trash dumping (14 sites), unusual conditions (10 sites including four with livestock in the stream), and exposed pipes (1 site).

Biological Assessment Synopsis for Rock and Carroll Creeks

Maryland Department of Natural Resources completed the Rock and Carroll Creeks Watershed Biological Assessment Synopsis. This study found that overall habitat was marginal, but was worse in the smaller second-order watersheds. Fish community showed some problems due to high impervious surface leading to flashy flow during storms and poor riffle habitat. Macroinvertebrate sampling also showed a moderate impairment in water quality or quantity.

Nutrient Synoptic Survey of the Lower Monocacy River Watershed

Maryland Department of Natural Resources completed the Lower Monocacy River Watershed nutrient synoptic survey in 2003. This survey sampled from Linganore Creek watershed, Bennett Creek watershed, and the outlets of other major tributaries. Nitrate/nitrite and orthophosphate concentrations were excessive in several subwatersheds. High nitrogen concentrations were related to agriculture (animal and row crops) in many areas. Possible sources of nitrogen included: manure as fertilizer, livestock in the stream, and failing septic systems (especially in small lot developments in Upper Bennett and Fahrney Branches). Phosphorus concentrations in the water are from phosphorus-saturated soils. Soils may become saturated in areas where manure is used as a fertilizer and application rates are based on nitrogen rather than phosphorus. Town Creek and Dollyhyde Creek contain high amounts of both nitrate/nitrite and orthophosphate. The document ranks the subwatersheds based on nutrient concentration and estimated yields. Subwatersheds ranked as having high nutrient levels should be targeted for restoration efforts.

Watershed Assessments

The County selected Ballenger Creek watershed for assessment due its close proximity to Frederick City and the resulting high rate of current and future growth. Although urban land use in the watershed is currently roughly 25% of the watershed, it is expected to increase to 62% within 20 years. A possible recreational trail is proposed along Ballenger Creek, from the Monocacy River to Ballenger Creek Park. Stream assessments found

some areas lacked in-stream fish cover, had high sediment deposition and embeddedness levels, had unstable poorly vegetated banks, and lacked a riparian buffer. There were also cases of livestock access to streams and stream channelization. Benthic and fish IBI scores were generally ranked as good in 2000 but were slightly lower based on MBSS sampling, possibly due to higher streamflow during 1996 sampling. MBSS samples found high nitrate-nitrogen levels at all stations. Overall, this basin is somewhat impacted by human activities. Stream monitoring is conducted roughly every two to three years in this subwatershed (Versar, Inc. 2001a).

A watershed assessment of Lower Bush Creek was conducted due to the large proposed development in Urbana. Overall habitat and index of biotic integrity scores were in the moderate range. Water quality results found relatively healthy streams with a few sites of elevated turbidity, total suspended solids, and the metals cadmium, copper, and zinc (Peter Pan Run). There were also high levels of nitrate-nitrogen. Some concerns expressed in this watershed plan include livestock access to streams, lack of riparian buffers, and large areas of riparian wetlands in need of protection from development. Stream monitoring is conducted roughly every two to three years in this subwatershed (Versar, Inc., 2001b).

A watershed assessment of Lower Linganore Creek was completed in 2002 (Versar, Inc., 2002). High rates of development are expected around Lake Linganore. There are three drinking water intakes on Linganore Creek: two upstream of Lake Linganore dam and one below. Linganore Creek has been classified by the State as a Class IV, Recreational Trout Waters stream. Therefore, this waterway may be especially sensitive to increases in turbidity and sediment loads. MDE's Source Water Assessment for the City of Frederick reported somewhat elevated levels of nitrogen. The agricultural herbicide Atrazine was reported in several samples. Some of the stations had moderate to severe bank erosion and high embeddedness, suggesting high sediment loads. Benthic index of biotic integrity ranged from poor to good. Stream monitoring is conducted roughly every two to three years in this subwatershed.

Common problems reported in these watershed assessments included areas underlain by limestone, livestock access to streams, runoff from cropland, inadequate stream buffers, failing septic systems, new construction, stormwater runoff from existing development, high rates of expected development, and changes in watershed hydrology.

These assessments resulted in several projects being initiated (Frederick County DPZ, 1998b), with some examples including:

- Ballenger Creek Elementary School stream restoration
- Urbana High School stormwater retrofits
- Fahrney and Pleasant Branches restoration (with Potomac Conservancy)
- Rocky Fountain Run fishery restoration
- Audubon Society stream restoration (in Upper Linganore watershed)

A WRAS was prepared by Frederick County for the Lower Monocacy River watershed. Some of the relevant natural resources objectives for the Lower Monocacy River watershed were as follows:

- Preserve and enhance natural areas (e.g. forests and wetlands).
- Increase vegetated riparian corridors and meadows for ground nesting birds.
- Protect and improve fish habitat (including cold water fisheries in Rocky Fountain Run and Ballenger Creek).

Restoration/Preservation

A moderately-sized Green Infrastructure hub is located in the south, and is only partially protected by Sugarloaf Mountain Park. Unprotected Green Infrastructure should be protected. Potential Green Infrastructure corridors, mostly in agriculture, follow the Monocacy River and several smaller streams (DNR, 2000-2003). Restoration of these corridors to natural vegetation is desirable. According to the Maryland Greenways Commission, potential greenways include Middletown-Myersville Trolley Trail, Bush Creek Trail, Monocacy River Scenic River Greenway, I-270 Transitway, Sugarloaf - Little Bennett Trail, Linganore Creek Trail, Rock Creek Trail, Monocacy River Water Trail, Ballenger Creek Trail, and Carroll Creek Trail.

Ballenger and Linganore Creeks were specifically targeted for park development in the Frederick County Comprehensive Plan. Portions of these creeks near proposed development will be evaluated for open space and linear park options. Additionally, the Walkersville Region Plan (1995) proposed including Israel Creek and open space areas in Walkersville, Woodsboro, and Libertytown in this greenway network.

Streams that should be developed into stream valley parks include: Glade Creek, Ballenger Creek, Linganore Creek, and Tuscarora Creek. The City of Frederick has already established parts of Carroll Creek as a stream valley park and intends to develop a Monocacy River linear park.

Within this watershed, there are several protected areas including the DNR-owned Monocacy Natural Resources Area (2,123 acres), Urbana Lake Property (67 acres), and Gambrill State Park (1,130 acres). Federal government land includes the C&O canal, the Monocacy National Battlefield, and Fort Detrick. There are also County parks, agricultural easements, and Private Conservation Areas (mainly Stronghold, Inc in Sugarloaf area) (Shanks, 2003).

There is one Nontidal Wetland of Special State Concern in this watershed, Bennett Tributary Swamp (also referred to as Sugarloaf Mountain WSSC). The following information was summarized from the 2003 document entitled *Nontidal Wetlands of Special State Concern of Five Central Maryland Counties and Coastal Bay Area of Worcester County, Maryland*. This site contains a spring-fed creek and seep with a State threatened species. It is located along a tributary to Bennett Creek. Areas up-slope of the site do contain invasive non-native plant species, but the wetland itself contains few. It is likely these weeds will soon spread into the wetland site if not maintained. The large

local deer population is impacting the site and should be controlled. This site is within the privately owned Sugarloaf Mountain Park. There is a logging trail that intersects the stream and the wetland. Logging and trail development should be avoided in the area. Any new development should employ use of Best Management Practices (BMPs). Spraying of pesticides should be avoided within the wetland.

Proposed stream restoration projects were assessed based on extent and severity of problem and potential for restoration benefit (ranked from 1 to 5 with 1 being the lowest rating and 5 being the highest). These problems are listed as being at a specific location, but may be widespread. A partial list is as follows: incised stream reach on Bens Branch at Gas House Pike (4.0), braided stream channel on Bens Branch across from Millime Court (4.0), livestock access to stream at Bens Branch (4.0) and an unnamed tributary to Hazelnut Run (3.7), lack of buffer into Lake Linganore from roads and lawns (4.3), golf greens extent to waterway without a buffer at Long Branch (2.7), absent/out of date storm water management at Pinehurst area of Lake Linganore (4.0). Unrestricted livestock access in western half of Ballenger Creek watershed on Ballenger Creek, Renn Branch, Butterfly Branch, and several headwater tributaries to Ballenger Creek. stream instability on Ballenger Creek (ranges from 3.3 to 4.3), King Branch and Arundel Branch (4.0). livestock access to stream at Bush Creek and tributaries (5.0).

An assessment of stream restoration and stormwater management control improvements is expected to be completed for Ballenger Creek subwatershed by mid-2005. This document will prioritize opportunities within this subwatershed, focusing on urban stormwater management that originates or impacts County land. Other opportunities on private land will also be noted.

The Versar, Inc document entitled *An Assessment of Stream Restoration and Stormwater Management Retrofit Opportunities in Lower Bush Creek Watershed, Frederick County, Maryland* located 24 potential restoration sites. These sites included stream restoration and stormwater management controls.

Prioritization of subwatersheds gets a bit complicated as Stated in the Lower Monocacy WRAS:

First, there are County priorities arising from environmental permits including the TMDL and the NPDES. Related to these permits are public health concerns including source water protection and ground water impacts from decentralized septic systems or other practices. Secondly there are County priorities arising from geologic conditions, regional plan updates and development patterns, broadly construed. Thirdly, there are priorities arising from stakeholder and partner interests and concerns, often focused on different aspects of the plan, e.g. forest buffers, wetland restoration, or community outreach or specific site locations as with the Audubon Society with two sanctuaries in the Upper Linganore Watershed or Carrolton Manor Trust which targets areas in the Monocacy Direct Watershed. And finally, there are priorities arising from funding

opportunities and cycles. These priority layers, mostly complementary, but occasionally competing or contradictory, are difficult to chart.

With this said, Linganore Creek is a high WRAS priority. Within this subwatershed, Town Creek “was contributing far more sediment and phosphorus to Lake Linganore than were the other two streams assessed” and is the first WRAS priority within Linganore Creek subwatershed. In addition to general programmatic approaches and BMPs, site specific recommendations include stream corridor restoration along Bens Branch. The Bennett watershed is also a priority since large amounts of development is occurring in that area. The WRAS goes into further detail on subwatersheds. The plan also lists many possible restoration projects (based on SCA data) throughout the watershed, including many sites listed as possible CREP projects, Backyard Buffer projects, and some fish barriers. One objective of this WRAS was to add 50 acres of wetlands by 2010 and improve the quality of existing wetlands. Potential wetland restoration sites were located on GIS maps using the criteria: hydric soils, proximity to other wetlands (within 300 feet), and land use. Note: the wetland prioritization model MDE developed also includes these criteria, in addition to others.

The Monocacy River Study and Management Plan (1990) proposed developing a Monocacy River overlay extending at least 500 feet on both sides of the River, with wider buffers where the existing conservation boundary is wider or in areas where there are sensitive resources outside the existing conservation buffer.

Specific restoration recommendations:

- Stormwater retrofits may present an opportunity to create wetlands or conduct stream restoration/stabilization.
- Restore wetlands and streams within the headwaters.
- Stream restoration based on various stream assessments.
 - Stream Corridor Assessments on Rock Creek and Carroll Creek found several sites of severe erosion at Rock Creek and Carroll Creek (tributary to Carroll behind West Frederick High School). These areas should be restored where possible.
 - Stream buffers should be a high priority along the Monocacy River, Israel Creek, and Linganore Creek (Frederick County DPZ, 1995b).
 - Incised stream reach on Bens Branch at Gas House Pike.
 - Braided stream channel on Bens Branch across from Millime Court.
 - Lack of buffer into Lake Linganore from roads, lawns, golf greens
 - Buffer at Long Branch.
 - Absent/out of date storm water management at Pinehurst area of Lake Linganore.
 - Unrestricted livestock access in Bens Branch, an unnamed tributary to Hazelnut Run, and western half of Ballenger Creek watershed on Ballenger Creek, Renn Branch, Butterfly Branch, and several headwater tributaries to Ballenger Creek.
 - Stream instability on Ballenger Creek, King Branch and Arundel Branch.
 - Livestock access to stream at Bush Creek and tributaries.

- Check feasibility of restoring Bens Branch across from Millime Court .
- Check feasibility of restoring Bens Branch at Gas House Pike.
- Additional restoration sites based on Stream Corridor Assessments, including sites where wetlands can be created in areas of currently inadequate forested stream buffer.
- Additional WRAS priorities (Frederick County DPW, 2004)
 - Linganore Creek watershed, and more specifically Town Creek subwatershed.
 - Bennett Creek watershed.
 - Additional possible restoration projects, including many sites listed as possible CREP projects, Backyard Buffer projects, and fish barriers.
 - Add 50 acres of wetlands by 2010 and improve the quality of existing wetlands.
- Restore the Scenic Monocacy River and a buffer around the River.
- Restore “gaps” within the Green Infrastructure to natural vegetation, especially along the Monocacy River and tributaries.
- Wetland restoration design should consider effects of possible underlying limestone.
- Restore/create wetlands designed to provide phosphorus and sediment retention in the Lake Linganore subwatershed.

Specific recommendations for protection:

- Protect the Scenic Monocacy River and buffer.
- Protect portions of Green Infrastructure that are not currently protected, especially along waterways.
- Protect wetlands and streams within the headwaters.
- Protect additional wetlands within the DNR-designated Ecologically Significant Areas.
- Protect springs and seeps identified in the 1990 Monocacy River Study.
- Currently, a large amount of headwater streams are covered with Interior Forests, many of which are unprotected. These should be the focus of preservation efforts.
- Stream buffers should be a high priority along the Monocacy River, Israel Creek, and Linganore Creek (Frederick County DPZ, 1995b).
- The following streams should be protected: Furnace Branch, Rocky Fountain Run, Tuscarora Creek, Ballenger Creek, Bennett Creek, Glade Creek, Bush Creek, Toms Creek, Carroll Creek, Owens Creek, Fishing Creek, Friends Creek, and Hunting Creek.
- Protect wetlands that provide the functions of phosphorus and sediment retention in the Lake Linganore subwatershed.

Upper Monocacy River (02140303)

Background

There are 128,661 land acres in the Frederick County portion of this watershed. Close to half of the land cover is agriculture (45%) and half is forested (44%), with the remaining

being developed land (10%) (MDP, 2002). Some of this watershed is located in Carroll County. The land use in Carroll County is fairly rural, dominated by agriculture with a small portion forest and some development. Also in the Carroll County area is Taneytown, a municipality designated as a community planning area where some future growth will be focused. For more detailed description on the watershed portion within Carroll County, refer to the section on that County.

Of the Frederick County watersheds, this one has the highest percentage forested land due to the extensive forests along steep areas near the Catoctin Mountain. The eastern part of this watershed is located in the Piedmont Province while the western part is located in the Appalachian Plateau (specifically the Blue Ridge Province). Within the Piedmont region, many of the streams have moderate slopes with rock or bedrock bottoms. The Appalachian Plateau has mainly rocky streams, of which may have steep slopes down mountainsides, or may meander along floodplains. The Monocacy River is the largest waterway, with main tributaries including Tuscarora, Hunting, Owens, and Toms Creeks. The Monocacy River is the largest tributary of the Potomac River (Frederick County, 2000). The Monocacy River has a fairly low stream gradient for being in the Piedmont region. The tributaries to the Monocacy, near the eastern Catoctin Mountains, are relatively healthy trout streams.

The geologic formations called Frederick Limestone and Grove Limestone are present in the southeastern portion of this watershed, around Walkersville and Frederick. This limestone is susceptible to sinkhole formation and groundwater contamination. For this reason, designs for wetland restoration/creation in these areas should take this into account.

The 3452-acre Cunningham Falls State Park Wildland is part of the Maryland Wildland Preservation System. To be in this program, the Maryland General Assembly must designate this area as a Wildland, land that retained its wilderness character, and it must be owned by DNR.

Based on SSURGO soil data, roughly 14% of the watershed is designated as prime farmland, with much of this being in the development areas near Walkersville and the City of Frederick. There is only a small percentage of hydric soils, scattered throughout the watershed, with one concentration being east of Emmitsburg (Shanks, 2005). The 1995 Walkersville Region Plan identifies wet soils mainly along streams and floodplains, but also south of Gravel Hill Road (west of Woodsboro).

The steep forested areas have the best trout waters. Streams with headwaters in Catoctin Mountains support high-quality cold-water fisheries, with many of these having brook or brown trout populations. Since riparian areas in the valleys have less natural vegetation than in the mountain areas, the streams start to warm-up. These warm-water streams support small mouth bass, channel catfish, and red-breasted sunfish. Owens Creek headwaters, Hunting Creek, Fishing Creek, and Little Hunting Creek contain populations of brook and/or brown trout. Little Hunting Creek is considered to be “the best wild fishery in the County.” Of the 424 stream miles, there are 380 miles of tributary streams

flowing into the Monocacy River. Of these, roughly 44% have inadequate vegetated buffers. Some of the stream buffers with inadequate vegetation are in areas of highly erodible soil. There are 58 sensitive tracked plant and animal species within this watershed and 26 ecologically significant areas (Shanks, 2005).

The Monocacy River was designated a State Scenic River in order to restore the water quality. In this watershed, three tributaries to the Monocacy were also listed as candidates for State Scenic Rivers, including: Friends Creek, Owens Creek, and Piney Creek (in Carroll County).

The second largest impoundment (after Lake Linganore in the Lower Monocacy watershed) is Cunningham Falls Lake. This is a 255 million gallon lake used for recreation, with only a small amount being used for the campground water supply.

Some of the more important permitted point source discharges include the Town of Thurmont WWTP, eight smaller WWTPs, and Taneytown WWTP in Carroll County. There is one major point source discharge within the Carroll County portion of this watershed, Taneytown WWTP, discharging into Piney Creek (Shanks, 2005).

Estimates of wetland acreage for the entire Maryland portion of the watershed, based on DNR mapped wetlands, are as follows:

- Palustrine
 - Emergent: 530 acres
 - Scrub shrub: 290 acres
 - Forested: 1,883 acres
 - Unconsolidated bottom: 657 acres
 - Unconsolidated shore: 5 acres
 - Farmed: 224 acres
- Riverine unconsolidated shore: 3 acres
- Total: 3,592 acres

MDE tracks all regulated nontidal wetland activity in Maryland, including regulated wetland impacts and gains. Based on data for the time period of January 1, 1991 through December 31, 2004, for this watershed, there has been a slight loss in wetlands (Walbeck, 2005).

Basin code	Permanent Impacts (acres)	Permittee Mitigation (acres)	Programmatic Gains (acres)	Other Gains (acres)	Net Change (acres)
02140303	-1.70	1.67	0	0	-0.03

Code of Maryland Regulations

All Maryland stream segments are categorized by Sub-Basin and are given a “designated use” in the Code of Maryland Regulations 26.08.02.08. This watershed is designated as follows:

- All of Potomac River and tributaries from Montgomery County line to Shenandoah River, except those stream segments designated below: Use I-P, water contact recreation, protection of aquatic life, and public water supply.
- Tuscarora Creek and all tributaries, Fishing Creek and all tributaries, Hunting Creek and all tributaries, Owens Creek and all tributaries, Friends Creek and all tributaries: Use III-P, natural trout waters and public water supply.
- Monocacy River and tributaries (above Rte. 40) except those listed as Use III-P above: IV-P, recreational trout waters and public water supply.

According to the draft master plan for Catoctin Furnace and the Manor Area of Cunningham Falls State Park, these areas are mainly managed for daily-use recreation. The environment in these recreational areas is suffering from soil compaction and trampling of the herbaceous understory layer by park-users. This park does provide protection to Little Hunting Creek, which is reported to have very good water quality (supporting Brown trout and Brook trout) and the unnamed stream in Manor Area (which stocks Rainbow trout). Flatter places within these recreational areas contain spots of soils with high water tables, springs and seeps. These springs and seeps provide cold water to the streams, allowing species requiring cold temperatures to thrive. Although many of these spring and seep areas are already wetlands and are protected by the park, there may be other springs and seeps in the vicinity that are not currently protected.

The Monocacy River Study and Management Plan

The following information was summarized from *The Monocacy River Study and Management Plan* (1990). Since much of the land adjacent to the Monocacy and its tributaries had fairly low topographic gradients, development and agriculture were possible next to the water. This close proximity increases pollutant entry into the waterways.

There are many springs and seeps, often being wetlands. The majority of these areas produce little water, with the exception of Fountain Rock Spring. Since these springs and seeps may provide important conditions required for certain species (e.g. brook trout and pearl dace), these sites may provide good opportunities for protection. The wetlands located in the mountain region, often getting water from seeps, contain rare plant species.

Trout streams include the following: Furnace Branch, Glade Branch, Bear Branch, Friends, Ballenger, Owens, Hunting Tuscarora, and Fishing Creek. Trout populations are higher in the northern waterways, suggesting that water quality in general is better in the north. Waterfowl densities are highest on the Monocacy near Michael's Dam, through the Monocacy Natural Resource Management Area to the Potomac. There are some wetlands in this area that could be protected to maintain wildlife habitat.

During the period of this 1990 study, the most dominant land use along the river was agriculture and old fields, with some residential development and light industry. The forest buffer width along the Monocacy River was generally poor, with only about half of

the streambanks having adequate buffers (with good buffers being found within park property).

Water Quality

There are two surface water community water supply reservoirs: Emmitsburg Reservoir (Town of Emmitsburg) and Fishing Creek Reservoir (City of Frederick). Major municipal point sources within the Frederick County portion of the watershed include Emmitsburg WWTP discharging into Toms Creek and Thurmont WWTP discharging into Hunting Creek.

There are several State-designated wellhead protection areas in this watershed. The largest two are on Limestone deposits in Walkersville and Thurmont. A third smaller one is in the Town of Emmitsburg. Source Watershed Assessments have been completed for several of these areas. The water system and associated contaminant susceptibilities are as follows:

- *Cloverhill III* (northern edge of Frederick city): nitrate and some microbiological contaminants
- *Cunningham Falls State Park* (Hunting Creek Lake): Giardia, Cryptosporidium, and other pathogens (from wildlife and livestock in the watershed).
- *Emmitsburg*: currently unsusceptible, but protection of watershed is recommended to protect this water supply.
- *Thurmont*: nitrate, radon, VOCs, SOCs, and microbiological contaminants. This water source is located partly in Frederick Limestone.
- *Walkersville*: susceptible to any activity within the watershed, especially inorganic compounds (nitrates), VOCs, SOCs, and microbiological contaminants. This water source is in Grove Limestone.
- *White Rock* (slightly northwest of Frederick City): radon.

The 1998 Clean Water Action Plan classified the watershed as “Priority” Category 1, a watershed not meeting clean water and other natural resource goals and therefore needing restoration. Since it is a “Priority” watershed, this watershed was selected as being one of the most in need of restoration within the next two years since it failed to meet at least half of the goals. It was also classified as “Selected” Category 3, a pristine or sensitive watershed most in need of protection. Failed indicators included high nutrient concentrations (especially phosphorus), poor benthic index of biotic integrity (BIBI), high percent unforested stream buffer (61%), and high soil erodibility (0.28). Indicators suggesting need for preservation included a high in-stream habitat index, a high fish index of biotic integrity (FIBI), a high imperiled aquatic species indicator, presence of trout spawning area, and providing fish hatchery water supply. It also had 3,489 acres of Wildland and 4 drinking water intakes.

According to the *2002 Maryland Section 305(b) Water Quality Report*, the upper Monocacy River and large tributaries fail to support all designated uses. The sections of the Monocacy River above Frederick City and near Pennsylvania have high levels of bacteria and the Monocacy River near Pennsylvania has high water temperatures (DNR,

2000b). Sources of elevated bacteria are likely due to agriculture and natural sources while the elevated temperatures are due to lack of stream riparian cover. Wadeable streams (stream order ≤ 4) in all subwatersheds do not support all designated uses due to low fish or benthic index of biotic integrity, low pH, and siltation (DNR, 2002). These poor communities may be the result of agricultural runoff, stream channelization, and poor bank stabilization. Hunting Creek Lake, a 46-acre lake within Cunningham Falls State Park, is also within this watershed and has seasonally low oxygen levels due to elevated nutrients from nonpoint source runoff. High fecal coliform bacteria was reported in this lake in 1996, resulting in a temporary restriction on swimming. This lake is not on the 303(d) List for impaired waters.

The 2004 303(d) List contains basins and subbasins that have measured water quality impairment and may require a TMDL. The basin/subbasin name, subbasin number (if applicable), and type of impairments are as follows:

- *Monocacy River*; fecal coliform, suspended sediments, and nutrients.
- *Tuscarora Creek* (021403030240 in Frederick County); poor biological community.
- *Glade Creek* (021403030242 in Frederick County); poor biological community.
- *Fishing Creek* (021403030243 in Frederick County); poor biological community.
- *Steep Creek Unnamed Tributary* (021403030243 in Frederick County); poor biological community.
- *Buzzard Branch* (021403030244 in Frederick County); poor biological community.
- *Little Hunting Creek* (021403030244 in Frederick County); poor biological community.
- *Little Hunting Creek Unnamed Tributary* (021403030244 in Frederick County); poor biological community.
- *Creagers Branch* (021403030245 in Frederick County); poor biological community.
- *Graceham Run* (021403030251 in Frederick County); poor biological community.
- *Muddy Run* (021403030251 in Frederick County); poor biological community.
- *Sandy Run* (021403030244 in Frederick County); poor biological community.
- *Unnamed tributary to Monocacy River* (021403030245 in Frederick County); poor biological community.
- *Motter's Run* (021403030249 in Frederick County); poor biological community.
- *Owens Creek* (021403030250 in Frederick County); poor biological community.
- *Owens Creek* (021403030253 in Frederick County); poor biological community.
- *Hunting Creek* (021403030251 in Frederick County); poor biological community.
- *Hunting Creek* (021403030252 in Frederick County); poor biological community.
- *Unnamed tributary to Hunting Creek* (021403030251 in Frederick County); poor biological community.
- *High Run* (021403030251 in Frederick County); poor biological community.
- *Piney Creek* (021403030254 in Carroll County); poor biological community.
- *Piney Creek* (021403030257 in Carroll County); poor biological community.

- *Unnamed tributary to Piney Creek* (021403030255 in Carroll County); poor biological community.
- *Unnamed tributary to Piney Creek* (021403030256 in Carroll County); sedimentation.
- *Turkey Creek* (021403030259 in Frederick County); poor biological community.
- *Toms Creek* (021403030259 in Frederick County); poor biological community.
- *Flat Run* (021403030260 in Frederick County); poor biological community.
- *Middle Creek* (021403030260 in Frederick County); poor biological community.

Long term water quality sampling for a station near Bridgeport rated the stream as fair to good Water quality sampling in 2002, while insufficient to make many conclusions, does show that WWTPs are contributing to higher nutrient concentrations in the tributaries. Additionally, the high TSS in Saint Mary's Run suggests an issue of soil erosion at this site. Based on a water resources pilot study conducted for the Monocacy River watershed, it was reported that based on development predictions for 2030, water withdraw from the streams and River will not be sufficient to provide water to develop while still maintaining adequate base flow. MBSS samples of BIBI found a fairly even distribution of sites ranging from good to very poor. FIBI samples were slightly better, but there were still many sites ranked very poor (Boward, 1995-1997, 2000-2001). MBSS sites rated as good were often associated with undisturbed forested areas of the western portion while sites rated as poor or very poor were often found in areas draining agriculture or developed land. However, there were some exceptions (Shanks, 2005).

Water impacts include: three major developed areas withdrawing water from the Monocacy River (Frederick, Westminster, and Gettysburg), sewage disposal, and agricultural and residential land use. An important issue in this waterway is suspended sediment, which inhibits aquatic species. This watershed discharges over two times the amount of sediment per acre than any other Potomac River watershed upstream of Point of Rocks. Other concerns in the Monocacy River are nutrients, pathogens (The Monocacy Scenic River Local Advisory Board, 1990), and inadequate riparian buffers (Shanks, 2005). Conversion of the natural buffers and creation of structures within the floodplain increases pollution entering the waterways and increases flash flooding (The Monocacy Scenic River Local Advisory Board, 1990). A Statewide fish advisory based on methylmercury was posted for large mouth bass, small mouth bass, and bluegill taken from impoundments (Shanks, 2005).

An assessment of Piney and Alloway Creeks was conducted in 1990-1991 by DNR and MDE. This watershed is completely located in Carroll County and Pennsylvania. Although it is not in Frederick County, it is in the Upper Monocacy Watershed and drains into the Monocacy River, so is important in restoring Frederick County waterways. The study found that these waterways had relatively good water in dry months but water high in phosphorus and sediment in wet months. Nonpoint sources were found to be the main contributors of nutrients. There have been dense mats of algae in Alloway stream in the spring. Benthic and fish analysis show a degraded stream system. Piney Creek had poorer streamside habitat than Alloway Creek, including inadequate riparian buffers and livestock access to streams.

A 2004 Upper Monocacy River nutrient synoptic survey sampled 104 subwatersheds. Of these, nitrate/nitrite concentrations were found to be excessive in eleven subwatersheds and high in seven others. Most of the elevated concentrations were associated with animal and row crop agriculture in Glade Creek, Tuscarora Creek, Hunting Creek, and Owens Creek subwatersheds. Most of these streams have poor riparian buffers and many have livestock access to the stream. It is likely that the sewer system serving Fort Detrick and the City of Frederick is also contributing some nutrients. Orthophosphate concentrations were excessive in twenty-one subwatersheds and high in thirteen others. Elevated levels were mostly in the Monocacy floodplain and are associated with suspended phosphorus-rich sediments in the water column. These subwatersheds tend to have more construction activity, degraded stream channels, and agriculture that may be contributing sediment.

Restoration/Preservation

A stream corridor assessment was completed for specific stream reaches within the Upper Monocacy watershed: Fishing Creek, Glade Creek, Hunting Creek, Owens Creek, Toms Creek, and Tuscarora Creek. Of the 130 stream miles surveyed, they identified 251 potential problems. With the most common problem being inadequate forested stream buffer (102 sites). The highest percentage inadequately buffered stream miles was in Glade Creek subwatershed. 28 of the 102 inadequate buffer sites were estimated to have decent wetland restoration potential, based on slope, bank height, and current conditions. There were 15 sites noted as having livestock access to the stream. Areas that should be highest priority for riparian buffer restoration should be headwater streams, streams leading directly to the Monocacy River, and sites that form gaps in existing forest buffer. The next most frequently identified problem was erosion (49 sites). Tuscarora Creek had the highest percentage eroding stream banks (38%). One site, located in Glade Creek, had very severe erosion. Some of the other identified potential problems were fish barriers (33 sites), pipe outfalls (24 sites), trash dumping (17 sites), and channel alterations (11 sites).

The Upper Monocacy WRAS had several goals, with those most relevant to this current project including:

- Restore riparian corridors
 - Planting vegetated buffers
 - Restoring wetlands, especially downstream of agriculture and development
- Identify and preserve pristine areas
- Protect and enlarge green infrastructure, large forest areas, and connectivity through riparian corridors

Specific subwatershed strategies, as discussed in the Upper Monocacy River WRAS, are as follows:

- Glade Creek - This subwatershed has a large proportion of prime farmland and Karst geology. It has a high amount of development pressure, excessive nitrogen

and phosphorus concentrations, and the lowest proportion of forested buffers in this watershed.

- Vegetated riparian buffers should be increased.
 - Wetland protection and restoration may be possible upstream of Legore Bridge near a State-designated Ecologically Sensitive Area.
 - Stream restoration in the headwaters of New Midway community.
 - Restoration at Glade Valley Golf Course to reduce impacts.
 - A possible wetland restoration was identified to protect a spring used for drinking water (site GC18).
- Tuscarora Creek – Much of this subwatershed is in the priority funding area. This area still has high ecological value, including a Brook trout fishery being present in the Clifford Branch, being a supplemental water supply for Frederick City, and having a high concentration of springs and wetlands. Phosphorus concentrations are high and excessive in Whiterock Run and Fox Road areas. The Whiterock package treatment plant and the high impervious surface along the downstream portion contribute to water quality issues.
 - Protect and manage remaining forested headwaters, springs, and wetlands.
 - Restore degraded resources.
 - Community outreach to encourage stream buffers, reduce fertilizer use, and increase on-site stormwater management.
 - Possible wetland restoration at identified sites: TC2, TC5, TC7 (Yellow Springs Elementary School), TC9 (Monocacy Middle and Elementary Schools).
- Fishing Creek – The western portion is protected as a water supply for Frederick City. Trout are present in the mainstem and tributaries. There are significant wetlands present.
 - Forest management.
 - Trail maintenance.
 - Increase connectivity using forest riparian buffers, including some buffer gaps west of Rte. 15.
 - Improve habitat for cold and warm water fisheries.
 - Restore and protect wetlands, including in Utica Park.
 - Possible wetland restoration at identified sites: FC1 (three dried ponds), FC4 (with Park and Rec.), FC8.
- Hunting Creek – Most of the headwaters are protected by Catoctin Mountain Park, Cunningham Falls State Park, and the Thurmont Watershed area. Development is taking place in the forested headwater areas upstream of these parks. Native brook trout are present above Hunting Creek Lake and brown trout are present below the lake. The Town of Thurmont impacts the Creek through stormwater impacts and the sewage treatment plant. Other impacts occur from Maple Run Golf Course.
 - Address the Thurmont sewage treatment plant issue.
 - Protect forested headwaters.
 - Restore degraded streams.

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- Possible wetland restoration projects were identified: HC1 (Thorpewood wetland restoration); HC14 (near intersection of Stottlemeyer Road and Rte. 77). This second site may include threatened vegetation.
- Owens Creek – Largely forested mountainous headwaters, with some protected by Catoctin Mountain State Park. A naturally reproducing trout stream is present in one of the headwater tributaries. Stocked trout fisheries are present for most of the tributaries upstream of Rte. 15. Excessive phosphorous concentrations are present in some of the downstream portion.
 - Establish riparian stream corridors, including in the area of Manahan, Foxville, and Deerfield Roads.
 - Education, including about opportunities for wetland restoration.
 - Encourage on-site stormwater treatment.
 - Possible wetland enhancement at identified site: OC40 – large wetland invaded by mile-a-minute weed.
- Toms Creek – Emmitsburg sewage treatment plant impacts the waters through sewage overflow into Flat Run. There are plans to upgrade this system. .St. Mary’s Run is also impacted by sewage. Cattail Branch has high and excessive nutrient concentrations.
 - Education, including about on-site stormwater management.
 - Plant riparian buffers along agricultural land.

There is a large Green Infrastructure hub in the western portion of the watershed that includes the protected areas of Cunningham Falls State Park, Catoctin Mountain National Park, the City of Frederick Municipal Forest, and Gambrill State Park. Potential Green Infrastructure corridors, mostly in agriculture, follow the Monocacy River and several smaller streams (DNR, 2000-2003). Restoration of these corridors to natural vegetation is desirable. According to the Maryland Greenways Commission, an existing greenways is the Catoctin Mountain Greenway and Catoctin Trail and proposed greenways are the Emmitsburg Greenway and Trail, Emmitsburg Rail Trail, H&F Trolley Trail, Monocacy River Water Trail, Monocacy Scenic River Greenway, and Catoctin Creek Trail.

Streams that should be developed into stream valley parks include: Glade Creek, Ballenger Creek, Linganore Creek, and Tuscarora Creek. The City of Frederick has already established parts of Carroll Creek as a stream valley park and intends to develop a Monocacy River linear park (The Monocacy Scenic River Local Advisory Board, 1990).

Glade and Tuscarora Creeks were specifically targeted for park development in the Frederick County Comprehensive Plan. Portions of these creeks near proposed development will be evaluated for open space and linear park options. Additionally, the Walkersville Region Plan (1995) proposed including open space areas in Walkersville, Woodsboro, and Libertytown in this greenway network.

The main protected areas in this watershed are along the Catoctin Mountain to the west, including Catoctin Mountain National Park, Cunningham Falls State Park, Gambrill State Forest, and the County-owned Thurmont Watershed, City of Frederick Municipal Forest.

There is also the County-owned Emmitsburg Watershed to the north. There are smaller County parks, several agricultural easements (especially in the east), and METs.

There are several Nontidal Wetlands of Special State Concern in this watershed. The following information was summarized from the 2003 document entitled *Nontidal Wetlands of Special State Concern of Five Central Maryland Counties and Coastal Bay Area of Worcester County, Maryland*. General management recommendations include limiting hydrological changes, including draining/filling/excavating, increased impervious surface, and groundwater drawdown by surrounding wells. Sediment and other pollutants from agriculture and development should be controlled. Best Management Practices should be established for any new development. Spraying of pesticides should be avoided within the wetland. Avoid livestock grazing within the site. Road maintenance should be performed with caution. Heavy recreation should be directed away from the sensitive species. Non-native species invasion is a problem and should be controlled. An excessive deer population is causing impact through deer browsing on sensitive species and trampling on vegetation (allowing a gap for non-native species invasion). A forested buffer should be maintained and logging should be prohibited in the buffer area and within the site itself. Any site recreational use should be directed away from the sensitive species. Restricting use by all-terrain vehicles (ATVs) should be strictly enforced. Additional site-specific recommendations are listed below.

- *Buzzard Branch*. The four Buzzard Branch sites are connected through hydrology and forest. They are part of a fairly large and healthy circumneutral seepage wetland habitat. This overall complex is unprotected. There is some light development around the site, a nearby road, and some camping in the area. Large forested parcels surround much of the site. It is recommended that the surrounding parcels be protected to maintain a sufficient buffer. Main threats include non-native plant species, excessive deer population, and altered hydrology.
 - *Buzzard Branch Site* This site is on the slopes above Buzzard Branch and is west of the Quaker camp. It contains two State rare threatened or endangered species, two uncommon species, and four plant species of local significance. There is an additional endangered animal that may use this wetland as foraging habitat. Recreational use is minimal.
 - *Buzzard Branch Bog*. This site is south of the Quaker camp, along the Buzzard Branch. There are three State rare threatened or endangered species, two uncommon species, and six plant species of local importance. There is an additional endangered animal that may use this wetland as foraging habitat. Recreational use is minimal.
 - *Buzzard Branch Bottom*. This site is along Buzzard Branch. There is one State threatened species, two uncommon species, and five plant species of local significance. The State threatened species was quite common in this system prior to timber harvesting. There is an additional endangered animal that may use this wetland as foraging habitat.
 - *East Buzzard Branch*. This site is located along Buzzard Branch, between the Mink Farm campground and the Quaker camp. It contains six State rare threatened or endangered species, three uncommon species, and six

species of local significance. There is an additional endangered animal that may use this wetland as foraging habitat. There is a moderate amount of recreational camping in the area.

- *Cunningham Falls Hollow*. The Foxville Swamp, Upper Hunting Creek Swamp, and Hunting Creek Hollow sites are part of a large circumneutral seepage wetland connected through a wetland/stream system.
 - *Foxville Swamp*. This site is located near Foxville on a tributary to Hunting Creek Lake. It contains two State rare threatened or endangered plant species, one of which has the only Maryland occurrence being at this site. It also contains an additional uncommon plant species. The site is surrounded by agriculture and roads. There are currently few invasive non-native weeds in the wetland, but the surrounding area are dominated by them. An excessive deer population is present at the site. The wetland is currently unprotected. Recommendations suggest purchasing the land or easements on adjacent property to protect the sensitive species and habitat within the wetland.
 - *Hunting Creek Hollow*. This wetland contains good diversity including two rare threatened or endangered species, two uncommon species, and seven locally important plant species. Route 77 and a parking lot are immediately north. Since this wetland is near a trail connecting Hunting Creek Lake and Cunningham Falls, many visitors pass through the vicinity. Recreational impact on this area should be limited. This site is protected by Cunningham Falls State Park.
 - *Upper Hunting Creek Swamp*. This site contains three State rare threatened or endangered plant species and additional uncommon or locally important plant species. The site is surrounding by roads on three sides and an old farm to the east. It is recommended that a conservation group purchase a conservation easement for the headwaters on the south and west sides, to maintain hydrology of the site. Acquisition is not recommended. The wetland is protected by Cunningham Falls State Park.
- *Eylers Valley*. This site is along the Little Owens Creek. This site contains a State-threatened species. Another State threatened species is located just south of the site. Surrounding the site are a church, houses, roads, and farm. A utility line bisects the wetland and is providing the open canopy necessary for the sensitive species. Mowing of this utility line (during late winter) should continue in order to limit woody succession. Woody succession should also be limited in other portions of the wetland and light grazing should be allowed to reduce vegetative competition. The site is currently unprotected.
- *Fishing Creek* Fishing Creek WSSC and Steep Creek Swamp WSSC form a circumneutral seepage wetland complex draining into Fishing Creek Reservoir. Primary threats include non-native plant species, excessive deer, and changes in hydrology.
 - *Fishing Creek*. This wetland follows a portion of Fishing Creek and incorporates two man-made ponds. It contains four State-threatened and endangered species, including one plant species with this being the only documented occurrence in the State. There is an additional plant species of

interest that occurs with the ponds and other State rare or uncommon species occur just outside of the site boundaries. An additional State endangered mammal may forage in the wetland. Recreation in this area includes hiking, mountain biking, and fishing. There are trails and fire roads within this system. The portion of the site along Fishing Creek is bordered by roads. This site is owned by the City of Frederick Municipal Forest.

- *Steep Creek Swamp*. This site is located at the confluence of Steep and Fishing Creeks. This site contains a State-threatened species and another locally uncommon species. Other State rare threatened or endangered species and locally uncommon species occur just outside of the site boundaries. An additional State endangered mammal may forage in the wetland. The site is abutted by roads on two sides. This site is protected by City of Frederick Municipal Forest.
- *Legore Bridge*. This site is located at the confluence of the Monocacy River and a tributary upstream of Le Gore Bridge. This wetland intersects two geologic formations with very different soil pH values, creating two distinct plant communities. This wetland contains three State rare or endangered plant species, three uncommon plant species, and two locally important species. The site is intersected by a dirt road with some invasive plant species present. All terrain vehicles have caused erosion on the stream and adjacent slopes. This site is currently unprotected.
- *Little Fishing Creek Pond*. This circumneutral seepage wetland is located adjacent to a man-made pond. The wetland contains a State threatened species and the surrounding mesic shore contains two additional State endangered species. The pond has a variety of aquatic plant species that are locally rare. This site is surrounded by the forested Catoctin Mountains. There is a moderate amount of recreational use including fishing, hiking, biking, and illegal ATV use. This site is protected by City of Frederick Municipal Forest. Main threats include non-native plant species, overabundant deer population, and human disturbance.
- *Owens Creek Swamp*. This site is a large healthy circumneutral seepage wetland containing five State threatened or endangered species and an uncommon species. The maturing forest canopy provides gaps that are critical to the survival of the sensitive species. The site is surrounded by mostly young forest with some recreational facilities including a historic sawmill, picnic area, camping, hiking and horseback riding trails, and roads. This site is protected by Catoctin Mountain National Park.
- *South Salamander Rock Fire Ponds*. This is a circumneutral seepage wetland near three man-made ponds. This site contains five State rare, threatened, or endangered species and other plant species of local importance. The site is located along a tributary to Steep Creek and is surrounded by the City of Frederick Municipal Forest and reservoir watershed and a road. The site is owned by the City of Frederick but is managed by DNR. To maintain the open habitat, the berms should be mowed every 3-5 years during the dormant season.
- *Turkey Creek*. This site contains Rainbow Lake, a man-made reservoir, which receives water from Turkey Creek. Lake mesic shoreline habitat of the State

threatened species is severely degraded from invasive weeds and shrubs. The site is surrounded by immature forest and has a berm on the eastern side. A road and parking lot are outside of the boundary. Recreational use includes a trail around the lake for fishing access. This site is part of the Emmitsburg Reservoir and is protected by Emmitsburg watershed.

- *Wigville Swamp*. This is a healthy circumneutral seepage wetland within a forest. This site contains two State rare threatened or endangered species and other uncommon or locally important species. The wetland is surrounded by forest, a road, and a few houses. It is located along Tower Road and is currently unprotected. It is recommended that a conservation group acquire or purchase easements on the surrounding properties. Main threats include non-native plant species, excessive deer population, and changes in hydrology.
- *Potential WSSC*. There are three potential WSSC, located along Steep Creek (south of South Salamander Rock Fire Ponds), parallel to Rocky Ridge Road (adjacent to Foxville Swamp – it is unprotected), and along Central Road.

The Monocacy River Study and Management Plan (1990) proposed developing a Monocacy River overlay extending at least 500 feet on both sides of the River, with wider buffers where the existing conservation boundary is wider or in areas where there are sensitive resources outside the existing conservation buffer.

Specific recommendations for restoration:

- Restore the Scenic Monocacy River and buffers.
- Restore wetlands and streams within the headwaters.
- Restore “gaps” within the Green Infrastructure to natural vegetation, especially along the Potomac River and tributaries.
- Wetland restoration design should consider effects of possible underlying limestone.
- Monocacy River extended buffer (The Monocacy Scenic River Local Advisory Board, 1990).
- Stream buffers should be a high priority along the Monocacy River, Glade Creek, and Beaver Dam Creek (Frederick County DPZ, 1995b).
- Stream restoration at sites identified within Stream Corridor Assessments, including:
 - Restore forest buffer (with some being wetland restoration potential) at headwater streams, streams leading directly to the Monocacy River, and sites that form gaps in existing forest buffer.
 - Remove livestock from stream .
 - Restore areas with stream erosion.
 - Remove fish blockages.
- Additional WRAS goals:
 - Restore vegetated riparian corridors.
 - Restore wetlands, especially downstream of agriculture and development.
 - Enlarge green infrastructure, large forest areas, and connectivity through riparian corridors.
 - Glade Creek watershed

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- Restore vegetated riparian buffers.
- Possible wetland restoration
 - upstream of Legore Bridge near a State-designated Ecologically Sensitive Area.
 - to protect a spring used for drinking water (site GC18).
- Stream restoration in the headwaters of New Midway community.
- Restoration at Glade Valley Golf Course to reduce impacts.
- Tuscarora Creek watershed
 - Restore degraded resources.
 - Restore stream buffers.
 - Possible wetland restoration at identified sites: TC2, TC5, TC7 (Yellow Springs Elementary School), TC9 (Monocacy Middle and Elementary Schools).
- Fishing Creek watershed
 - Increase connectivity using forest riparian buffers, including some buffer gaps west of Rte. 15.
 - Improve habitat for cold and warm water fisheries.
 - Restore wetlands
 - including in Utica Park.
 - at identified sites: FC1 (three dried ponds), FC4 (with Park and Rec.), FC8.
- Hunting Creek watershed
 - Protect forested headwaters.
 - Restore degraded streams.
 - Possible wetland restoration projects were identified: HC1 (Thorpewood wetland restoration); HC14 (near intersection of Stottlemeyer Road and Rte. 77). This second site may include threatened vegetation.
- Owens Creek watershed
 - Establish riparian stream corridors, including in the area of Manahan, Foxville, and Deerfield Roads.
 - Wetland restoration.
 - Possible wetland enhancement at identified site: OC40 – large wetland invaded by mile-a-minute weed.
- Toms Creek watershed.
 - Restore riparian buffers along agricultural land.

Specific recommendations for protection:

- Protect portions of Green Infrastructure that are not currently protected, especially along waterways.
- Protect wetlands and streams within the headwaters.
- Protect additional wetlands within the DNR-designated Ecologically Significant Areas.
- Protect springs and seep wetlands (The Monocacy Scenic River Local Advisory Board, 1990):
 - along the Monocacy River.

- around Catoctin Furnace and the Manor Area.
- Protect wetlands along the Monocacy near Michael's Dam, through the Monocacy Natural Resource Management Area to the Potomac, to maintain wildlife habitat (The Monocacy Scenic River Local Advisory Board, 1990).
- Protect the Scenic Monocacy River and extended buffer (The Monocacy Scenic River Local Advisory Board, 1990).
- Stream buffers should be a high priority along the Monocacy River, Glade Creek, and Beaver Dam Creek (Frederick County DPZ, 1995b).
- The following streams should be protected: Furnace Branch, Rocky Fountain Run, Tuscarora Creek, Ballenger Creek, Bennett Creek, Glade Creek, Bush Creek, Toms Creek, Carroll Creek, Owens Creek, Fishing Creek, Friends Creek, and Hunting Creek (The Monocacy Scenic River Local Advisory Board, 1990).
- Hunting, Owens, and Toms Creeks should be given special protection (Frederick DPZ, 1995a).
- Protect WSSC and buffers, for example:
 - Purchase the land or easements on properties adjacent to Foxville Swamp WSSC to protect the sensitive species and habitat within the wetland (DNR, 2003a).
 - Purchase a conservation easement for the headwaters on the south and west sides of the WSSC Upper Hunting Creek Swamp to maintain hydrology of the site (DNR, 2003a).
 - Acquire or purchase easements on the properties surrounding Wigville Swamp WSSC (DNR, 2003a).
- Additional WRAS strategies:
 - Identify and preserve pristine areas
 - Protect green infrastructure, large forest areas, and connectivity through riparian corridors
 - Glade Creek watershed: wetland protection upstream of Legore Bridge near a State-designated Ecologically Sensitive Area.
 - Tuscarora Creek watershed: protect and manage remaining forested headwaters, springs, and wetlands.
 - Fishing Creek watershed:
 - Forest management.
 - Protect wetlands, including in Utica Park.
 - Hunting Creek watershed: protect forested headwaters.

Double Pipe Creek (02140304)

Background

Most of this watershed is located in Carroll County. Of the 17,720 land acres in the Frederick County portion of this watershed, most is agriculture (82%), with the remaining in forest (13%) and developed (5%) (MDP, 2002). The Frederick County portion of this watershed has the lowest percentage developed land and the highest percentage agriculture of all the Frederick watersheds, partly because there are no large towns in the Frederick County portion of this watershed. The Carroll County portion is also mainly

agriculture. There are a few municipalities in Carroll County portion of this watershed, also being areas where future growth will be focused including: Union Bridge, New Windsor, and portions of Westminster and Manchester. For more detailed descriptions of the watershed portions within this County, please refer to the section for the individual County.

This watershed is located completely within the Piedmont Province. Within the Piedmont region, many of the streams have moderate slopes with rock or bedrock bottoms. The main waterway is Double Pipe Creek, which flows into the Monocacy River. The Monocacy River is the largest tributary of the Potomac River (Frederick County, 2000). The Monocacy River has a fairly low stream gradient for being in the Piedmont region . 56% of the Monocacy River watershed is located in Frederick County (Frederick County, 2000).

The Monocacy River was designated a State Scenic River partially to aid in restoration of water quality. Little Pipe Creek was also listed as a candidate for a State Scenic Rivers.

Estimates of wetland acreage for the entire watershed, based on DNR mapped wetlands, are as follows:

- Palustrine
 - Emergent: 1,119 acres
 - Scrub shrub: 327 acres
 - Forested: 1,240 acres
 - Unconsolidated bottom: 310 acres
 - Unconsolidated shore: <1 acres
 - Farmed: 171 acres
- Total: 3,167 acres

MDE tracks all regulated nontidal wetland activity in Maryland, including regulated wetland impacts and gains. Based on data for the time period of January 1, 1991 through December 31, 2004, for this watershed, there has been a gain in wetlands (Walbeck, 2005).

Basin code	Permanent Impacts (acres)	Permittee Mitigation (acres)	Programmatic Gains (acres)	Other Gains (acres)	Net Change (acres)
02140304	-2.89	3.47	19.33	0	19.92

Code of Maryland Regulations

All Maryland stream segments are categorized by Sub-Basin and are given a “designated use” in the Code of Maryland Regulations 26.08.02.08. This watershed is designated as follows:

- All of Potomac River and tributaries from Montgomery County line to Shenandoah River, except those stream segments designated below: Use I-P, water contact recreation, protection of aquatic life, and public water supply.
- Bear Branch and all tributaries (from confluence with Bennett Creek): Use III-P, natural trout waters and public water supply.

- Monocacy River and tributaries (above Rte. 40) except those listed as Use III-P above: IV-P, recreational trout waters and public water supply.

Water Quality

There are no major point sources within the Frederick County portion of this watershed. There is one major point source in the Carroll County portion of this watershed, Westminster WWTP, discharging into Little Pipe Creek.

There are currently no State-designated wellhead protection areas in the Frederick portion of this watershed.

The 1998 Clean Water Action Plan classified the watershed as Category 1, a watershed not meeting clean water and other natural resource goals and therefore needing restoration. It was also classified as Category 3, a pristine or sensitive watershed that needs protection. Failed indicators included high nutrient concentrations (especially phosphorus), poor benthic index of biotic integrity (BIBI), and a high percent unforested stream buffer (75%). Indicators suggesting need for preservation included a high imperiled species indicator and a high amount of wetland-dependent species.

According to the 2002 *Maryland Section 305(b) Water Quality Report*, portions of the Double Pipe Creek mainstem fail to support all designated uses due to bacteria from natural and unknown sources. Wadeable tributaries (stream order ≤ 4) to this creek fail to support all designated uses due to poor benthic community from siltation of agricultural runoff, habitat alteration, and changes in hydrology.

The 2004 303(d) List contains basins and subbasins that have measured water quality impairment and may require a TMDL. The basin/subbasin name, subbasin number (if applicable), and type of impairment are as follows:

- *Double Pipe Creek*; fecal coliform, nutrients, sedimentation.
- *Sam's Creek* (021403040269); poor biological community.
- *Sam's Creek Unnamed Tributary* (021403040248); poor biological community.
- *Sam's Creek Unnamed Tributary* (021403040268); sedimentation.
- *Haines Branch* (021403040269 in Frederick County); poor biological community.
- *Clemson Branch* (021403040269 in Frederick County); poor biological community.
- *Beaver Dam Creek* (021403040270 in Frederick County); poor biological community.
- *Beaver Dam Branch* (021403040270 in Frederick County); poor biological community.
- *Roop Branch* (021403040272 in Carroll County); poor biological community.
- *Priestland Branch* (021403040273 in Carroll County?); poor biological community.
- *Little Pipe Creek* (021403040276 in Carroll County); sedimentation.
- *Little Pipe Creek* (021403040274); poor biological community.
- *Copps Branch* (021403040276 in Carroll County); poor biological community.

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- *Meadow Branch* (021403040277 in Carroll County); poor biological community.
- *Meadow Branch* (021403040278 in Carroll County); sedimentation.
- *Meadow Branch Unnamed Tributary* (021403040277 in Carroll County); poor biological community.
- *Bear Branch* (021403040281 in Carroll County); poor biological community.
- *Bear Branch* (021403040282 in Carroll County); poor biological community.
- *Bear Branch Unnamed Tributary* (021403040281 in Carroll County); poor biological community.
- *Big Pipe Creek* (021403040284 in Carroll County); poor biological community.
- *Big Pipe Creek* (021403040286 in Carroll County); poor biological community.
- *Big Pipe Creek* (021403040280 in Carroll County); poor biological community.
- *Big Pipe Creek* (021403040283 in Carroll County); poor biological community.
- *Big Pipe Creek Unnamed Tributary* (021403040280 in Carroll County); poor biological community.
- *Big Pipe Creek Unnamed Tributary* (021403040283 in Carroll County); poor biological community.
- *Big Pipe Creek Unnamed Tributary* (021403040279 in Carroll County); poor biological community.
- *Big Pipe Creek Unnamed Tributary* (021403040287 in Carroll County); poor biological community.
- *Big Pipe Creek Unnamed Tributary* (021403040278 in Carroll County); poor biological community.
- *Big Silver Run* (021403040285 in Carroll County); poor biological community.
- *Big Silver Run Unnamed Tributary* (021403040285 in Carroll County); poor biological community.

Some water quality concerns for this river include inadequate riparian buffer in many sections, sediment, nutrients, and pathogens.

MBSS sites found BIBI and FIBI of mostly poor to very poor (Boward, 1995-1997, 2000-2001).

Restoration/Preservation

There is no State-designated Green Infrastructure within the Frederick County portion of this watershed.

There are numerous agricultural easements and two METs. There is no government-owned land.

There are no Nontidal Wetlands of Special State Concern within the Frederick County portion of this watershed.

Specific recommendations for restoration:

- Restore the Scenic Monocacy River.

- Restore wetlands and streams within the headwaters.
- Stream buffers should be a high priority along the Monocacy River and Pipe Creek (Frederick County DPZ, 1995b).
- Pipe Creek is a State priority watershed due to the high amount of land in agriculture and the highly erodible soils (Frederick County DPZ, 1995b).

Specific recommendations for protection:

- Protect the Scenic Monocacy River.
- Protect wetlands and streams within the headwaters.
- Stream buffers should be a high priority along the Monocacy River and Pipe Creek (Frederick County DPZ, 1995b).
- Pipe Creek is a State priority watershed due to the high amount of land in agriculture and the highly erodible soils (Frederick County DPZ, 1995b).

Catoctin Creek (02140305)

Background

Of the 76,930 land acres, over half is agriculture (53%), a third is forest (34%), and a smaller amount is developed (13%) (MDP, 2002). This watershed is completely within the Blue Ridge Province, a part of the Appalachian Plateau. The Appalachian Plateau has mainly rocky streams, of which may have steep slopes down mountainsides or may meander along floodplains. The main waterway is Catoctin Creek, leading directly to the Potomac River. This Creek has steeper topography than the Monocacy River, and therefore has a gradient five times greater than the Monocacy River (Frederick County DPZ, 1997).

Catoctin Creek and its tributaries provide water for two municipalities and receive effluent from four sewage treatment plants, with the main water source being Fishing Creek Reservoir.

Estimates of wetland acreage for the entire watershed, based on DNR mapped wetlands, are as follows:

- Palustrine
 - Emergent: 263 acres
 - Scrub shrub: 105 acres
 - Forested: 429 acres
 - Unconsolidated bottom: 167 acres
 - Farmed: 54 acres
- Riverine unconsolidated shore: 2 acres
- Total: 1,020 acres

MDE tracks all regulated nontidal wetland activity in Maryland, including regulated wetland impacts and gains. Based on data for the time period of January 1, 1991 through December 31, 2004, for this watershed, there has been a slight loss in wetlands (Walbeck, 2005).

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Basin code	Permanent Impacts (acres)	Permittee Mitigation (acres)	Programmatic Gains (acres)	Other Gains (acres)	Net Change (acres)
02140305	-0.96	0	0	0.17	-0.80

Code of Maryland Regulations

All Maryland stream segments are categorized by Sub-Basin and are given a “designated use” in the Code of Maryland Regulations 26.08.02.08. This watershed is designated as follows:

- All of Potomac River and tributaries from Montgomery County line to Shenandoah River, except those stream segments designated below: Use I-P, water contact recreation, protection of aquatic life, and public water supply.
- Catoctin Creek and all tributaries (above alternate U.S. Rte. 40): Use III-P, natural trout waters and public water supply.
- Catoctin Creek mainstem (below Alternate U.S. Rte. 40): Use IV-P, recreational trout waters and public water supply.

Water Quality

There are no major point sources within this watershed. There is one surface water community water supply withdrawing from Little Catoctin Creek for the Town of Myersville.

There are several State-designated wellhead protection areas in this watershed, with the largest being around Middletown. Source Watershed Assessments were completed for several of these. The water system name and associated contaminant susceptibility are as follows:

- *Cambridge Farms* (east of Jefferson): nitrate and microbiological contaminants
- *Copperfield* (west of Jefferson): some microbiological contaminants.
- *Fountaindales* (near Middletown): microbiological contaminants and VOCs.
- *Myersville*: springs are susceptible to pathogens (including fecal coliform); ground water is susceptible to inorganic compounds, SOCs, and VOCs; Little Catoctin Creek is susceptible to agricultural chemicals, pathogens, and turbidity.

The 1998 Clean Water Action Plan classified this watershed as Category 1, a watershed not meeting clean water and other natural resource goals and therefore needing restoration. Since it is a “Priority” Category 1 watershed, this watershed was selected as being one of the most in need of restoration within the next two years since it failed to meet at least half of the goals. It was also classified as Category 3, a pristine or sensitive watershed that needs protection. Failed indicators included high nutrients (especially phosphorus), a high percent unforested stream buffer (64%), and high soil erodibility (0.30). Indicators suggesting need for preservation included a high amount of wetland dependent species, trout spawning area, and one drinking water intake.

According to the *2002 Maryland Section 305(b) Water Quality Report*, the Catoctin Creek mainstem between the Potomac River and I-70 does not support all designated

uses due to elevated levels of bacteria from unknown sources. However, the *2000 Maryland Section 305(b) Water Quality Report* States that this same section fully supports all uses. Some of the wadeable streams do not fully support all designated uses due to the poor biological community (DNR, 2002). It is speculated that one of the reasons is a change in hydrology. Catoctin Creek and an unnamed tributary to Catoctin Creek do not support all designated uses (DNR, 2000b)

The 2004 303(d) List contains basins and subbasins that have measured water quality impairment and may require a TMDL. The basin/subbasin name, subbasin number (if applicable), and type of impairment are as follows:

- *Catoctin Creek*; fecal coliform, nutrients, suspended sediments.
- *Unnamed tributary to Little Catoctin Creek* (021403050217); poor biological communities.
- *Catoctin Creek* (021403050218); poor biological communities.
- *Middle Creek* (021403050221); poor biological communities.

MBSS sites found FIBI of poor and very poor (two sites were sampled) and BIBI of fair to very poor (Boward, 1995-1997, 2000-2001).

Restoration/Preservation

There is a long Green Infrastructure hub on the Washington-Frederick border, mostly protected by the South Mountain Natural Environmental Area. The northern part of this watershed contains Green Infrastructure hub near the Catoctin Mountains that are unprotected (DNR, 2000-2003). Unprotected Green Infrastructure should be protected. According to the Maryland Greenways Commission, existing or potential greenways include Catoctin Creek Trail, Middletown-Myersville Trolley Trail, Middletown Greenway, and the Appalachian Trail/South Mountain Greenway.

The following information is based on the document *Rural Legacy FY 2003: Applications and State Agency Review*. Approximately 26,351 acres in the southwestern corner of Frederick, including Myersville and Burkittsville, are designated as Rural Legacy area. This area is currently largely undeveloped (89%). This area was chosen in order to protect productive agriculture, including many dairy and livestock farms, the Appalachian Trail and watershed, the town of Burkittsville, and Civil War battlefields in and around South Mountain Battlefield State Park. The goal is to protect 17,267 acres (66%). Currently, 8,189 acres (31%) of this land is protected through various methods. The sponsors are Frederick County Department of Planning and Zoning and Mid-Maryland Land Trust Association, Inc. The report also includes a list of property owners who are interested in selling an easement and the priority of acquiring these easements. Generally the intent of the Rural Legacy Program is to focus preservation efforts around historic and scenic roads, develop greenbelts, and add to large areas of already-protected lands. In this case, Priority 1 sites are located mainly around Burkittsville and near U.S. Rte. 17 and U.S. Rte. 340 interchange. Since the Rural Legacy Program funds are not adequate enough to support all of these requests, other programs should consider preservation of these sites.

There are a few Nontidal Wetlands of Special State Concern within this watershed that are all currently unprotected. The following information was summarized from the 2003 document entitled *Nontidal Wetlands of Special State Concern of Five Central Maryland Counties and Coastal Bay Area of Worcester County, Maryland*. General management recommendations include limiting hydrological changes, including draining/filling/excavating, increased impervious surface, and groundwater drawdown by surrounding wells. Sediment and other pollutants from agriculture and development should be controlled. Best Management Practices should be established for any new development. Spraying of pesticides should be avoided within the wetland. Avoid livestock grazing within the site. Nearby road maintenance should be performed with caution. Heavy recreation should be directed away from the sensitive species. Non-native species invasion is a problem and should be controlled. An excessive deer population is causing impact through deer browsing on sensitive species and trampling vegetation (allowing a gap for non-native species invasion). A forested buffer should be maintained and logging should be prohibited in the buffer area and within the site itself. Any site recreational use should be directed away from the sensitive species. Restrictions on all-terrain vehicles (ATVs) use should be strictly enforced.

- *Little Catocin Creek Glade*. This site contains two significant habitat types: a circumneutral seepage wetland and a relatively healthy acidic/xeric glade. The wetland portion contains a State rare plant species and a locally significant plant species. The adjacent xeric habitat contains two additional State threatened or endangered plant species and two uncommon plant species. These areas currently have few invasive non-native species, which is another reason to protect them. This wetland is at the headwater of Little Catocin Creek. It is owned by The Nature Conservancy but will be transferred to a local conservation group soon. The site is surrounded by forest in private ownership. It is recommended that a conservation group purchase conservation easements on these surrounding properties to ensure long-term protection of this buffer.
- *Ridenour Swamp*. This relatively healthy circumneutral seepage wetland is along portions of Middle Creek. It containing three State rare, threatened, or endangered species and four uncommon species. This site is also utilized as breeding habitat for different warbler species. A youth camp, a few houses, and two secondary roads surround the site. There is some dumping on Ridenour Road, which is adjacent to the wetland. The DNR GreenPrint program recently acquired this site.
- *Spruce Run*. This site contains the significant habitat of maturing high quality forest. There is a State rare species within the wetland and a mature population of an uncommon tree species (butternut) just outside of the site. Several other springs and seeps are located along the slope. A few houses, old fields, and Catocin Mountain forest surround the site. Main threats include invasion of non-native species, large deer population, and alteration of hydrology.

Specific recommendations for restoration:

- Restore “gaps” within the Green Infrastructure to natural vegetation, especially along the Potomac River and tributaries.
- Restore wetlands and streams within the headwaters.

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- Reducing nitrogen and phosphorus entering the wetland water in the Brunswick area may improve these wetlands (Frederick County DPZ, 1998).
- A proposed wetland mitigation near the mouth of Little Catoctin Creek – was being studied in 1998 (Frederick County DPZ, 1998).
- Stream buffers are necessary on Catoctin Creek, Little Catoctin Creek, and Middle Creek (Frederick County DPZ, 1997).
- Improve the currently poor riparian buffers on the middle and upper sections of Little Catoctin Creek and spots along the Catoctin Creek (Frederick County DPZ, 1998).

Specific recommendations for protection:

- Protect portions of Green Infrastructure that are not currently protected, especially along waterways and larger hubs.
- Protect wetlands and streams within the headwaters.
- Protect unprotected WSSC and their buffers.
- Stream buffers are necessary on Catoctin Creek, Little Catoctin Creek, and Middle Creek (Frederick County DPZ, 1997).
- Use buffers and BMPs to protect Catoctin Creek, Little Catoctin Creek, Knoxville Branch, Dutchman Creek, Lander Branch (and others) from sediment and pollution (Frederick County DPZ, 1998).