Conewago Creek Watershed Characterization Plan

Summer 2016

Prepared by
Carroll County Bureau of Resource Management

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List of Acronyms

BMPs	best management practices
COMAR	Code of Maryland Regulations
DNR	Maryland Department of Natural Resources
EPA	United States Environmental Protection Agency
FEMA	Federal Emergency Management Agency
GIS	geographic information system
HSG	hydrological soil group
IBI	Index of Biotic Integrity
MBSS	Maryland biological stream survey
MDE	Maryland Department of the Environment
NLCD	National Land Cover Database
NPDES	national pollution discharge elimination system
PFA	priority funding area
RTE	rare, threatened or endangered
SW	stormwater
TMDL	total maximum daily load
TSS	total suspended sediments
USDA	United States Department of Agriculture
WLA	wasteload allocation

I. Characterization Introduction

A. Purpose of the Characterization

The Conewago Creek Watershed Characterization Plan is intended to provide a background on the hydrological, biological and other natural characteristics of the watershed as well as discuss human characteristics that may have an impact within the watershed. The information provided in this report as well as information gathered during the Conewago Creek Watershed stream corridor assessment (SCA) will be used as a tool to help direct the watershed implementation plan for the Conewago Creek Watershed. The implementation plan will be used to identify opportunities for water quality improvements within the watershed as required by the County's National Pollutant Discharge Elimination System (NPDES) permit, and is designed to meet approved Total Maximum Daily Loads (TMDLs) for the Conewago Creek Watershed.

B. Location and Scale of Analysis

The Conewago Creek Watershed encompasses areas within Carroll County, Maryland as well as Adams and York Counties, Pennsylvania. The majority of the Conewago Creek Watershed is located in Pennsylvania, while a small portion resides in northern Carroll County. The Conewago Creek Watershed is within the Piedmont Plateau Province of Maryland. The Piedmont Plateau province is characterized by gentle to steep rolling topography, low hills, and ridges (MGS 2009). The watershed area within Carroll County covers 3,468 acres within two sub-watersheds. Figure 1-1 depicts the location of the Conewago Creek Watershed and the subwatersheds within Carroll County. Conewago Creek is a tributary of the Susquehanna River in Pennsylvania, with its watershed draining into a small portion of northern Carroll County, which is a tributary to the Chesapeake Bay. Table 1-1 displays the distribution of acreage between the subwatersheds within Conewago Creek Watershed. The analyses presented in this report are done at the subwatershed scale. This allows for restoration and preservation efforts to be focused on smaller drainage areas where efforts can be prioritized and more easily monitored.

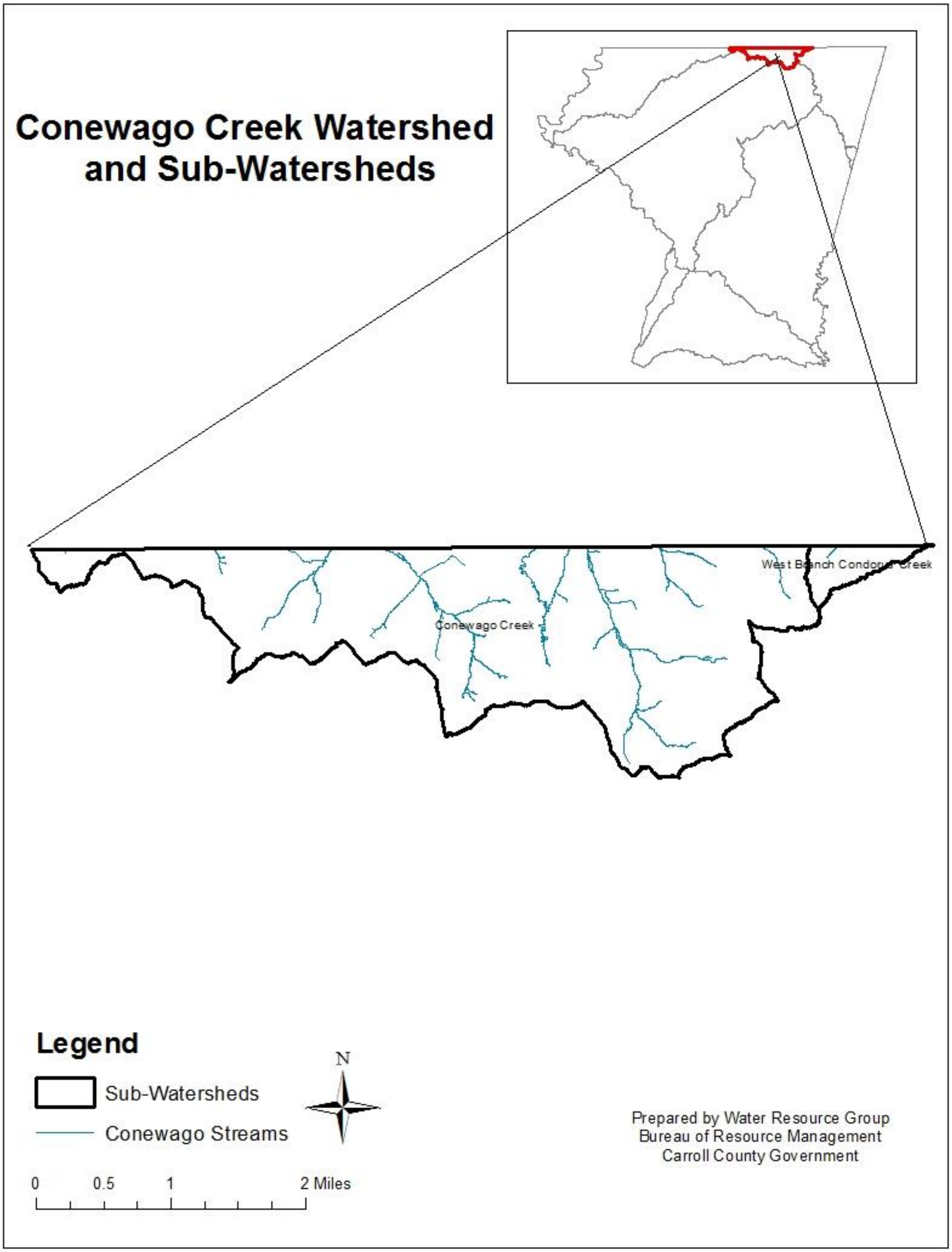

Figure 1-1: Conewago Creek Watershed Location Map

Table 1-1: Conewago Creek Watershed's Subwatershed Acreages

DNR 12-digit Scale	Subwatershed	Acres
020503010289	Conewago Creek	3,337.61
020503010290	West Branch Condorus Creek	130.27
Conewago Creek Watershed Total		**3,467.88**

C. Report Organization

This report is organized into six different chapters:

Chapter 1 presents the purpose of the characterization plan, shows a general location of the watershed within the County and lists the acreage distribution among the subwatersheds.

Chapter 2 presents background information on the natural characteristics of the watershed. Natural characteristics discussed in this chapter include climate, topography, soils, geology, wetlands and forest cover.

Chapter 3 focuses on anthropogenic influence within the watershed. The human component focuses on land use/land cover, impervious surface area, storm drain systems, drinking water and wastewater systems, and other point source locations. Chapter 3 will also discuss best management practices (BMPs) that have been installed in the watershed as well as any lands that have been protected through various programs.

Chapter 4 focuses on water quality. This chapter will discuss the stream designations, water quality data collected within Conewago Creek Watershed, and the total maximum daily loads (TMDLs) associated with the Conewago Creek Watershed.

Chapter 5 summarizes the living resources within the Conewago Creek Watershed including aquatic and terrestrial, as well as any rare, threatened or endangered (RTE) species.

Chapter 6 summarizes the purpose and use of the Characterization Plan and related work completed within the watershed. This plan will be used in developing the restoration plan for the watershed. This Chapter also lays out approximate cost in completion of this work.

II. Natural Characteristics

A. Introduction

The natural characteristics of a watershed provide the background for the biological and hydrological processes within the system. In this chapter we look at these characteristics in detail, which provides a foundation for the later chapters on human characteristics, water quality, and living resources. The natural characteristics to be covered in this chapter include: climate; physical location characteristics such as topography, soils and geology; and surface water resource characteristics such as wetlands, floodplains and forest cover. This chapter will also take a look at ecologically important areas and groundwater resources. Potential sources of degradation and the actions needed to address impacted areas can be evaluated by an inventory of these features within the watershed. Each watershed is unique, and the process of gathering information about the watershed may reveal key issues that will influence the watershed restoration plan. The Conewago Creek Watershed and its subwatersheds are shown in Figure 2-1.

B. Climate

The climate of the region is characterized as a humid continental climate, with four distinct seasons modified by the proximity of the Chesapeake Bay and Atlantic Ocean (DEPRM, 2000). The average temperature during the warm summer months is approximately 80 degrees Fahrenheit; while the average temperature during the cooler winter months is 40 degrees Fahrenheit. Rainfall is evenly distributed through all months of the year, with most months averaging between 3.0 and 3.5 inches per month. Storms in the fall, winter, and early spring tend to be of longer duration and lesser intensity than summer storms, which are often convective in nature with scattered high-intensity storm cells. The average annual rainfall is approximately 44 inches per year. The average annual snowfall is approximately 33 inches per year, with the majority of accumulation in December, January, and February.

The climate of a region affects the rate of soil formation and erosion patterns, and by interacting with the underlying geology, influences the stream drainage network pattern and the resulting topography.

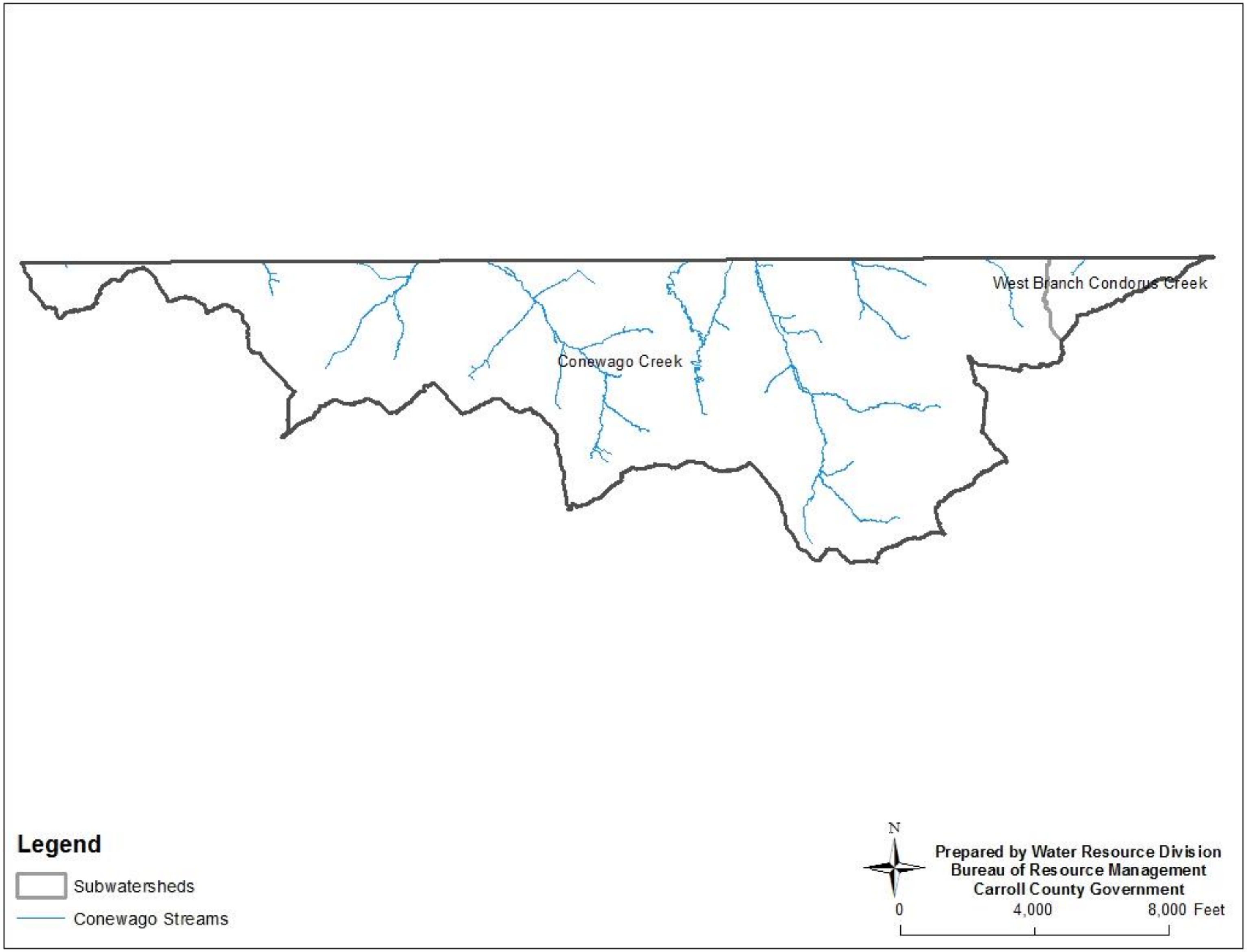

Figure 2-1: Conewago Creek Subwatershed Locations

C. Physical Location

The Conewago Creek Watershed lies entirely within the Piedmont Plateau Province, predominantly within the Upland Region of this physiographic province. The Piedmont Plateau Province is characterized by low rolling hills with clay-like moderately fertile soils, and complex geology of numerous rock formations consisting of different materials and ages intermingled with one another.

1. Topography

Topography of the land and nearby surrounding areas, including steepness and concavity affect surface water flows, potential for soil erosion, and development suitability. Lands with steep slopes are more prone to soil erosion and may contribute to the amount of pollutants released into a water system. For this watershed characterization we categorized slopes into three categories using soil data from the Carroll County Soil Survey: low slopes (0-8 %), medium slopes (8-15 %), and high slopes (>15 %). The Web Soil Survey produced by the National Cooperative Soil Survey and operated by the United States Department of Agriculture (USDA): Natural Resources Conservation Service provides soil data and slope information. Table 2-1 presents the subwatersheds' slopes and the percentages of each subwatersheds' slopes as part of the overall Conewago Creek Watershed. Figure 2-2 displays the slope categories and their distribution throughout the Conewago Creek Watershed.

Table 2-1: Conewago Creek Watershed Slope Categories

DNR 12-Digit Scale	Subwatershed	Slope Category (%)		
	Percent of overall total	Low	Medium	High
020503010289	Conewago Creek	40.6	44.1	15.3
	Percent of overall total	39.0	42.5	14.7
020503010290	West Branch Condorus Creek	38.9	31.8	29.3
	Percent of overall total	1.5	1.2	1.1
Conewago Creek Watershed Total		40.5	43.7	15.8

Note: The top row of each subwatershed is the percent of each slope category within that subwatershed. The second grey row below is the percent of that subwatershed's slopes as part of the overall Conewago Creek Watershed.

There is a small percentage of the Conewago Creek Watershed that has high soil slopes, less than 16% of the total watershed residing in Carroll County. Most of the high slopes are in the eastern portion of the watershed. Most of Conewago Creek Watershed consists of low to medium soil slopes. Low slopes make up approximately 1,404 acres, or about 40%, of the Watershed. Most of the Conewago Creek Watershed consists of medium slopes; though medium soil slopes and low soil slopes occur in relatively equal percentages throughout the Watershed. Medium slopes encompass approximately 1,514 acres, or about 44%, of the Watershed.

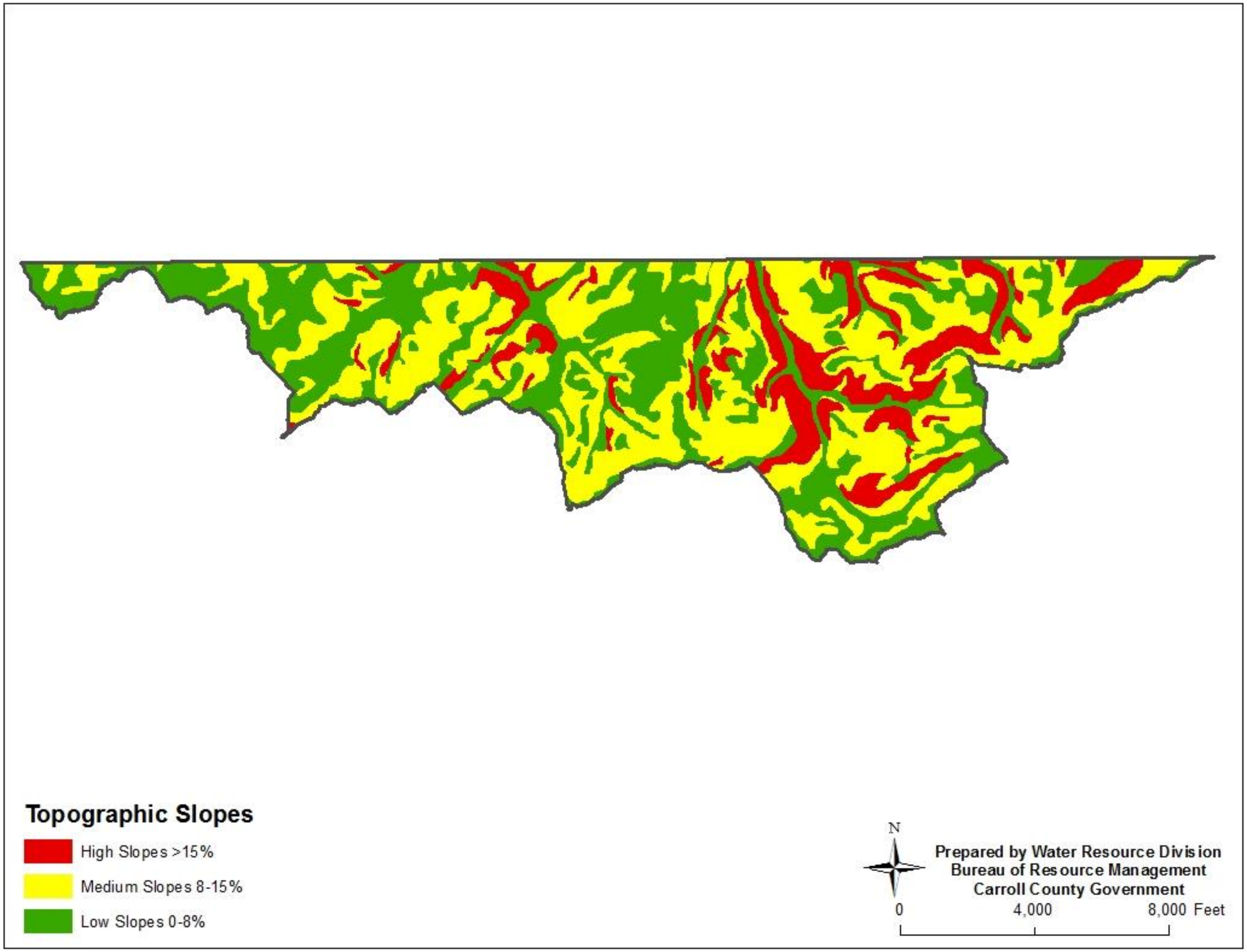

Figure 2-2: Conewago Creek Watershed Topography and Slope Categories

2. Soils

Independent of topographic slope, terrestrial systems within a watershed are greatly influenced by the type and condition of underlying soil. Soil factors such as drainage and permeability also greatly influence the amount of water present in a stream as well as water quality.

Soil composition is determined by factors including climate, organic matter, and type of parent material present. Within the Piedmont Plateau Province, highly metamorphosed schist, gneiss, and phyllite make up the vast majority of the parent material. Local soil conditions can vary greatly depending on organic matter and the localized climate. Chester and Manor soils are common in the Piedmont Plateau Province from Pennsylvania to North Carolina, including the Conewago Creek Watershed (Costa, 1975).

a. Hydrologic Soil Groups

The Natural Resource Conservation Service classifies soils into four Hydrological Soil Groups (HSG) based on runoff potential. Runoff potential is the opposite of infiltration capacity; soils with high infiltration capacity will have low runoff potential, and vice versa. The four HSG are A, B, C, and D; where group A generally has the smallest runoff potential and Group D has the greatest. Soils with low runoff potential will be less prone to erosion, and their higher infiltration rates result in faster flow-through of precipitation to groundwater (DEPRM, 2008).

The HSG classification was obtained from USDA technical release-55 'Urban Hydrology for Small Watersheds'.

> **Group A** is composed of sand, loamy sand or sandy loam types of soil. It has low runoff potential and high infiltration rates even when thoroughly wetted. They consist chiefly of deep, excessively drained sands or gravels and have a high rate of water transmission.
>
> **Group B** is composed of loam or silt loam. This group has a moderate infiltration rate when thoroughly wetted and consist mostly of deep to moderately deep, moderately well to well drained soils with moderately fine to moderately coarse textures.
>
> **Group C** is composed primarily of sandy clay loam. These soils have low infiltration rates when thoroughly wetted and consist mostly of soils with a layer that impedes downward movement of water. These soils also have a moderately fine to fine structure.
>
> **Group D** is composed of clay loam, silty clay loam, sandy clay, silty clay, or clay. This group has the highest runoff potential. They have very low infiltration rates when thoroughly wetted and consist mostly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, and shallow soils lying over an impervious material.

The hydrologic soil data from the Carroll County Soil Survey is summarized in Table 2-2 and shown in Figure 2-3.

Table 2-2: Conewago Creek Subwatershed Hydrologic Soil Group Categories

DNR 12-digit scale	Subwatershed	Hydrologic Soil Group %			
	Percent of overall total	A	B	C	D
020503010289	Conewago Creek	0	87.7	8.9	3.4
	Percent of overall total	0	84.4	8.6	3.2
020503010290	West Branch Condorus Creek	0	96.1	<1	3.0
	Percent of overall total	0	3.6	<1	<1
Conewago Creek Watershed Total		**0**	**88.0**	**8.6**	**3.4**

Note: The top row of each subwatershed is the percent of each soil category within that subwatershed. The second grey row below is the percent of that subwatershed's soils as part of the overall Conewago Creek Watershed.

Group A soils are not found within Conewago Creek watershed. The majority of the Conewago Creek Watershed is group B soils, making up about 88% of the Watershed. Nearly all areas that are group B soils are areas not in the immediate vicinity of streams or ponds. While the overall percentage of groups C and D soils are fairly low, these areas should be targeted when considering where the greatest potential for addressing soil conservation exists. Most of the group C and D soils are surrounding streams and pond areas of the watershed. Overall group D soils are not common in Conewago Creek Watershed, making up around 3% of the Watershed.

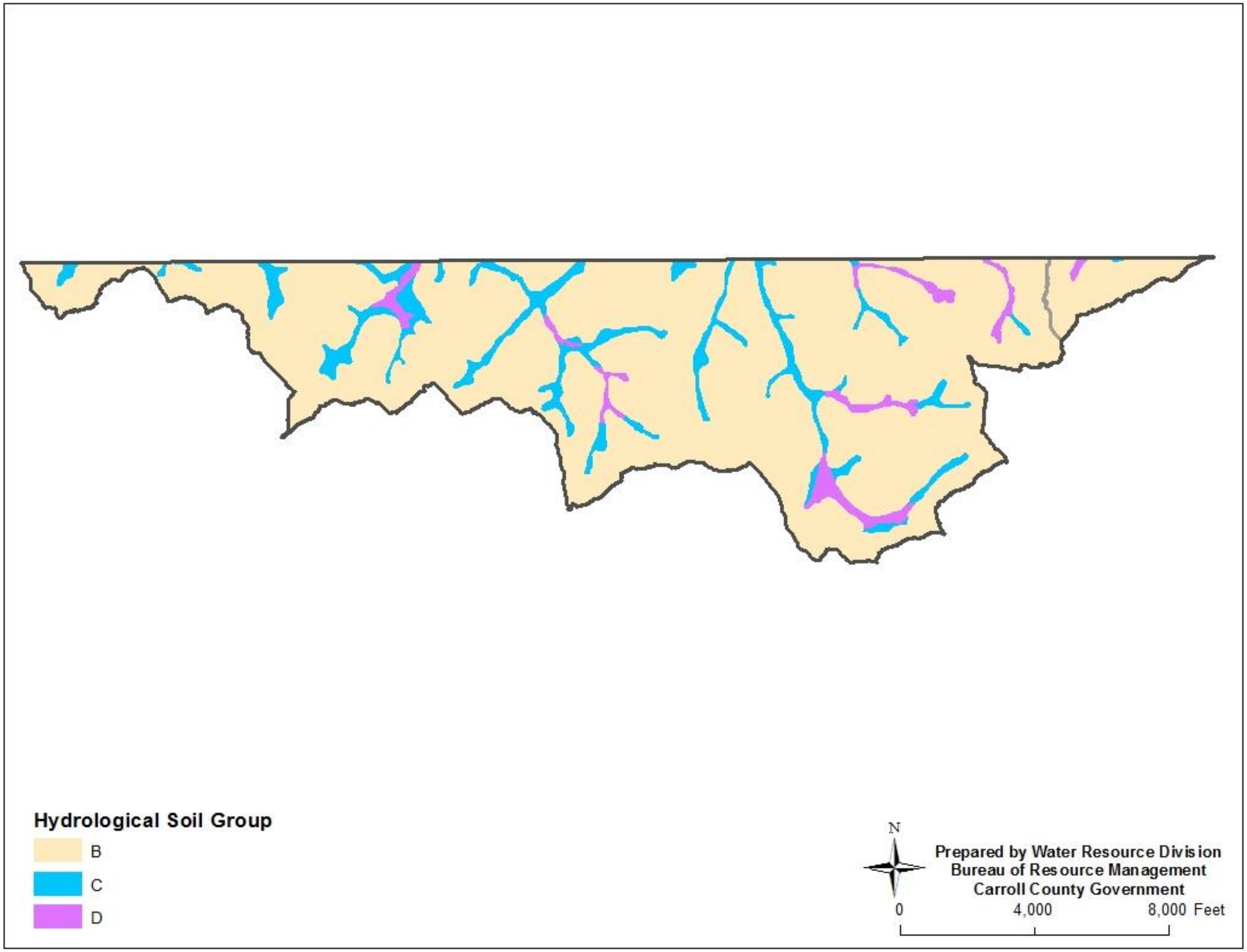

Figure 2-3: Conewago Creek Watershed Hydrological Soil Groups

3. Geology

The geological formations within the Conewago Creek Watershed are shown in Figure 2-4. Types of geological formations within a watershed can impact and alter the chemical composition of surface and groundwater, as well as the rate of recharge to groundwater. The underlying geology also determines soil formation. Intrinsically, the underlying geology can be closely correlated to the water quality within that system by affecting the buffering capacity.

The Conewago Creek Watershed, like most of the Piedmont Plateau Province, consists of metamorphic rock, mainly crystalline schists, gneiss and phyllite. Marburg formation contains primarily phyllite, metasilstone, and quartzite. These formations have moderate infiltration rates with average recharge to groundwater. However, the Calcerous Zone is composed of Marble and may be associated with karst environments. This formation has a higher infiltration rate and is highly susceptible to groundwater contamination due to the potential increased infiltration capacity.

In 1988, Carroll County initiated a water resource study. Part of this study focused on groundwater resource development in Carroll County. Aquifer type is the ultimate governing factor for groundwater development; however, natural factors like precipitation and topography play an important role in recharge. Carroll County has three distinct aquifer types: saprolite, carbonate rock, and triassic rock aquifers—all with varying rates of groundwater recharge. The carbonate rock aquifer has the highest recharge rate of the three types with an estimated drought recharge of 550,000 gallons per day per square mile (GPD/MI2). The triassic aquifer groundwater recharge under drought conditions is estimated at 220,000 GPD/MI2. The groundwater recharge rate for the saprolite aquifer varies widely depending on the hydrologic group (Carroll County Water Resource Study, 1998).

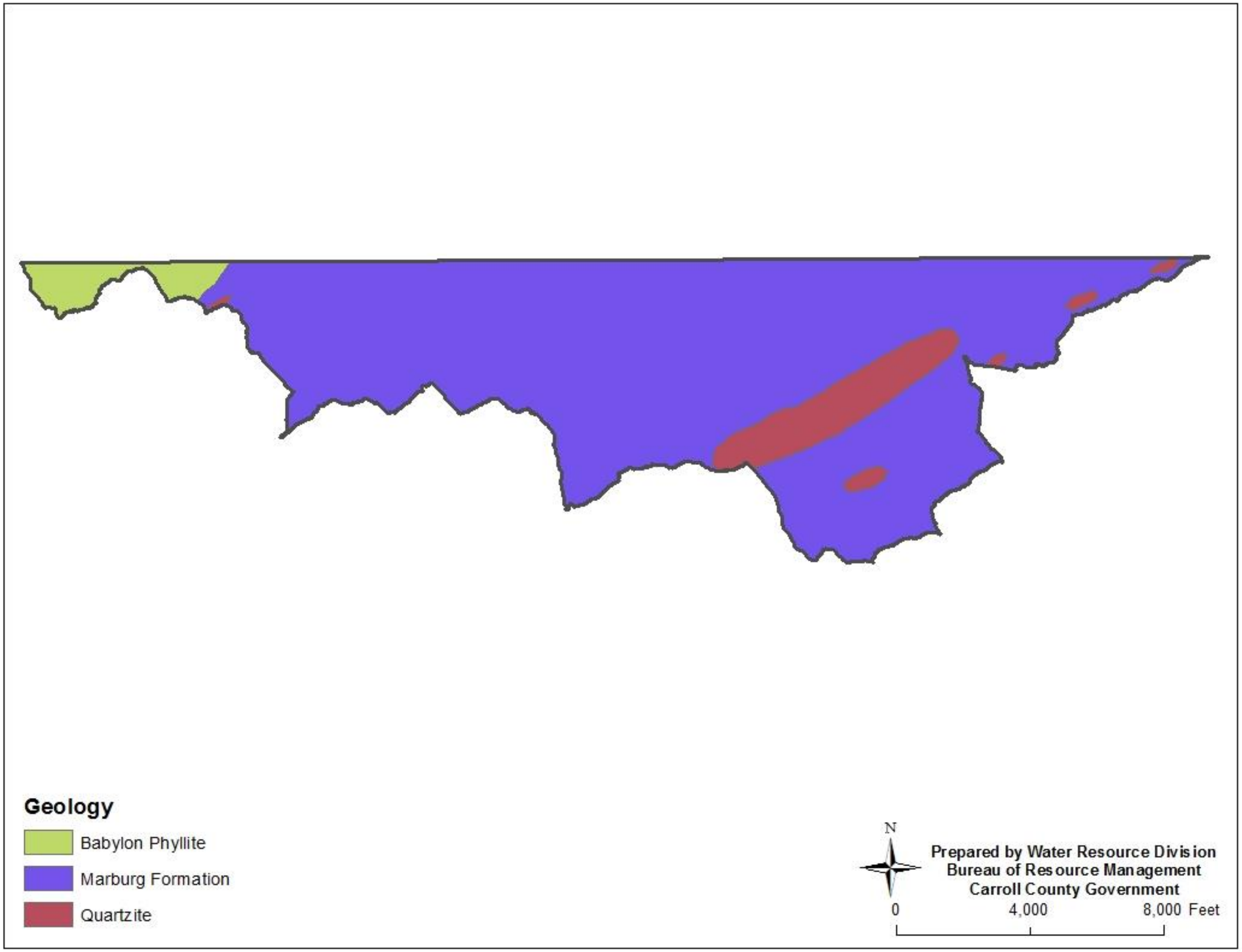

Figure 2-4: Conewago Creek Watershed Geology

D. Surface Water Resources

Physical resources within a watershed can greatly alter the hydrological process and can affect water quality. The following section will examine those resources that contribute in stabilizing stream flow as well as help with natural filtration.

1. Wetlands

Wetlands are a beneficial surface water resource. Wetlands provide downstream flood protection by absorbing and slowly releasing storm flows. Wetlands also naturally improve water quality with their filtering capability, nutrient uptake, and transformation.

Wetlands are defined by the US Army Corps of Engineers and the US Environmental Protection Agency (EPA) as: "areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas." Wetlands in the Conewago Creek Watershed, as seen in Figure 2-5, can generally be found in low lying areas around streams. This is common of the Piedmont Plateau Province due to the relief in topography, geology, and depth to groundwater.

There are three main sources of wetland information available in Maryland. The first is the National Wetlands Inventory which covers the entire country. The second is the Maryland Department of Natural Resources (DNR) which has mapped wetlands for the State, and the third is the National Land Cover Database (NLCD). The statistical data in this report was based off of the delineations from the NLCD. Actual acreage may be greater when field verified. The estimated acreage of wetlands by subwatershed for the Conewago Creek Watershed can be found in Table 2-3.

Table 2-3: Conewago Creek Watershed Wetland Acreage

DNR 12-Digit Scale	Subwatershed	Wetland Estimates	
		Acres	**%**
020503010289	Conewago Creek	2.97	0.09
020503010290	West Branch Condorus Creek	0	0
	Conewago Creek Watershed Total:	**2.97**	**0.09**

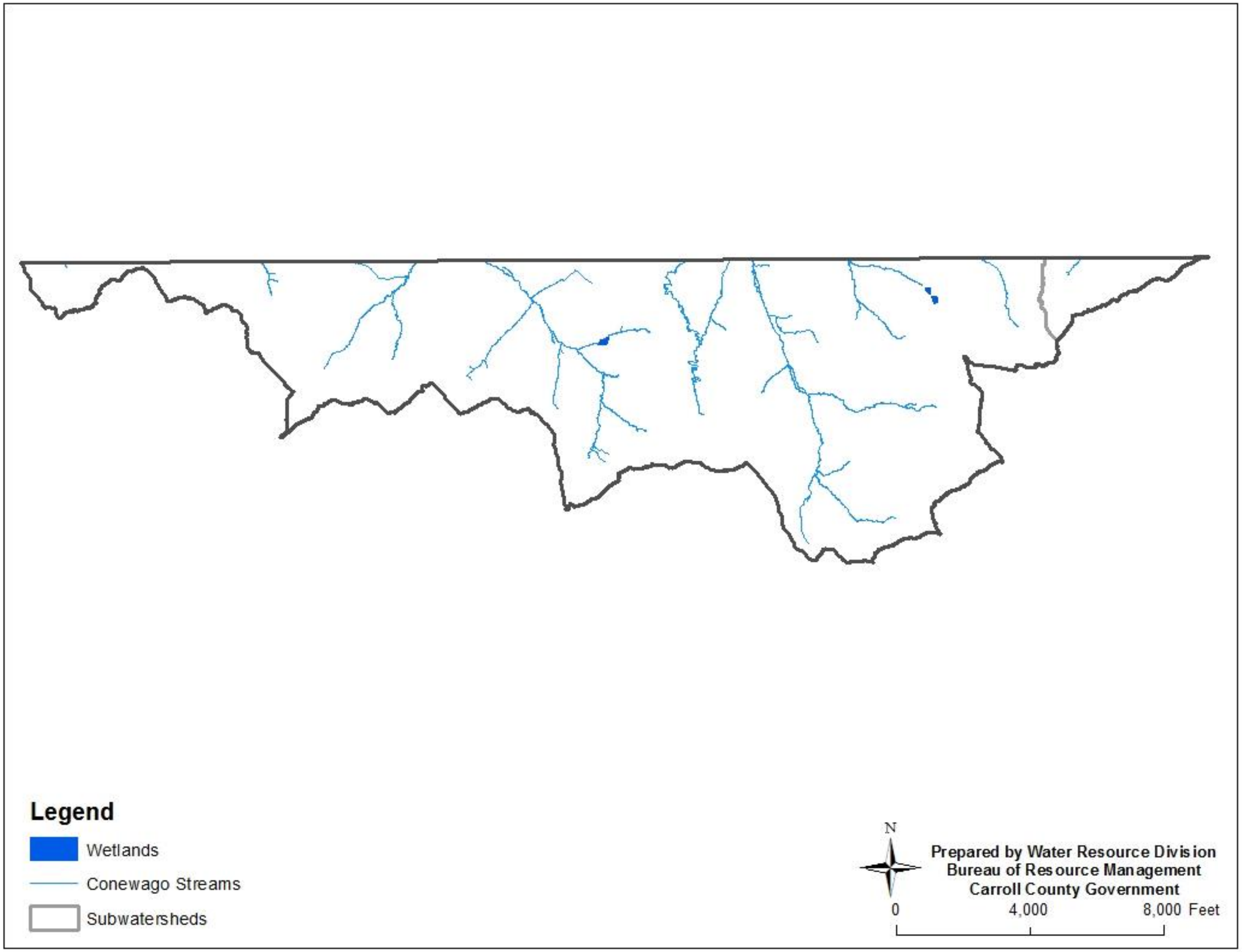

Figure 2-5: Conewago Creek Watershed Wetland Acreage

2. Floodplains

Floodplains in their natural state provide benefits to both human and natural systems. Benefits range from reducing the number and severity of floods to handling storm water runoff and minimizing non-point source pollutants. A natural floodplain will slow the velocity of water moving through a system, allowing sediment to settle out and nutrients to be taken up by the surrounding vegetation. Natural floodplains also contribute to groundwater recharge by allowing infiltration, which in turn will reduce the frequency of low surface flows, allowing for a healthier ecosystem.

Many floodplains are ideal locations for hike and bike paths, open spaces and wildlife conservation which in turn will make the community more ascetically appealing. By allowing a floodplain to remain in its natural state, people benefit from outdoor education and the scientific knowledge that comes from the undisturbed ecosystem.

Floodplain information obtained from Federal Emergency Management Agency (FEMA) 2015 effective mapped data shows there are no floodplains in the Conewago Creek Watershed. The FEMA has updated flood risk identification using newer technology to establish flood risk zones and base flood elevations. Floodplain information obtained from FEMA 2015 effective mapped data.

3. Forest

Forests are home to many forms of life, and play an essential role environmentally including but not limited to climatic regulation, carbon cycling, biodiversity preservation, and soil and water conservation. Among land cover types, forest provides the greatest protection for soil and water quality. A healthy forest will hold soil in place which assists in reducing runoff, conserving nutrients and protecting streams from erosion. The riparian forest or corridor directly adjacent to a stream helps to moderate stream temperatures, which in many cases can support cold-water fisheries. In addition to supplying much needed shade for streams, the riparian forest is responsible for supplying detritus matter to the stream, which is natural food and energy input for streams in the Piedmont Plateau Province region.

a. Forest Cover

A healthy forest not only plays an important role environmentally, but can have great aesthetic and recreational benefits as well. Forest areas within the Conewago Creek Watershed today consist of secondary succession forest that have regrown and matured. Large forest blocks will provide greater ecological benefits than smaller blocks, because less fragmented landscapes benefit interior dwelling species.

Conewago Creek Watershed contains 11,143 acres of forest over multiple land uses, and covers about 29 percent of the land within the watershed. The forest cover within the Conewago Creek Watershed can be found in Figure 2-6 and is shown in Table 2-4.

Table 2-4: Conewago Creek Watershed Forest Cover

DNR 12-Digit Scale	Subwatershed	Total Acres	Forested Acres	% Forested
020503010289	Conewago Creek	3,337.6	1,065.1	31.9
020503010290	West Branch Condorus Creek	130.3	29.6	22.7
Conewago Creek Watershed Total:		**3,467.9**	**1,094.7**	**31.6**

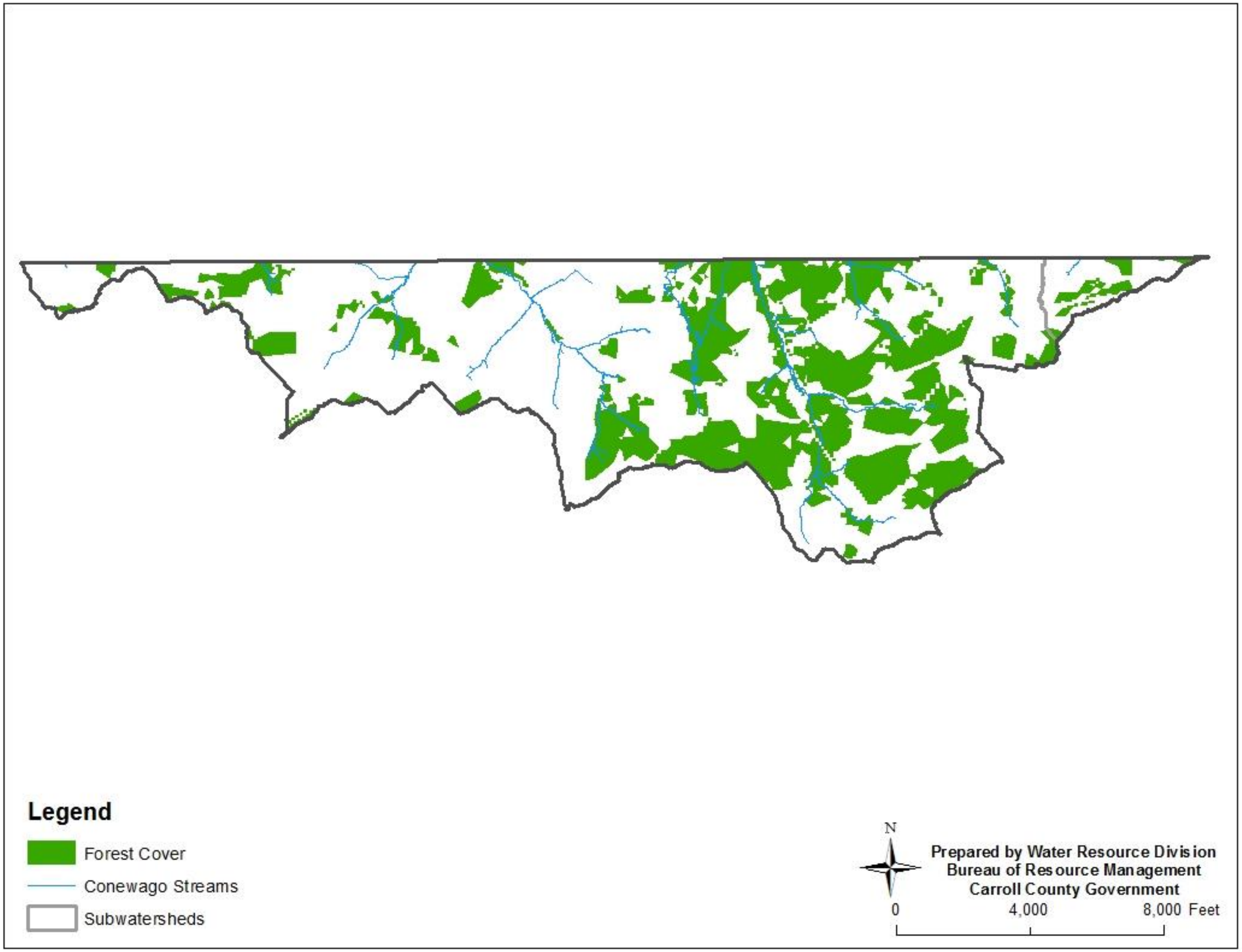

Figure 2-6: Conewago Creek Watershed Forest Cover

E. Ecologically Important Areas

The DNR has mapped a statewide network of ecologically important areas across the State called "Green Infrastructure". These areas are known as hubs and corridors. Hubs consist of large blocks of important natural resource land, and corridors connect one hub to the next. The large blocks of land that make up this green infrastructure consist primarily of contiguous forest land, but also may include wetlands and other naturally vegetated lands.

The DNR has mapped this network of ecologically important land by using several geographic information system (GIS) data layers to develop the areas that met specific parameters for green infrastructure. Hubs will contain one or more of the following:

- Areas containing sensitive plant or animal species;
- Large blocks of contiguous interior forest (at least 250 contiguous acres);
- Wetland complexes with at least 250 acres of unmodified wetlands;
- Streams or rivers with aquatic species of concern, rare cold-water or black-water ecosystems, or important to anadromous fish, and their associated riparian forest and wetlands; and
- Conservation areas already protected by public and private organizations (i.e. the DNR, The Nature Conservancy).

These "Green Infrastructure" areas comprise the bulk of the State's natural support system. As stated previously, forest systems are important resources that attribute to filtering and cooling water, storing and cycling nutrients, conserving soils, protecting areas from storm and flood damage, and maintaining the hydrologic function of the watershed. For more information on the Green Infrastructure identification project through the DNR, see:

http://dnr.maryland.gov/land/green_infra.asp

Lands identified through the "Green Infrastructure" project where protection is needed may be addressed through various programs, including rural legacy program, open space, or conservation easements.

Figure 2-7 shows the hubs and corridors within the Conewago Creek Watershed as identified through the DNR "Green Infrastructure" project.

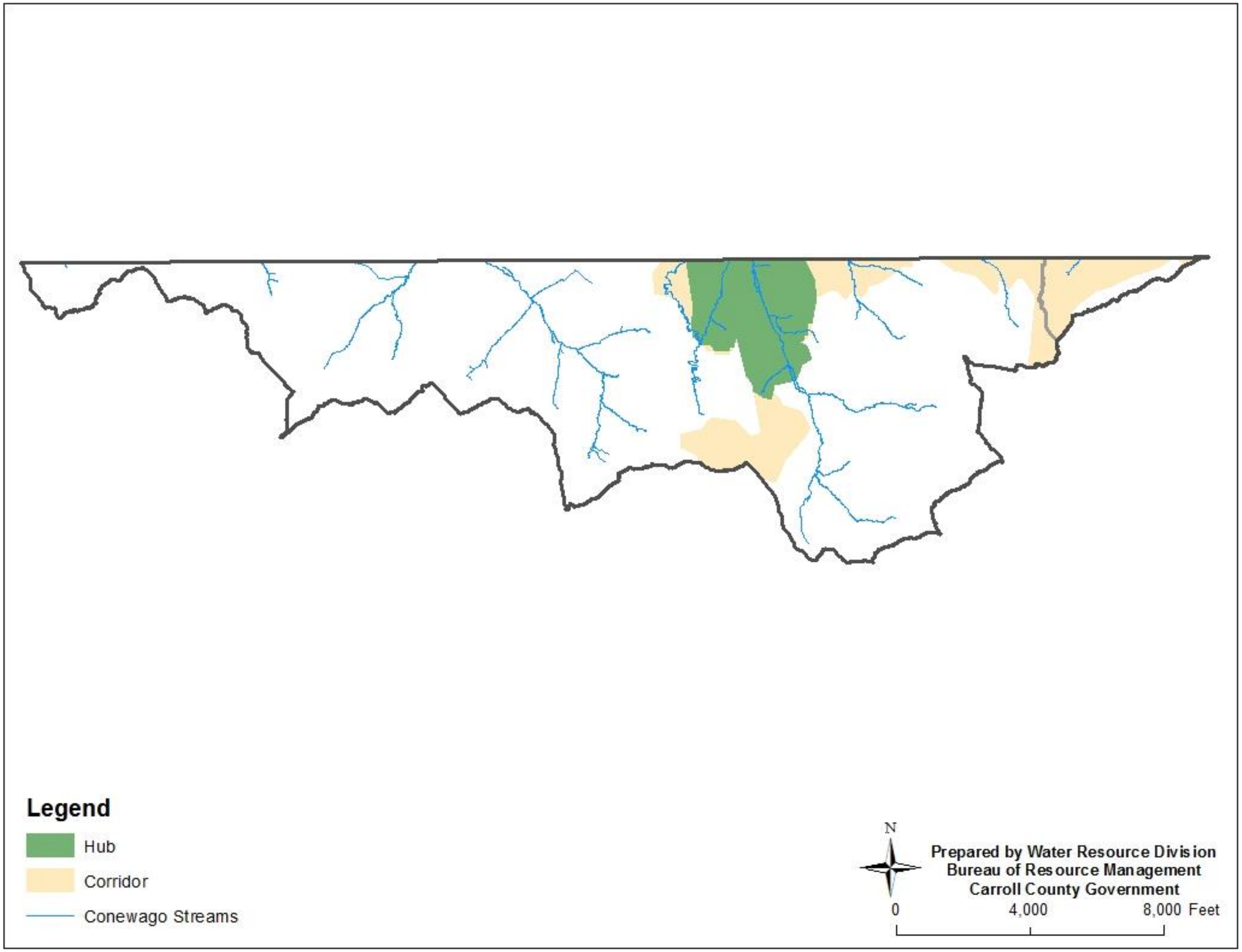

Figure 2-7: Conewago Creek Watershed Green Infrastructure

F. Groundwater Resources

Groundwater development potential in Carroll County is limited to the type of aquifer in the area. Of the aquifer types within Carroll County, each has unique water-bearing and yielding properties. The underlying bedrock units have minimal primary porosity and permeability. As such, groundwater occurs principally in interconnected joints, fractures, and faults within the rock mass, as well as in the relatively shallow weathered zone overlying the bedrock and beneath the soil horizon (Carroll County Water Resources Study, 1998).

Transmissivity indicates the ease at which groundwater moves through an aquifer in response to the water table gradient within the aquifer. Transmissivity is a governing factor in determining the amount of water which may be withdrawn in a given area. A highly transmissive aquifer will allow a greater volume of water to be withdrawn than an aquifer with low transmissivity, with a given water table drawdown. Low transmissivity will cause significantly less flow in the groundwater, and restricts withdrawal rates.

To obtain satisfactory well yield, well location is critical and must intersect a permeable fracture. Fracture trace zones are evident on aerial photographs as alignments of valleys and swales, contrasting soil tones, differences in vegetation type and growth along with the occurrence of springs and seeps.

Groundwater withdrawal, if ungoverned will ultimately lower the water table, affecting stream-flow. It is important to maintain a balance between biological needs of a stream and water withdrawal needs. Aquifers are replenished by the seepage of precipitation, but the amount that is absorbed is dependent on geologic, topographic, and human factors, which determine the extent and rate that aquifers are replenished.

The ground works as an excellent mechanism for filtering particulate matter, but natural occurring contaminants such as iron and manganese, as well as human induced contaminants such as chemicals and oil are easily dissolved and could be found in high concentrations within the water. Since underlying rocks have varying porosity and permeability characteristics, water quality will also vary greatly. Rock types with a higher rate of recharge generally have lower associated water quality.

III. Human Characteristics

The following chapter will look at human characteristics of the watershed, and how anthropogenic modifications could impact the natural ecosystem. Specifically, this chapter will examine the general land use and land cover of the watershed, as well as specific human modifications such as impervious surface cover, storm water systems, drinking water, and waste water systems.

A. Population

The natural landscape of the Conewago Creek Watershed has been modified for human use over time. Anthropogenic modifications have potential to degrade both the terrestrial and aquatic ecosystems. The Conewago Creek Watershed currently has an estimated population of approximately 2,550 persons. If you spread the population evenly across the entire Watershed it would equal about one person per 1.36 acres.

B. Baseline and Current Land Cover

As the land use of a watershed is modified over time it will ultimately influence the water quality within that watershed. Natural landscapes, like forests and grasslands allow for infiltration of stormwater while absorbing excess nutrients. Unmanaged impervious surfaces don’t allow for infiltration, causing stormwater to concentrate. The increased runoff velocity will de-stabilize stream banks, causing potential sedimentation problems downstream. Within the Conewago Creek watershed, cropland is the dominant land cover at about 35.7 percent of the total land, followed by forest which accounts for 31.6 percent, and pasture/hay, which accounts for about 16.4 percent of the total land cover.

The 2011 NLCD data was compared to current property data and existing land uses within the county in order to identify any gaps in urban land cover. Additional areas identified as urban were based on section II.4 (table 1) of MDE’s accounting for SW WLA document, and consisted of rural residential lots less than three (3) acres that were listed as non-urban land uses within the NLCD database. This analysis showed a 0% increase in low-density residential land cover since 2011, which has been incorporated into Table 4. The NLCD performs land cover analysis on 5 year intervals, with the next round expected to be completed sometime in 2016.

The following table, Table 3-1 shows the current land cover data for the Conewago Creek watershed, as well as the changes in land cover over time since 2001. The current land cover, as of 2011, within the Conewago Creek Watershed can be found in Figure 3-1.

Table 3-1: Conewago Creek Watershed Baseline and Current Land Cover

Land Cover	Acres 2001	Percent 2001	Acres 2006	Percent 2006	Acres 2011	Percent 2011	Current Acres	Percent
Open Water	0	0	0	0	0	0	0	0
Low-Density Residential	259.9	7.5	259.4	7.5	271.9	7.9	271.9	7.9
Low-Density Mixed Urban	13.8	<1	13.8	<1	13.9	<1	13.9	<1
Medium-Density Mixed Urban	0.15	<1	0.15	<1	0.15	<1	0.15	<1
High-Density Mixed Urban	0	0	0	0	0	0	0	0
Barren Land	0	0	0	0	0	0	0	0
Forest	1,099.1	31.8	1,095.8	31.7	1,094.7	31.6	1,094.7	31.6
Shrub/Scrub	256.0	7.4	247.3	7.1	255.5	7.4	255.5	7.4
Grassland	6.4	<1	18.5	<1	18.7	<1	18.7	<1
Pasture/Hay	623.6	18.0	570.5	16.5	566.5	16.4	566.5	16.4
Cropland	1,198.5	34.6	1,252.0	36.2	1,235.9	35.7	1,235.9	35.7
Wetland	2.9	<1	2.9	<1	3.0	<1	3.0	<1

Source: National Land Cover Database

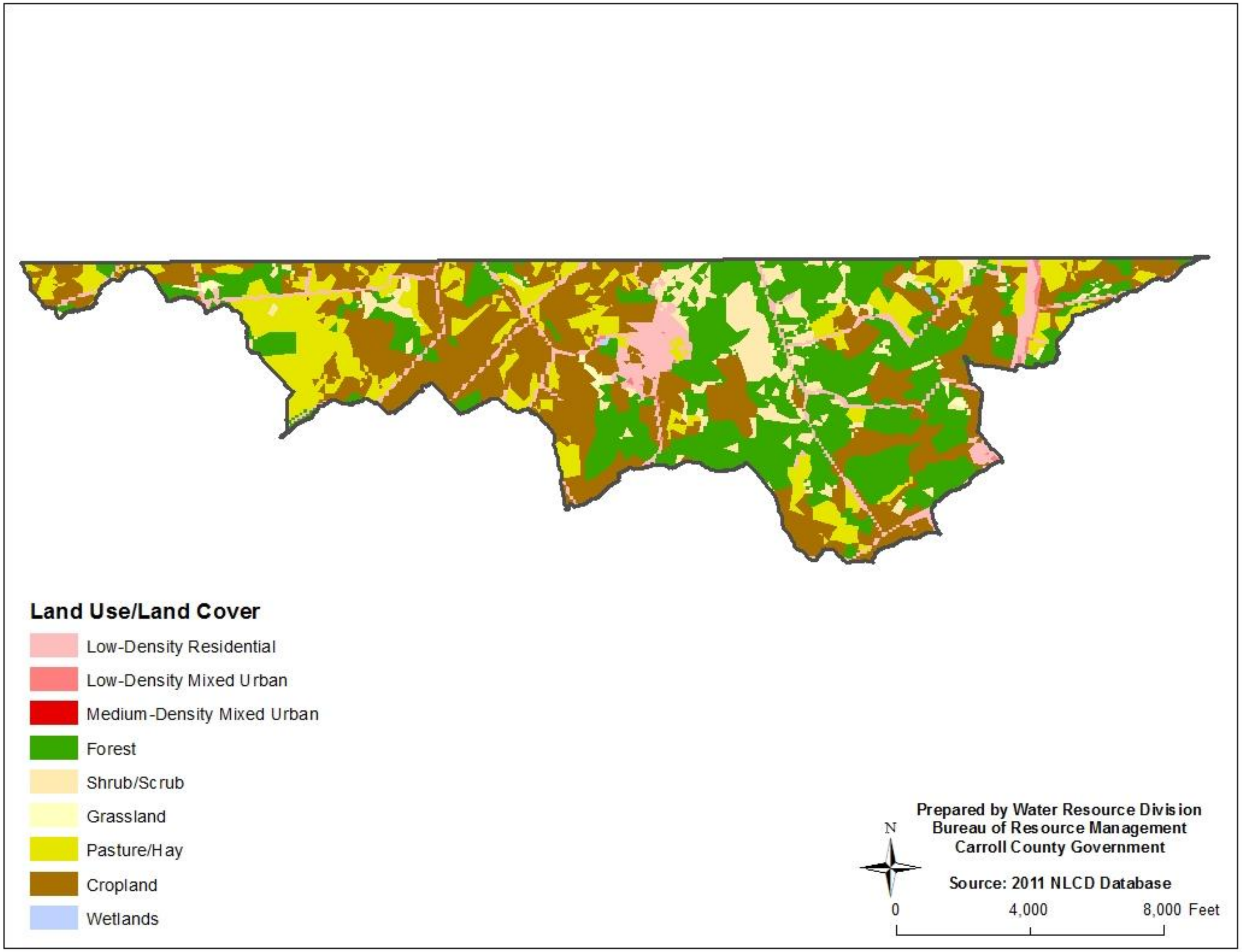

Figure 3-1: Conewago Creek Watershed Land Use and Land Cover

C. Priority Funding Areas, Zoning and Build Out

1. Priority Funding Areas

The Maryland Smart Growth Areas Act of 1997 introduced the concept of Priority Funding Areas (PFAs). The Maryland Planning Act and Smart Growth initiatives require that the local jurisdictions map specific growth areas to target infrastructure dollars from the State. Priority Funding Areas are existing communities and locations where State funding for future growth will be designated. These designated areas have specific boundaries and are the focal area for employment, social, and commercial growth within the watershed. There are no designated PFAs within the Conewago Creek Watershed.

2. Zoning and Build-Out

Zoning refers to the regulation of land for the purpose of promoting compatible land uses. Typically zoning specifies the areas in which residential, industrial, recreational or commercial activities may take place. The current zoning for the Conewago Creek Watershed can be found in Figure 3-2. Carroll County does not regulate zoning within the municipalities. The majority of the Conewago Creek Watershed (83%) is zoned agricultural.

Build-out analyzes the number of residential units in a given area that could be built based on the current zoning. Build out looks at existing development and, based on a yield calculation, determines how many more residential units can be built in the future. Within the Conewago Creek Watershed there are 116 parcels remaining with potential development on 1,551 acres for an estimated lot yield of 169 (build out data was provided by Carroll County Department of Land and Resource Management). This data is based on a medium range buildable land inventory estimate by land use designations. The medium range estimates have been determined to be the most accurate for build out. The full buildable land inventory report can be found at: http://ccgovernment.carr.org/ccg/compplanning/BLI/.

Figure 3-3 shows the remaining parcels in Conewago Creek Watershed where residential units could be built.

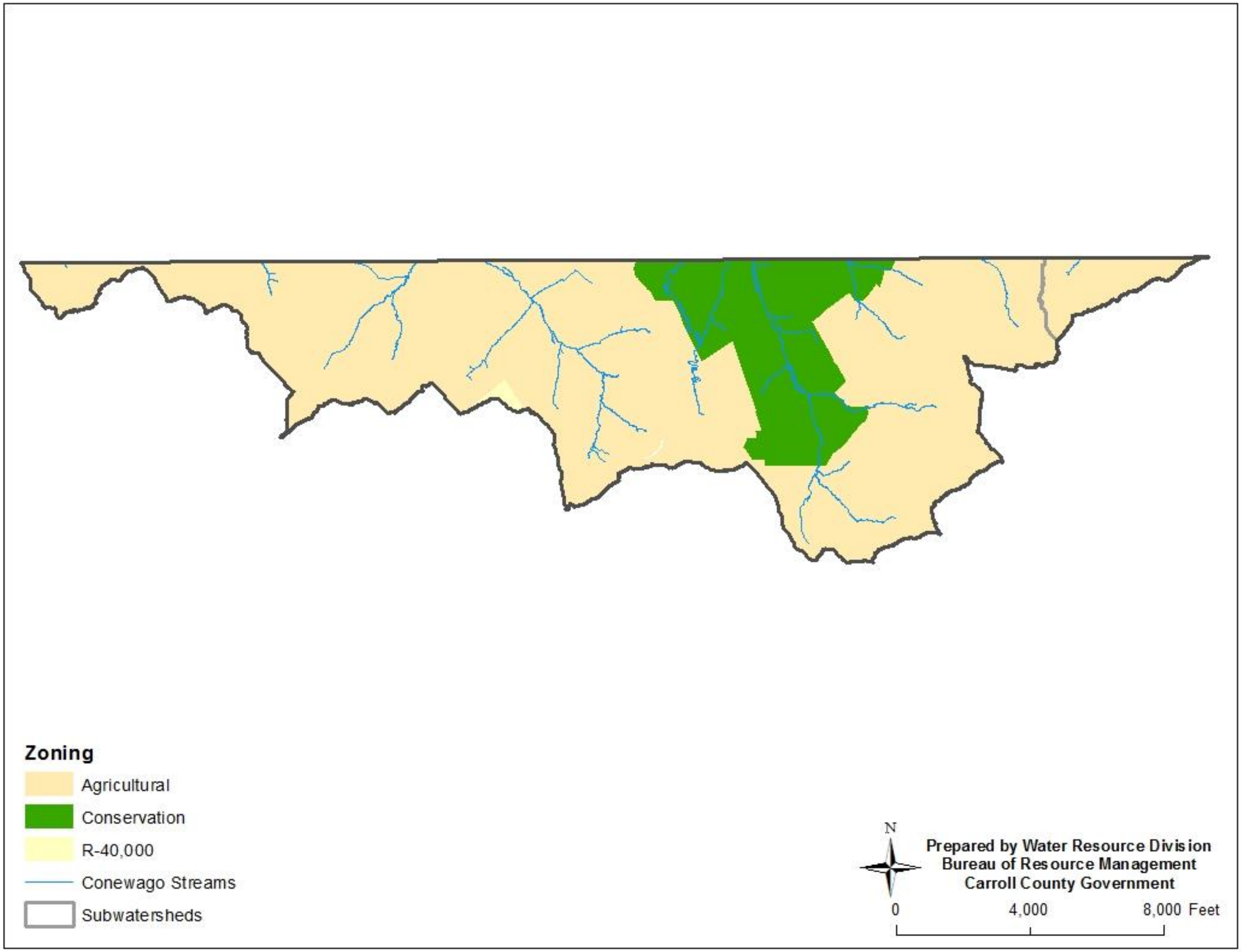

Figure 3-2: Conewago Creek Watershed Zoning

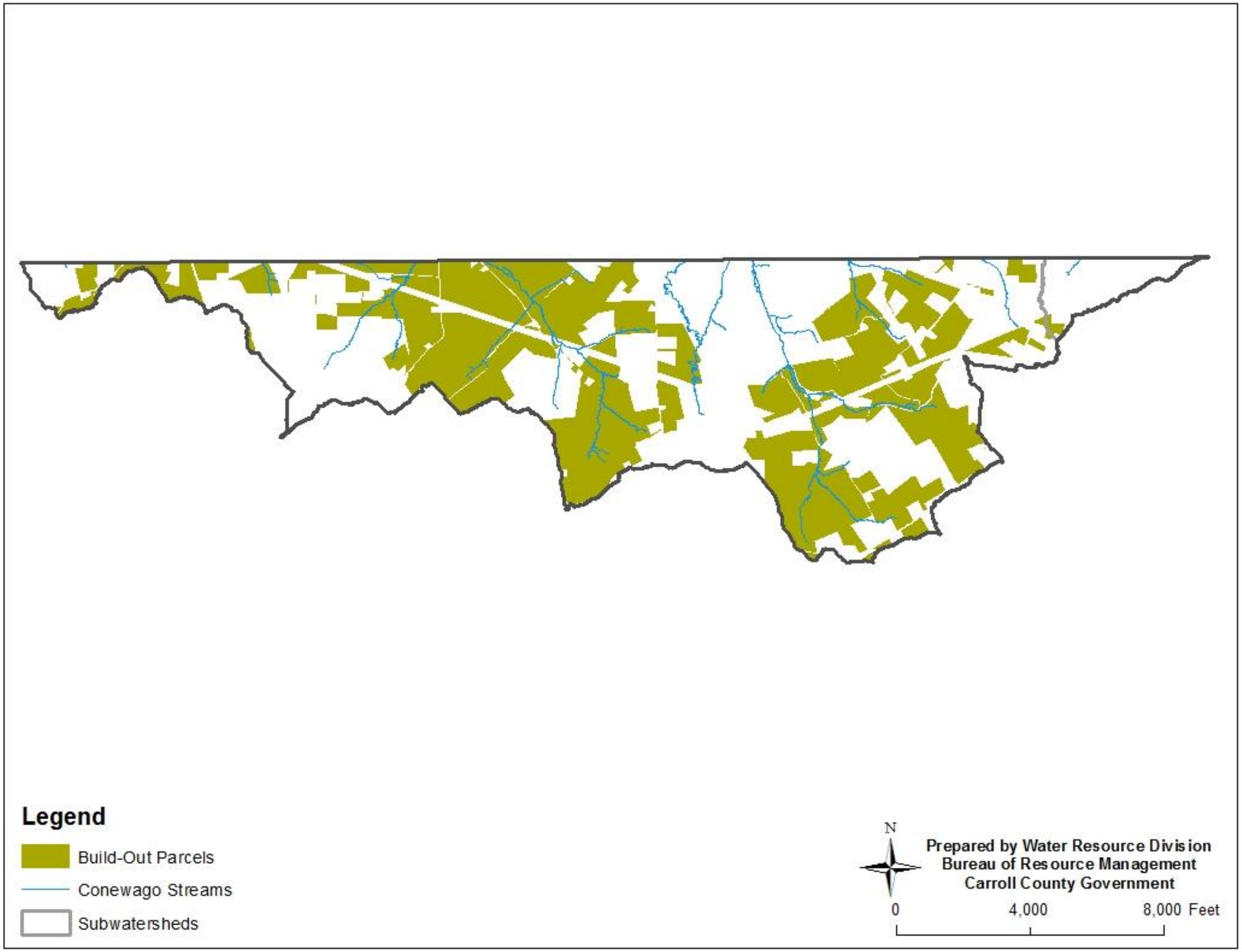

Figure 3-3: Conewago Creek Watershed Build-Out Parcels

D. Impervious Surfaces

Watershed and stream health have been tied, via various studies to the amount of impervious surface that lies within the system. Impervious surfaces such as roads, parking areas, and rooftops block the natural seepage of rainwater into the ground, resulting in concentrated stormwater runoff with an accelerated flow rate.

There are two general ways to quantify impervious cover: total impervious and effective impervious. Total impervious accounts for all impervious surfaces within a catchment, and effective impervious is the impervious area within the watershed that is directly connected to stream channels. Table 3-2 shows the estimated total impervious area by subwatershed for the Conewago Creek Watershed.

Table 3-2: Conewago Creek Watershed Estimated Impervious Surface Area

DNR 12-digit Scale	Subwatershed	Acres	Impervious Acres	Percent Impervious
020503010289	Conewago Creek	3,337.6	96.4	2.9
020503010290	West Branch Condorus Creek	130.3	6.1	4.7
Conewago Creek Watershed Total		**3,467.9**	**102.5**	**3.0**

The Conewago Creek Watershed is estimated to have 102.5 acres of total impervious within the catchment and accounts for approximately 3 percent of the total land area. Effective impervious was not calculated for this exercise because it is difficult to accurately determine without proper field verification, but it is a much lesser percent.

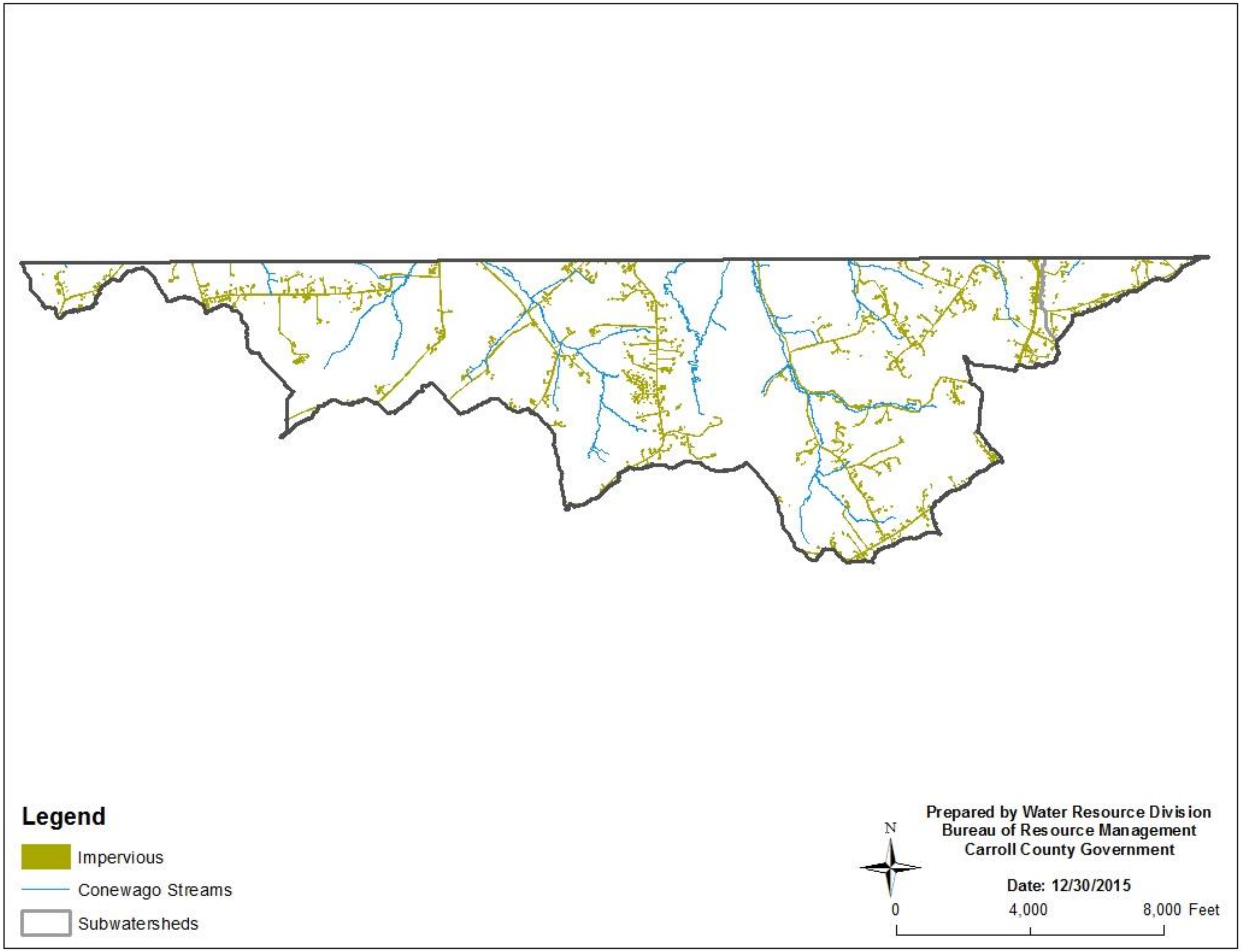

Figure 3-4: Conewago Creek Watershed Impervious Surface Area

E. Stormwater

Stormwater consists of runoff from precipitation and snowmelt that flows over the land or an impervious surface that is unable to infiltrate into the ground. As the runoff flows across a surface it can accumulate debris, chemicals, sediment and other pollutants that could adversely affect the water quality of a stream. An increased amount of unmanaged impervious surface within a watershed is likely to increase the amount of polluted stormwater reaching stream channels.

1. Stormwater Management Facilities

In the 1980's, the State of Maryland required stormwater management for new development to manage the quantity of runoff. These requirements were initially put in place to treat subdivisions with less than 2 acre lots. For lots greater than 2 acres, stormwater management was only required to address road runoff. In 2000 Maryland Department of Environment (MDE) released a new design manual for stormwater which required greater water quality and quantity controls and included stormwater management for subdivisions with lots greater than 2 acres.

There are different types of management facilities with varying degrees of pollutant removal capability. Facilities that infiltrate stormwater runoff have among the highest pollutant removal capability, while the initial dry pond design has the lowest pollutant removal efficiency and was designed to control water quantity. There are currently no existing stormwater management facilities within the Conewago Creek Watershed.

Stormwater management facilities proposed for implementation to assist in addressing the stormwater wasteload allocation TMDLs are listed within the Conewago Creek Watershed TMDL restoration plan.

2. Storm Drain Systems

Storm drainage systems consist of either contoured drainage swales or a curb and gutter system with inlets and associated piping. Both systems function to efficiently remove water from impervious areas in order to prevent flooding, but have varying effects on water quality. The curb and gutter system can be directly connected to a stream through its piping network and deliver increased volumes of water, as well as untreated pollutants from the connected impervious surface to the stream. Contoured drainage swales do not allow water to move as efficiently as the curb and gutter system. Swales allow some water to infiltrate, which provides some filtering of pollutants, and reduces the amount of water delivered to a stream.

F. Drinking Water

Having safe drinking water is fundamentally important to support human and livestock populations within a watershed. Within the Conewago Creek Watershed, drinking water comes from private wells. In neighboring watersheds, there are also public water service areas, though Conewago Creek Watershed does not have connection to public water service at this time.

1. Wellhead Protection Areas

Wellhead protection areas established under the Safe Drinking Water Act are surface and subsurface regulated land areas around public drinking water wells and/or well fields. Wellhead protection areas are regulated to prevent contamination of water supply. Ideally a wellhead protection area will encompass the entire recharge area for a well. There are no wellhead protection areas within the Conewago Creek Watershed at this time.

2. Public Water Service Area

Within the Conewago Creek Watershed, there are no public water service areas to provide residents with public water at this time. The Manchester area is the nearest location that has existing public wells, future well locations as well as existing storage tanks.

A water use appropriation permit is required for any entity withdrawing more than 10,000 gallons of water a day from a single source. Appropriations are determined by the MDE water supply program, and are necessary to conserve and protect wells as a vital resource for the residents in the State of Maryland. At any given time these wells could either be online or offline depending on maintenance and demand. There are no community well locations or associated public service areas in the Conewago Creek Watershed.

3. Water Supply

All of the residents within the Conewago Creek Watershed obtain their water from private wells located on their property; within Conewago Creek Watershed there are about 595 private water wells. Since the underlying geology within the Conewago Creek Watershed consists mainly of New Oxford Formation and quartzite, the associated water withdrawals from these wells come from an unconfined aquifer. The fractured rock of the Piedmont Plateau Province allows surface water to pass through soil and into the underlying rock fractures; therefore, the source of the water is locally derived.

G. Wastewater

Wastewater is any water consumed through human use that adversely affects water quality by anthropogenic influence, and must be properly contained and treated. Treatment and containment of wastewater can be accomplished by either on-site septic systems or through public conveyance to a community or private wastewater treatment plant. Treatment of wastewater is essential because any untreated wastewater, either from a residential or industrial operation, has the potential for carrying harmful contaminants to the natural environment.

1. Public Wastewater Service Area

Public service areas convey wastewater through a piping system from residences and businesses to a treatment facility prior to discharge. Each hookup to the sewer line has a cleanout in which the private landowner is responsible for maintaining. The main part of the system consists of gravity flow lines with manholes for access, pumping stations, and force mains. The public utility is responsible for maintenance on the main lines of the wastewater system. Within the Conewago Creek Watershed there are no homes utilizing public service at this time. Manchester is the closest area that offers public wastewater service.

2. Wastewater Discharge Locations

Within the Conewago Creek Watershed, there are no areas that are served through public wastewater system.

3. On-Site Septic Systems

On-site septic systems are the main source of waste disposal in rural and low density areas within Conewago Creek Watershed. When maintained and functioning properly, on-site septic systems are effective at treating nitrogen, but are not as effective at treating phosphorus. Improved treatment of nitrogen can be remedied by making sure the leach field is properly located to prevent wastewater effluent from directly entering a body of water. However when these systems fail or are inadequately maintained, excessive nutrients and bacteria can be released causing degradation of groundwater quality and nearby aquatic systems. There are currently approximately 595 septic systems within the Conewago Creek Watershed..

H. NPDES Point Sources

Any facility that discharges wastewater, whether it is industrial or municipal, or any facility that performs activities that could have a negative impact on a waterway by introducing pollutants into the watershed must obtain a National Pollutant Discharge Elimination System (NPDES) permit. NPDES permits implement restrictions on pollutant loads to be discharged from the source, as well as documenting potential pollutant spills, treatment to wastewaters and regulating pollutants before reaching a water body. There are no current NPDES permits within the Conewago Creek Watershed (information obtained from EPA.GOV Envirofacts).

I. Protected Lands

Protecting land ensures that non-urban land uses will remain intact over time on the specific parcel being protected. These lands are preserved through various programs, and the extent of protection can vary greatly from one property to the next. Preservation and protection include areas such as parks or watershed protection zones, as well as areas that are being intensively managed for agriculture. Protected lands may be preserved through direct public ownership or via public and private easement acquisition.

Table 3-3 lists the type of protected lands within the Conewago Creek Watershed along with the representative acreage. About 919.4 acres, or about 26.5%, of the total land area within Conewago Creek Watershed has some sort of land protection. Agricultural easements have the highest percentage of protection within the watershed at 14.3% with nearly 496 acres preserved. Figure 3-5 shows where the protected areas are located within the Watershed.

Table 3-3: Conewago Creek Watershed Protected Lands

Type of Protection	Acres	Percentage
Agricultural Easement	495.7	14.3
Open Space and Parks	355.4	10.3
Forest Conservation Easement	68.3	2.0
Water Resource Easement	0	0
Floodplain Easement	0	0
Total	**919.4**	**26.5**

1. Rural Legacy Program

Maryland's Rural Legacy Program was created in 1997 to protect large, continuous tracts of land from sprawl development and to enhance natural resources, agricultural, forestry and environmental protection through cooperative efforts among state and local governments and land trusts. http://www.dnr.state.md.us/land/rurallegacy/index.asp

The goals of the rural legacy program are:

- Establish greenbelts of forests and farms around rural communities in order to preserve their cultural heritage and sense of place;
- Preserve critical habitat for native plant and wildlife species;
- Support natural resource economies such as farming, forestry, tourism and outdoor recreation; and
- Protect riparian forests, wetlands, and greenways to buffer the Chesapeake Bay and its tributaries from pollution run-off.

The Conewago Creek Watershed is sandwiched between the Little Pipe Creek Rural Legacy Area to the west, and the Patapsco Rural Legacy Area South to the east. Conewago Creek Watershed is not affected by the Rural Legacy Program.

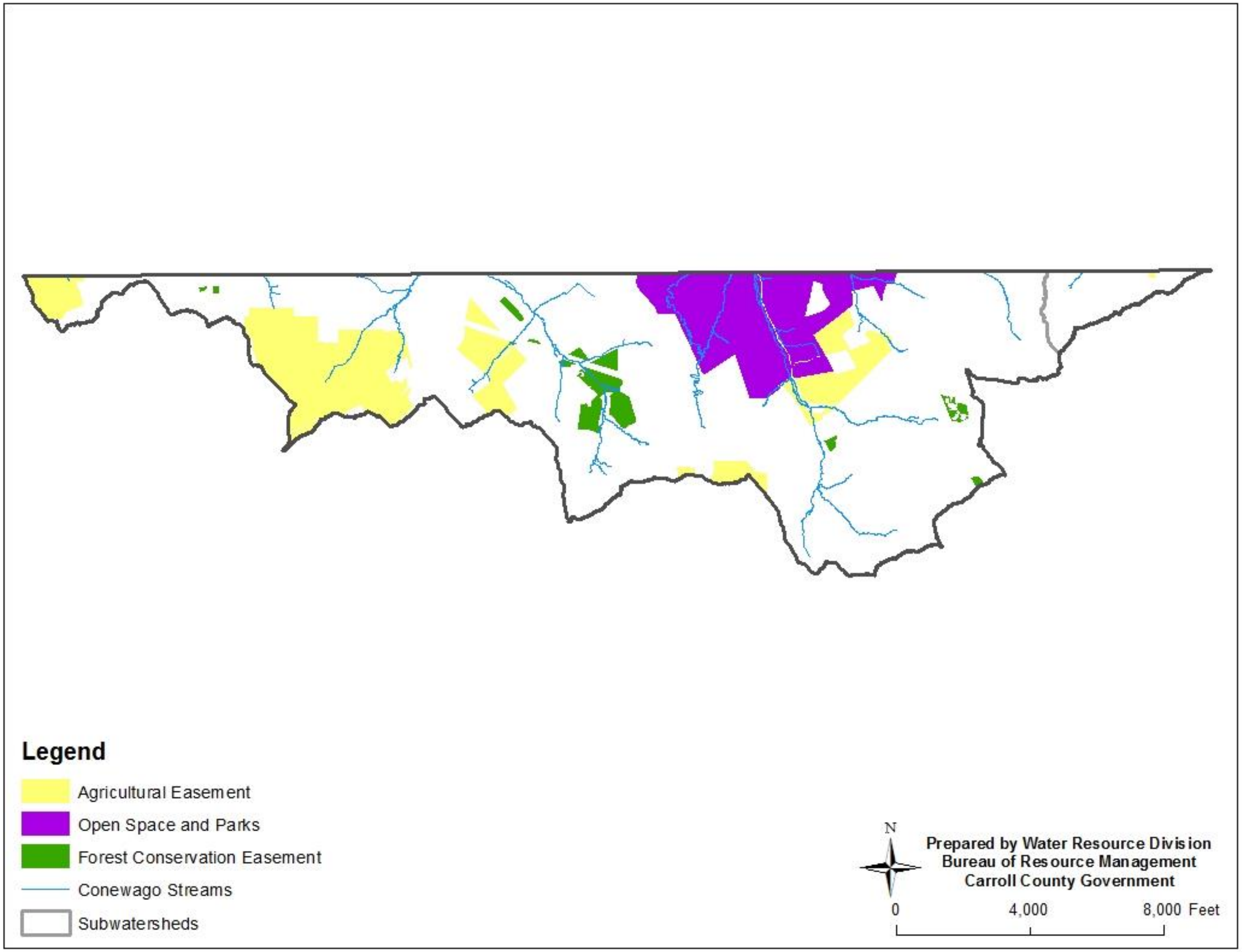

Figure 3-5: Conewago Creek Watershed Protected Lands

J. Agricultural Best Management Practices

Agricultural BMPs are ground management practices that help minimize runoff and movement of pollutants into waterways. Agricultural BMPs can be categorized as soft BMP's such as streambank fencing and cover cropping, or hard BMP's like heavy use areas and waste storage structures. Appendix A lists the agricultural BMPs located in the Conewago Creek Watershed, and provides a detailed explanation of the types of practices used throughout Carroll County. Figure 3-6 shows the locations of agricultural BMPs within the Conewago Creek Watershed; each location may have several agricultural BMPs in place.

1. Farm Plan Acres

Farm conservation and nutrient management plans consist of a combination of agronomic, engineered, and management practices that protect and properly utilize the natural resources found on the operation in order to prevent deterioration of the surrounding soil and water. A conservation plan is written for each individual operation and dictates what management practices are necessary to protect and improve soil and water quality. A nutrient management plan is a plan written for the operator to manage the amount, timing, and placement of nutrients in order to minimize nutrient loss to the surrounding waterbodies while maintaining optimum fertilization for crop yield. The Conewago Creek Watershed has approximately 1,440 acres of agricultural land in farm management plans and 0 acres of agricultural land in comprehensive nutrient management plans.

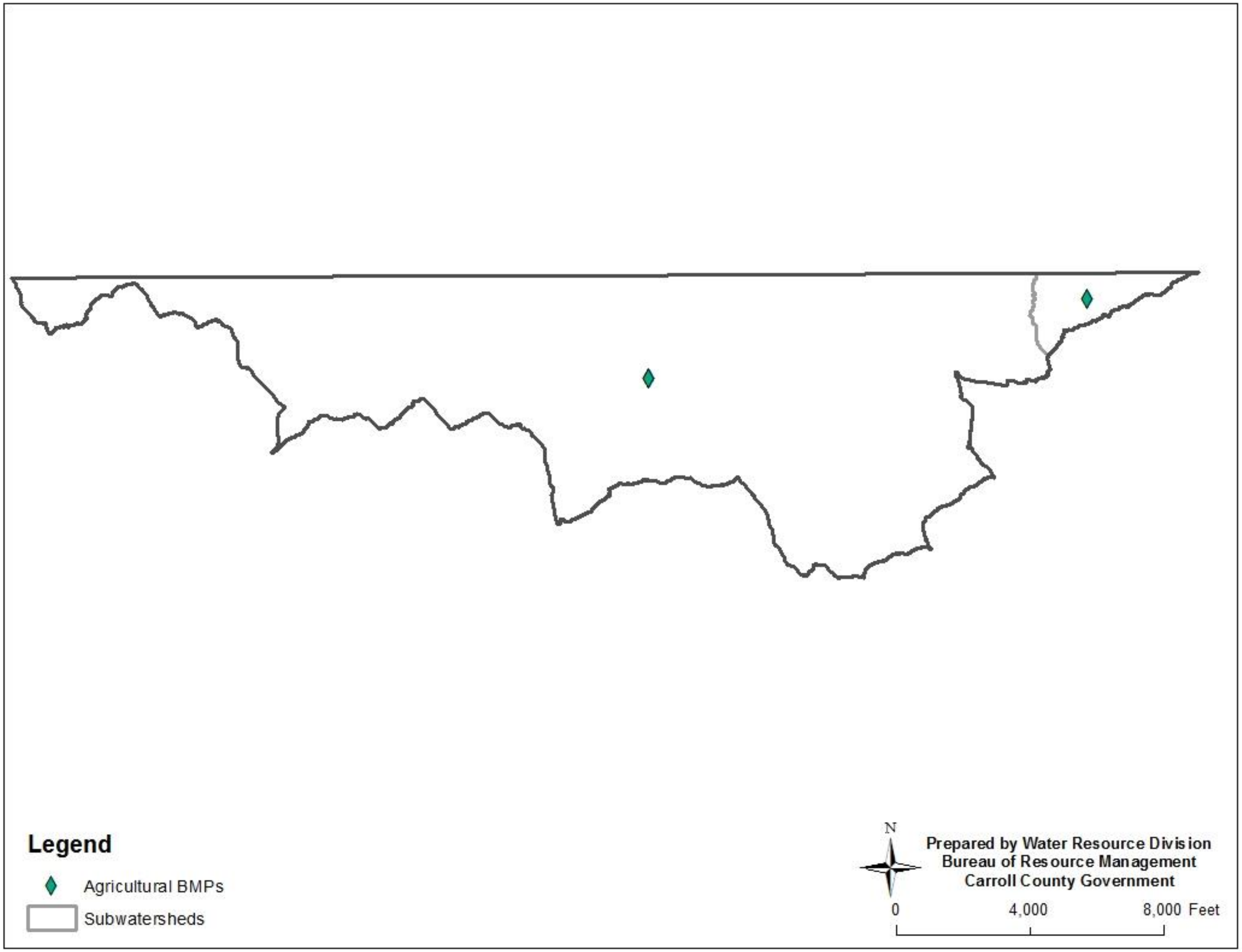

Figure 3-6: Conewago Creek Watershed Agricultural BMP Locations

IV. Water Quality

A. Introduction

Maryland water quality standards have been adopted from the Federal Clean Water Act, Section 101, "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters". Individual standards are established to support beneficial use of waterbodies such as fishing, aquatic life, drinking water supply, boating, water contact recreation and protection for terrestrial wildlife. Local monitoring allows for documenting the status of local waterbodies and where restoration or mitigation may be needed. This chapter will look at the designated uses within Conewago Creek Watershed, current water quality impairments that have been assigned and existing water quality data within the watershed. Water quality data is utilized along with identified impairments from the stream corridor assessment (Chapter 5) to prioritize preservation and restoration.

B. Designated Uses

All bodies of water, including streams within Maryland and all other states, are each assigned a designated use. Maryland's designated water uses are identified in the Code of Maryland Regulations (COMAR) 26.08.02.08. The designated use of a water body refers to its anticipated use and any protections necessary to sustain aquatic life. Water quality standards refer to the criteria required to meet the designated use of a water body. A listing of Maryland's designated water uses are as follows:

- Use I: Water contact recreation, and protection of nontidal warm water aquatic life.
- Use II: Support of estuarine and marine aquatic life and shellfish harvesting (not all subcategories apply to each tidal water segment)
    - Shellfish harvesting subcategory
    - Seasonal migratory fish spawning and nursery subcategory (Chesapeake Bay only)
    - Seasonal shallow-water submerged aquatic vegetation subcategory (Chesapeake Bay only)
    - Open-water fish and shellfish subcategory (Chesapeake Bay only)
    - Seasonal deep-water fish and shellfish subcategory (Chesapeake Bay only)
    - Seasonal deep-channel refuge use (Chesapeake Bay only)
- Use III: Nontidal cold water – usually considered natural trout waters
- Use IV: Recreational trout waters – waters are stocked with trout

If the letter "P" follows the use class listing, that particular stream has been designated as a public water supply.

The Conewago Creek Watershed contains all Use I-P waters, which allow for water contact recreation, protection of aquatic life and public water supply. Use I-P waters designated use includes growth and propagation of non-trout fish and other aquatic life, contact water sports, fishing and water supply for agriculture and industrial use as well as the public. Use IV-P waters, for recreational trout, surround Conewago Creek Watershed to the west and the south.

C. Tier II Waters

States are required by the federal Clean Water Act to develop policies, guidance, and implementation procedures to protect and maintain existing high quality waters and prevent them from degrading to the minimum allowable water quality. Tier II waters have chemical or biological characteristics that are significantly better than the minimum water quality requirements. All Tier II designations in Maryland are based on having healthy biological communities of fish and aquatic insects. There are no Tier II designated stream segments for the Conewago Creek watershed.

D. Total Maximum Daily Loads

Streams and other waterbodies that are unable to meet their designated use as defined by the COMAR are known as impaired waters. Impaired waters are placed on the 303(d) list, which is a section of the Clean Water Act that tracks impaired and threatened waterbodies.

The MDE uses the 303(d) list of impaired waters to establish TMDL's. A TMDL establishes the maximum amount of a pollutant or stressor that a waterbody can assimilate and still meet water quality standards for its designated use. Each TMDL addresses a single pollutant, whereas one waterbody may have multiple TMDL's. TMDL's are calculated by adding the sum of the allowed pollutant loads for point sources, non-point sources, projected growth, with a margin of safety built in. Load allocations are calculated through the use of watershed modeling using existing and historical data collected in the field.

More information on TMDL's and the 303(d) list can be found at:
http://www.mde.maryland.gov/programs/Water/TMDL/Pages/Programs/WaterPrograms/tmdl/index.aspx

1. Current Impairments

There are current nutrient impairments within the Conewago Creek Watershed; however there is no assigned TMDL for the watershed at this point.

E. Water Quality Data

Water quality data within the Conewago Creek Watershed has been collected and monitored throughout the years by varying agencies with different program goals. This section will focus on the current monitoring being performed by Carroll County, as well as monitoring results from DNR's MBSS program.

1. Current Monitoring

The County's current monitoring strategy is focused primarily around retrofit locations where reductions in loadings can be documented from the before and after study approach. The Bureau of Resource Management does not currently have a monitoring location in the Conewago Creek Watershed.

2. Maryland Biological Stream Survey

The Maryland biological stream survey (MBSS) was started by the DNR in 1993 and expanded statewide in 1994 to characterize the health of Maryland's 10,000+ miles of freshwater streams. The MBSS was Maryland's first stream sampling program intended to provide unbiased estimates of stream conditions. Data is collected at each site on the physical, chemical, and biological characteristics, and then combined into an overall assessment. In this chapter we will discuss the chemical data of the MBSS, and in Chapter 5 we will focus on the biological data of the MBSS. The MBSS goal is to provide the best possible information for the protection and restoration of Maryland's stream ecological resources. The MBSS's objectives to help meet this goal include:

- Assess the current condition of ecological resources in Maryland's streams and rivers;
- Identify the impacts of acidic deposition, climate change, and other stressors on ecological resources in Maryland's streams and rivers;
- Provide an inventory of biodiversity in Maryland's streams;
- Assess the efficacy of stream restoration and conservation efforts to stream ecological resources;
- Continue to build a long-term database and document changes over time in Maryland's stream ecological condition and biodiversity status; and
- Communicate results to the scientific community, the public, and policy makers.

a. Maryland's DNR Results

The DNR has conducted four rounds of MBSS: Round 1 in 1995-1997, Round 2 in 2000-2004 and Round 3 in 2005-2009, a targeted sampling in 2011 and Round 4 began in 2014. Each Round surveyed random and targeted stream reaches from first through fourth order streams. As the MBSS program has progressed, it has shifted to include more targeted sampling focused on a wide range of other program objectives such as TMDL and watershed delineation needs. Information on MBSS site surveys throughout the State can be seen here:
http://www.streamhealth.maryland.gov/map.asp.

Site locations for the DNR MBSS are shown in Figure 4-1.

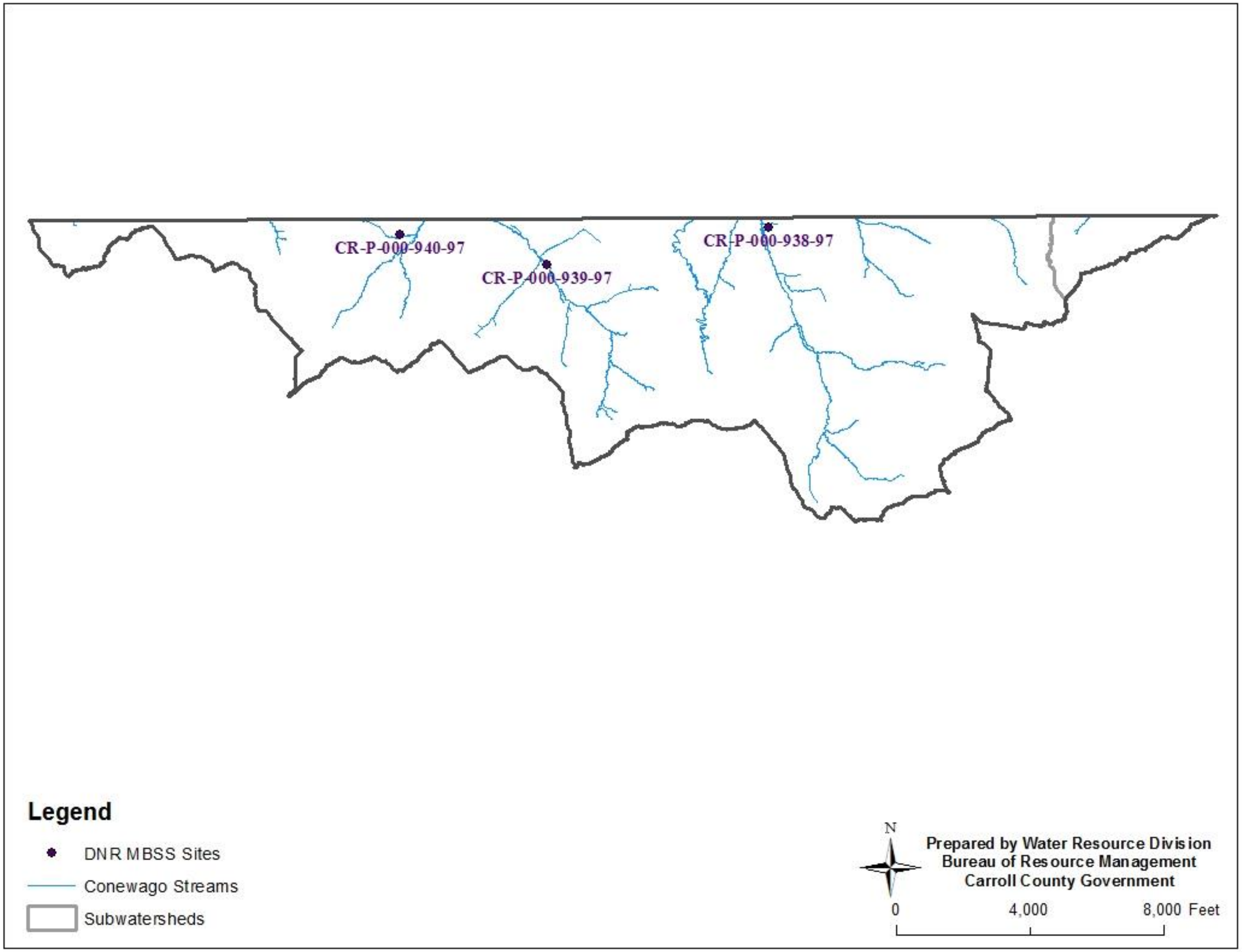

Figure 4-1: Conewago Creek Watershed DNR MBSS Locations

The chemical characteristics of a water body influence stream health impacting the habitat and biota. Stream acidification is known to have detrimental effects on aquatic animals. High acidity environments can affect animals' physiological functions, and influences the availability and toxicity of metals to aquatic animals. All streams contain a background level of nitrogen that is essential to the survival of the plants and animals in that stream; however the amount of nitrogen in many streams has increased as a result of anthropogenic influences. Agricultural runoff, wastewater discharge, and nonpoint sources are common culprits leading to an increased nitrogen load. Elevated levels of phosphorus in Maryland waters are usually associated with agricultural impacts. Elevated nitrogen and phosphorus concentrations can cause nutrient enrichment in aquatic systems which lead to decreased amounts of dissolved oxygen. Continued exposure to low dissolved oxygen environments can suffocate biota or lead to reduced spawning success. The COMAR states that dissolved oxygen concentrations greater than 5 mg/l are the standard and a level generally considered healthy for aquatic life. Increased nutrient loads are also linked toxic algal blooms. Conductivity is a measure of the ability of water to pass an electrical current, as affected by inorganic dissolved solids. Organic compounds like oil and phenol do not conduct electrical current very well and therefore have a low conductivity when in water. Discharges to streams can change the conductivity depending on the pollutant. A failing sewage system would raise the conductivity because of the presence of chloride, phosphate, and nitrate while an oil spill would lower the conductivity.

The chemical results obtained during DNR's MBSS sampling are listed in Table 4-1 and summarized in Table 4-2. Data included in this document were provided by the Maryland Department of Natural Resources Monitoring and Non-tidal Assessment Division.

Table 4-1: Conewago Creek Watershed DNR's MBSS Chemical Results

12-Digit Scale	**Subwatershed**	**Field pH**	**Temperature (°C)**	**Dissolved Oxygen**	**Conductivity**
Site Identification	Stream Segment				
020503010289	**Conewago Creek**				
CR-P-000-938-97	Conewago Creek Unnamed Tributary	6.94	17.2	7.8	138
CR-P-000-939-97	Conewago Creek Unnamed Tributary	6.28	17.6	8.8	173
CR-P-000-940-97	Conewago Creek Unnamed Tributary	6.51	21.3	8	158

Table 4-2: Conewago Creek Watershed DNR's MBSS Chemical Results Summary

	Field pH	**Temperature (°C)**	**Dissolved Oxygen**	**Conductivity**
Maximum	6.94	21.30	8.80	173.00
Minimum	6.28	17.20	7.80	138.00
Average	6.58	18.70	8.20	156.33

The Conewago Creek Watershed DNR MBSS data demonstrates there is sufficient dissolved oxygen to adequately support aquatic life. The dissolved oxygen level measured during the DNR MBSS sampling event averaged to 8.20 mg/l, which is greater than the COMAR standard of 5.0 mg/l, a level generally considered healthy for aquatic life. The water temperature was below 20°C, averaging in at 18.70°C in the watershed. Stream waters below 20°C are generally considered optimal for fish and most other aquatic benthos. The pH of the water was relatively neutral but slightly acidic, at 6.58.

V. Living Resources

A. Introduction

Living resources is the basic knowledge about how living things function and interact with one another and their environment. Water is an integral component of the habitat of all species. Living resources require water to survive, and will respond to changes not only in water availability but water quality as well. These responses allow us to gain a better understanding of how watershed conditions can have an effect on living habitats, and determine whether or not current water management practices are adequately providing for the needs of the natural communities. This Chapter will focus on the aquatic biology within the Conewago Creek Watershed, including any RTE species that may be present within the watershed.

B. Aquatic Biology

A number of programs and agencies regularly collect biological data from streams, including the DNR fisheries program in conjunction with MBSS, as well as individual efforts within the County. Biological indicators such as fish and benthic invertebrates are used to study watershed health. Metrics such as species diversity, percent abundance of pollution-sensitive or pollution-indicative organisms, and total organism abundance are used to determine if the benthic community shows signs of stress. Signs of stress in the watershed include poor species diversity, large abundances of a few organisms, and presence of pollution-tolerant organisms.

Signs of biological impairment are indicative of an environmental stressor within the watershed. Such stressors can be natural or anthropogenic in nature; and further analyses need to be conducted to determine the potential cause of environmental stress. Additional analyses to habitat, water quality and land use can help in finding indications of specific biological stressors or pollutants.

Biological data has become a critical component in assessing water quality, and has been incorporated into the Maryland water quality standards. The Biological Water Quality Standard states:

26.08.02.03-4 Biological Water Quality Criteria
A. Quantitative assessments of Biological communities in streams (biological criteria) may be used separately or in conjunction with the chemical and physical criteria promulgated in this chapter to assess whether water quality is consistent with purposes and uses in Regulations .01 and .02 of this chapter.
B. The results of the quantitative assessments of biological communities shall be used for purposes of water quality assessment, including, but not limited to, those assessments required by §§ 303(d) and 305 (b) of the federal Clean Water Act (33 U.S.C. §§ 1313 (d) and 1315(b)).
C. These assessments shall use documented methods that have been subject to technical review, produce consistent and repeatable results, and are objectively interpretable.
D. In using biological criteria to determine whether aquatic life uses are being met, the Department shall allow for the uncertainty and natural variability in environmental monitoring results by using established quantitative and statistical methodologies to establish the appropriate level of uncertainty for these determinations.

E. The Department shall determine whether the application and interpretation of the assessment method are appropriate. In those instances where the Department determines the assessment method is not appropriate, it will provide its justification for that determination.

1. Index of Biotic Integrity

The biological aspects of the MBSS include fish index of biotic integrity (IBI) and benthic IBI. The fish IBI is a quantitative rating of the health of the fish assemblage found at each site. Scores range from 1 (very poor) to 5 (good). No fish IBI were calculated for sites with a catchment area less than 300 acres. The benthic IBI scores are similar, but focus on benthic macroinvertebrates collected in the stream segment. The scores rate how the stream segments compare to reference streams that are considered minimally impacted. Low scores indicate significant deviation from reference conditions, indicating severe degradation; while high scores indicate the segment is comparable to reference streams and are minimally impacted.

a. Maryland's DNR Results

Locations of the specific sites sampled can be seen in Figure 4-1. Data included in this document were provided by the Maryland Department of Natural Resources Monitoring and Non-tidal Assessment Division and did not include FIBI or BIBI data.

C. Sensitive Species

Sensitive species are those plants and animals that are among the rarest in Maryland and most in need of conservation efforts. These species are at the greatest risk of local extinction, and are generally the most sensitive to environmental degradation.

1. Rare, Threatened and Endangered Species

Rare, threatened and endangered species are those plants and animals that are the most at risk to maintain healthy populations. For watershed restoration purposes, it is important to know and account for the habitats of such sensitive species. Protecting and expanding these habitats help to preserve biodiversity and is a critical component in successfully restoring a watershed. The DNR's Wildlife and Heritage Program identifies important areas for sensitive species conservation known as stronghold watersheds. Stronghold watersheds are the places where RTE species have the highest abundance of natural communities. Within the Conewago Creek Watershed the south eastern portion is identified as having sensitive state-listed species; and special protection is necessary to ensure the persistence of these communities. There is also approximately 902 acres of targeted ecological areas within the Conewago Creek watershed. Targeted ecological areas are a limited number of areas that rank exceptionally high for ecological criteria and that have a practical potential for preservation. A complete list of all rare, threatened, and endangered plants and animals within Carroll County and throughout the state of Maryland can be found at: http://www.dnr.state.md.us/wildlife/espaa.asp.

Figure 5-1 shows targeted ecological areas for sensitive species within the Conewago Creek Watershed. Sensitive species areas where designated by the DNR.

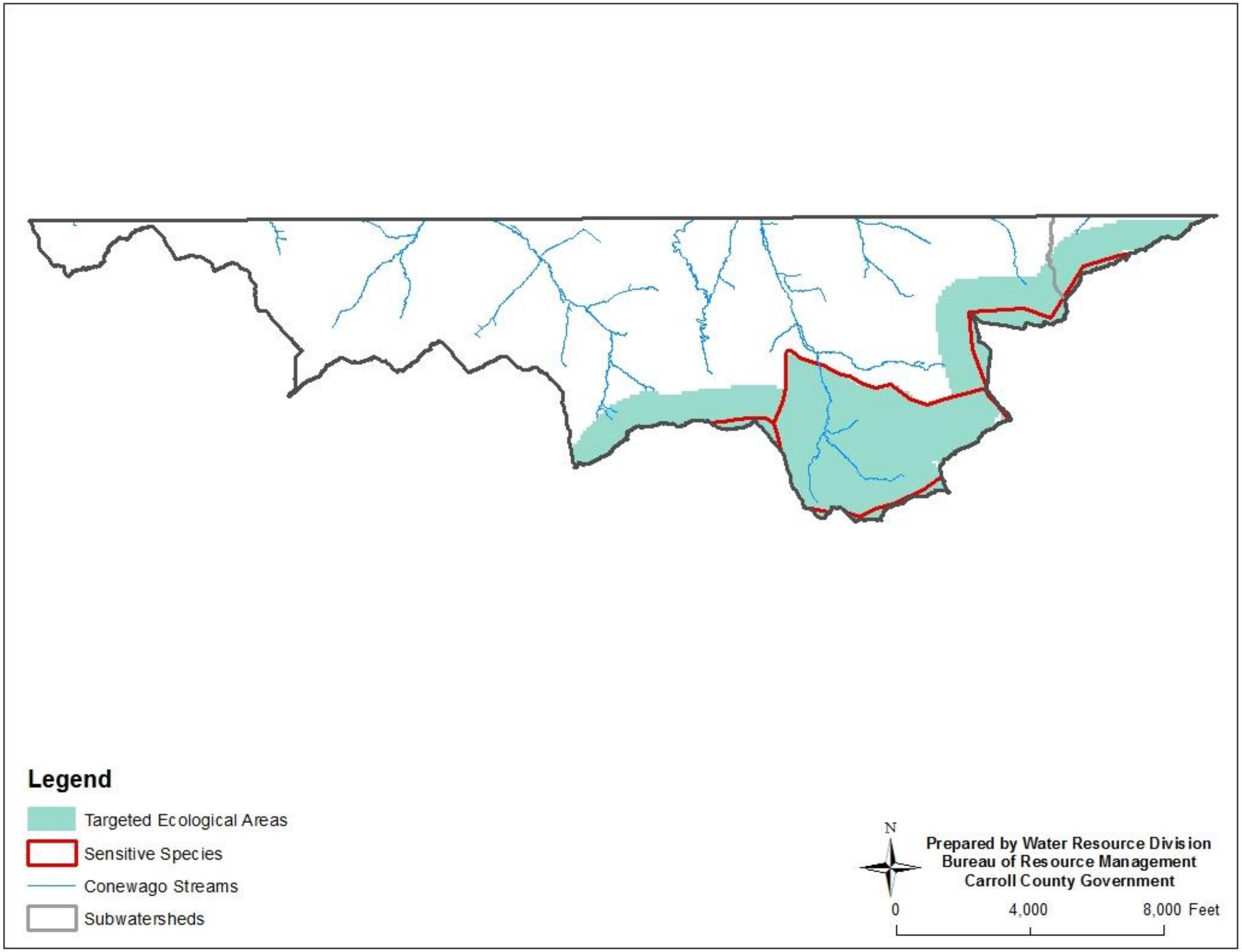

Figure 5-1: Conewago Creek Watershed Targeted Ecological Areas

D. Stream Corridor Assessment

A Stream Corridor Assessment (SCA) of the Conewago Creek Watershed was conducted during the winter of 2014 by Carroll County Bureau of Resource Management staff. The Conewago Creek SCA was based on protocols developed by the Maryland Department of Natural Resources watershed restoration division (Yetman, 2001). The goal of this assessment was to identify and rank current impairments within the watershed to assist in prioritizing locations for restoration implementation.

This assessment reached out to 70 landowners within the Conewago Creek Watershed whose property is intersected by a stream corridor. Landowner permission was obtained through a mailing that detailed the assessment, permission results can be found in Figure 5-2. A response card was also included for the landowner to send back with their permission response. Only properties with owner permission were assessed. Access was granted for approximately 13 of the 17 stream miles, or 73%, within the Conewago Creek Watershed.

The most common impairments identified during the assessment are shown in Figure 5-3, and consisted primarily of inadequate streamside buffers as well as fish barriers. Table 5-1 lists the data points by severity across the entire watershed.

Table 5-1: Stream Corridor Assessment – Identified Impacts

Identified Impacts	Total	Very Severe	Severe	Moderate	Low	Minor
Erosion	**9**		1	2	2	4
Inadequate Buffer	**12**		1	5	2	4
Pipe Outfall	**3**				3	
Fish Barrier	**12**	1	3	3	3	2
Total	**36**	**1**	**5**	**10**	**10**	**10**

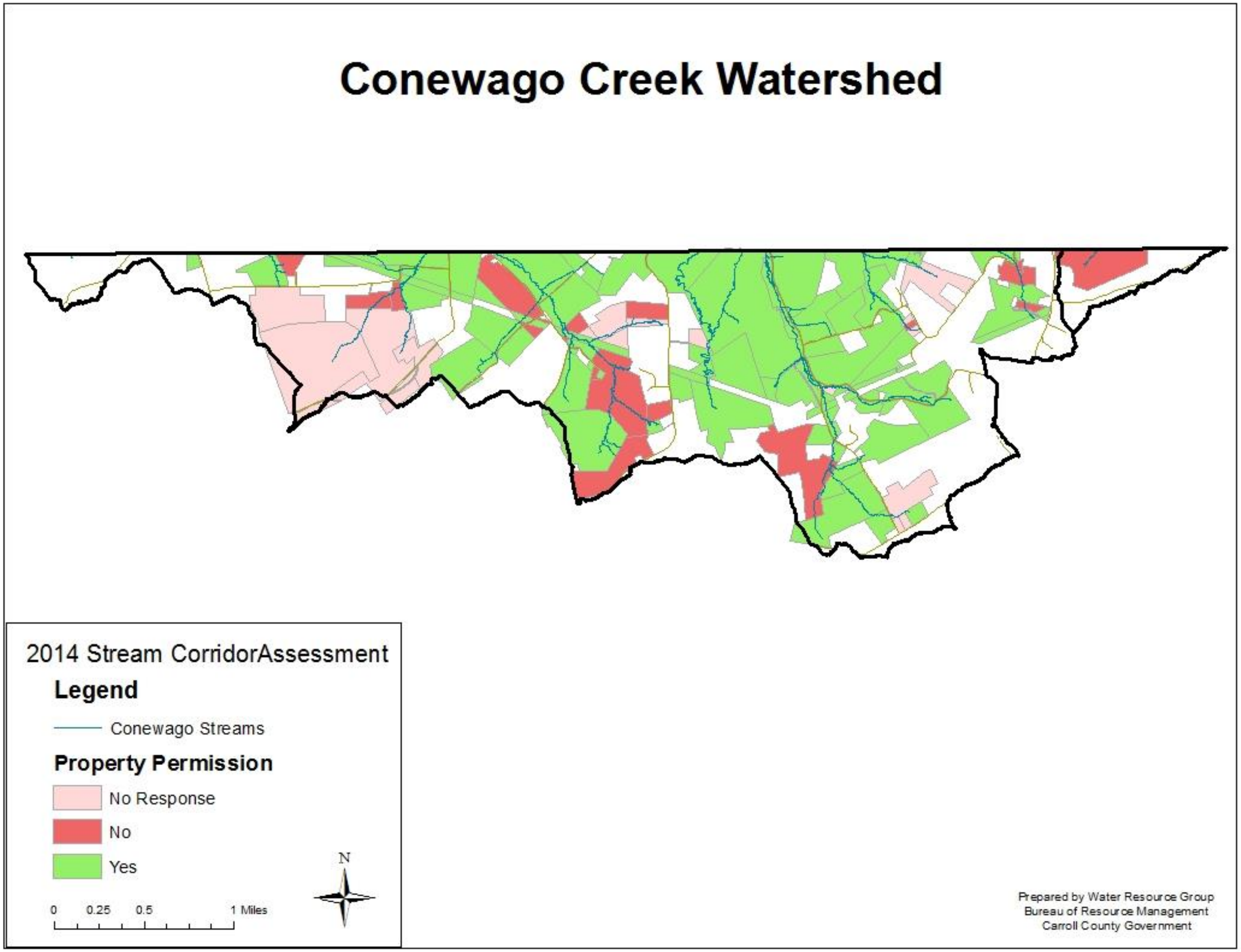

Figure 5-2: SCA Landowner Participation

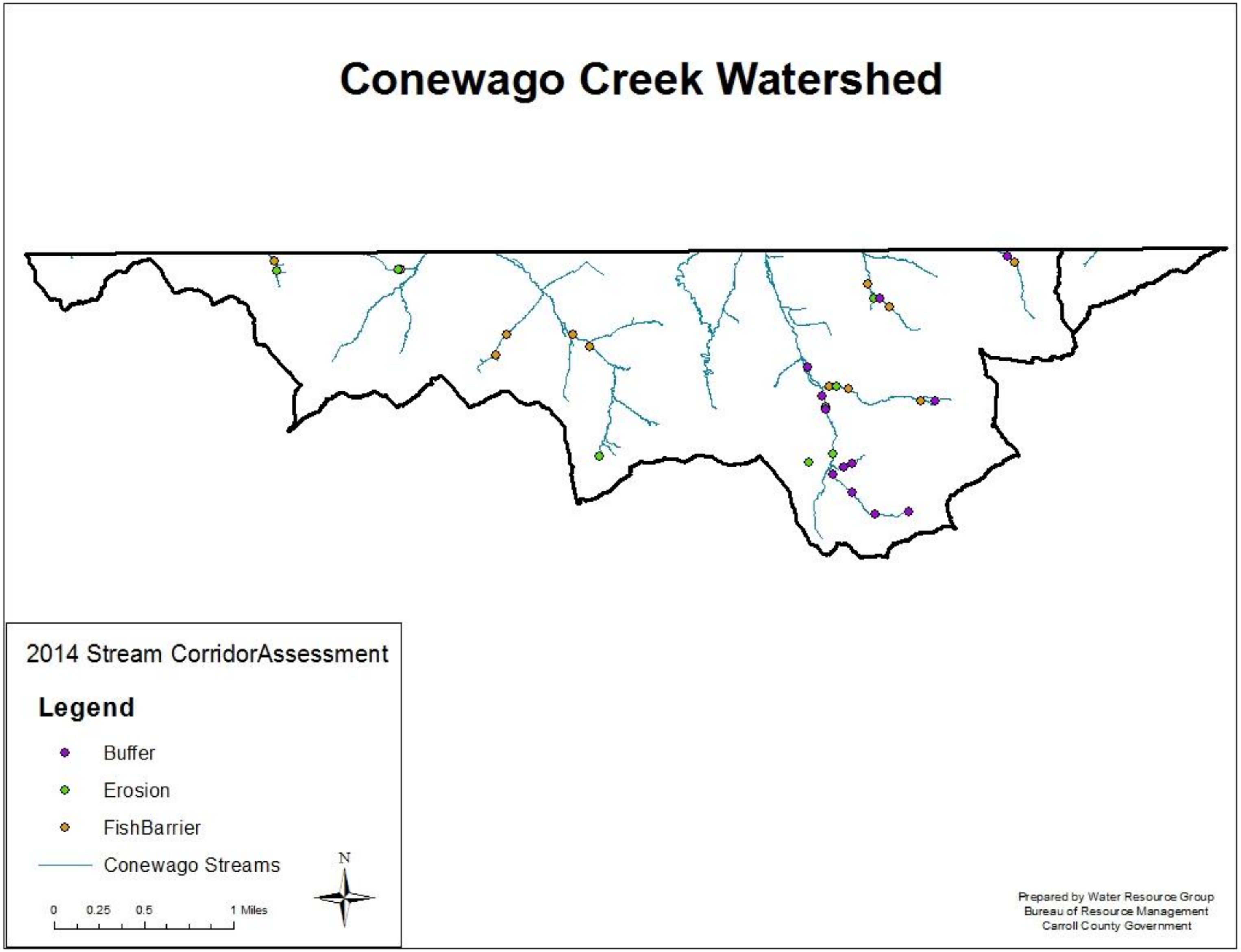

Figure 5-3: Most Commonly Identified Impacts

The most common problem identified through the stream corridor assessment was inadequate stream side buffers. Buffer areas were identified as inadequate for 1.2 miles, or less than 10% of the streams assessed, with 7% of the entire watershed classified as having inadequate buffers. 7 of the sites identified the stream as unshaded, and livestock was noted to be present at 5 different sites. Of the 12 sites identified, none had been recently planted. Approximately a quarter mile of streams were noted to have an erosion problem, primarily caused by bends at steep slope. Most were noted as low to minor impacted downcuts.

VI. Characterization Summary

A. Summary

This Characterization Plan was developed to describe the unique background of the Conewago Creek Watershed. The contents and data presented in this plan will be used by the Carroll County Bureau of Resource Management to develop a Watershed Restoration Plan that will lay out the Bureau's goals for addressing environmental impacts within the watershed. The purpose of the Watershed Restoration Plan will be to focus on identified impacts discovered during stream corridor assessments and to prioritize projects at a subwatershed scale based on the water quality data collected by the MDE as well as County staff initiatives. The Watershed Restoration Plan will also be used by the Bureau as a document to track project implementation in each subwatershed in order to track progress towards meeting applicable goals within the watershed.

B. Cost Summary

The following breakdown shows an approximate cost summary for the completion of the Conewago Creek Watershed stream corridor assessment, as well as the development of this Conewago Creek Watershed Characterization Plan.

Field Time: Assessment was completed over a span of 2 weeks; field crew averaged 3 days per week for a total of 6 field days.

Field Hours: Field crew averaged 4 hours/day over the 6 days for a total of 24 hours. Field crew varied from 2-3 people performing the assessment for a cumulative total of 60 field hours. Total cost of staff time in field was roughly $1,800 (120 hours at an average of $30/hour).

Plan Development: Watershed plan development took approximately 1 month ($3,350 staff time) and consisted of a full analysis of the stream corridor assessment as well as a complete characterization of the watershed.

Cost: Total estimated cost to complete the Prettyboy stream corridor assessment and the Watershed Characterization Plan was approximately $5,150.

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Appendix A: Agricultural Best Management Practices

Conewago Creek Watershed Agricultural Best Management Practices

Best Management Practice	Extent	Unit
362 - Diversion	180	FT
192 / 1923 – Farm Plan	1,440.1	AC
412 - Grassed Waterway	0.7	AC
329 - Residue and Tillage Mgmt, No Till	45.2	AC
391 - Riparian Forest Buffer	6.6	AC
728 - Stream Crossing	1	ST
382 – Fencing	1,540	FT
614 - Watering Facility	2	NO

Practices which are used by farmers to minimize soil loss, trap nutrients, and minimize the amounts of nutrients and pesticides used on the land. The following definitions related to best management practices used throughout Carroll County:

Access Control: The temporary or permanent exclusion of animals, people, vehicles, and/or equipment from an area.

Conservation Cover: Establishing and maintaining permanent vegetative cover to protect soil and water resources.

Conservation Cropping: Growing crops in a planned sequence on the same field.

Contour Farming: Tillage, planting, and other farming operations performed on or near the contour of the field slope.

Critical Area Planting: Planting vegetation, such as trees, shrubs, vines, grasses, or legumes on highly erodible or critically eroding areas.

Diversion: A diversion is an earthen embankment similar to a terrace that directs runoff water from a specific area.

Fencing: A constructed barrier to livestock, wildlife or people.

Filter Strip: A strip or area of herbaceous vegetation that removes contaminants from overland flow.

Forage and Biomass Planting: is the establishment of adapted and/or compatible species, varieties, or cultivars of herbaceous species suitable for pasture, hay, or biomass production

Forage Harvest Management: The cutting and removal of forages from the field as hay, greenchop, or ensilage.

Grassed Waterway: A natural or constructed channel that is shaped or graded to required dimensions and established with suitable vegetation.

Heavy Use Area: The stabilization of areas frequently and intensively used by people, animals or vehicles by establishing vegetative cover, surfacing with suitable materials, and/or installing needed structures.

Lined Waterway or Outlet: an erosion resistant lining of concrete, stone, or other permanent material. Vegetative or rock cover protects the drainageway from erosion.

Livestock Pipeline: A pipeline and appurtenances installed to convey water for livestock or wildlife. Provides a safe, reliable method of conveying water to a watering facility.

Mulch Till: Managing the amount, orientation, and distribution of crop and other plant residue on the soil surface year-round, while limiting the soil-disturbing activities used to grow crops in systems where the entire field surface is tilled prior to planting.

No-Till: Managing the amount, orientation, and distribution of crop and other plant residues on the soil surface year-round, while limiting soil disturbing activities to only those necessary to place nutrients, condition residue and plant crops.

Nutrient Management Plan: Managing the amount (rate), source, placement (method of application), and timing of plant nutrients and soil amendments for each field or management unit.

Pond: A water impoundment made by constructing a dam or an embankment or by excavating a pit or dugout.

Prescribed Grazing: Involves managing the harvest of vegetation with grazing and/or browsing animals to improves or maintain quantity and quality of forage for grazing and browsing animals' health and productivity.

Riparian Forest Buffer: An area of predominately trees and/or shrubs located adjacent to and up-gradient from water bodies.

Riparian Herbaceous Cover: Establishment and maintenance of grasses, grass-like plants and forbs that are tolerant of intermittent flooding or saturated soils and that are established or managed in the transitional zone between terrestrial and aquatic habitats.

Roof Runoff Management: Structures that collect, control, and transport precipitation from roofs.

Spring Development: Collection of water from springs or seeps to provide water for a conservation need.

Stream Crossing: A stabilized area or structure constructed across a stream to provide a travel way for people, livestock, equipment, or vehicles.

Subsurface Drain: A conduit, such as corrugated plastic tubing, tile, or pipe, installed beneath the ground surface to collect and/or convey drainage water.

Underground Outlet: A conduit or system of conduits installed beneath the surface of the ground to convey surface water to a suitable outlet.

Upland Wildlife Habitat Management: Creating, maintaining, or enhancing areas to provide food, cover and habitat connectivity for upland wildlife.

Waste Facility Closure: The closure of waste facilities (treatment lagoons and liquid storage facilities), that are no longer used for their intended purpose, in an environmentally safe manner.

Waste Storage Structure: A waste storage impoundment made by constructing an embankment and/or excavating a pit or dugout, or by fabricating a structure.

Wastewater Treatment Strip: An area of vegetation designed to remove sediment, organic matter, and other pollutants from wastewater.

Watering Facility: A watering trough or tank that provides livestock with drinking water at planned locations to protect vegetative cover.