Natural Resources Technical Supplement

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I. INTRODUCTION

Natural resources play a key role in Fauquier County's economy, land-use decisions, values, and quality of life. They take many forms ranging from agricultural soils, forest and mineral resources, healthy ecosystems, scenic attributes, open rural landscapes, biodiversity, recreational opportunities, to the water that sustains the county's communities and economy. Natural resources are not infinite, and they cannot be sustained without responsible management. Therefore, to conserve these resources and preserve the rural landscapes, natural resources management elements should be incorporated into Fauquier County's planning strategies.

The primary intent of this plan is to further the County's Vision, more specifically the Comprehensive Plan's Guiding Principle A, which states that "*the County's natural and cultural heritage are intrinsic to the County's character"* and Policies 1, 4, and 5 thereunder, which advocate that the County, "*preserve the County's cultural, ecological and environmental resources to ensure the continued quality of life within the County for its residents and visitors"* and "*use conservation easements, Purchase of Development Rights and the Land Use Taxation programs to protect these resources*" and "*safeguard the environment with water and air quality and natural resource management."*

A. Background

Since most natural resources do not recognize political boundaries, for the purpose of this plan, Fauquier County's natural resources issues will be analyzed, discussed and placed in the context of all of Fauquier County. However, the inclusion of the incorporated towns is largely for the purpose of context. This plan will not apply to these incorporated towns.

This plan identifies Fauquier County's most significant natural resource attributes, as well as outlines the various challenges in retaining these valuable assets so that they may be passed on to future generations. Natural resources of Fauquier County are not infinite, and they will not be sustained without responsible management. Therefore, to conserve these resources and preserve Fauquier County's rural landscapes, natural resources management elements shall be incorporated into Fauquier County's planning strategies.

The following eight elements were incorporated into this plan:

1) Provide a background and context to issues and critical challenges facing the county;
2) Outline a clear vision of near and distant future conditions;
3) Delineate clear goals and objectives that effectively link these actions to the established strategy and vision;
4) Establish a strategy for realizing this vision;
5) Provide a framework for implementation and incorporation into the planning and decision-making process;
6) Be organized in several subsections to enable the reader to easily locate topics of interest;
7) Be narrative-based, readable, and even educational; and
8) Be written in a way that people unfamiliar with the topic can make sense of even complex natural science topics.

B. Public Input and Plan Development

During the initial input phase, several orientations and public input meetings were held, and people were encouraged to complete a natural resource survey. One hundred people completed this survey. Questionnaire responders came mostly from northern portions of the County (40.4%); followed by Warrenton (20.2%), Southern County (11.1%), Outside Fauquier County (8.1%), "Rural Central" (7.1%), Bealeton (5.1%), New Baltimore (4.0%), Remington (3.0%) and Opal (1.0%). The majority (64.2%) lived and worked in the County, while 29.5% lived in the County but worked in other locations, and 6.3% worked in the County but lived outside. Lastly, the majority of responders claimed to "live on a farm" (52.2%); while 34.8% lived in rural settings, but not a farm; and 13.0% lived in a town or a Service District. Beyond this initial public input phase, there have been several other meetings, presentations, and other public input opportunities that were held and helped inform the development of this document.

II. VISION

In 2013, the Fauquier County Department of Community Development began gathering public input for the revision of the heritage and natural resources sections of the Comprehensive Plan. Public meetings and an online questionnaire provided residents across the County with the opportunity to define current natural resource issues, priorities, challenges and opportunities.

The input indicated that the dominant themes concerning County residents included: water quality protection (both rural and urban); the importance of natural resource integrity in Fauquier County's future; the importance of open spaces; the preference to integrate natural resource protection into farmland protection efforts; the need to participate in broader natural resource efforts and issues; the support for stream bank protection efforts; the desire not to be an urban environment; support for multi-faceted approaches to conservation efforts; and a strong role for the County to work in cooperation with, and in support of, related state and federal natural resource conservation efforts.

Vision Statement

Fauquier County's natural resources are integral to the County's identity, character, and sense of place. Both the renewable and non-renewable natural resources are essential to the cultural, environmental, social, and economic well-being of the County. Fauquier County government will work in partnership with its citizens, organizations, businesses, other Virginia municipalities, and state and federal agencies, to make natural resource and ecosystem conservation an essential strategy for maintaining quality of life, building a thriving local economy, creating jobs, and conserving natural resources. Fauquier County citizens will be empowered with a greater understanding of natural resource stewardship and planning tools as the County prepares for the future.

III. FAUQUIER COUNTY NATURAL RESOURCES, AN OVERVIEW

Although it is recognized that natural resources are complex systems that are integrally linked, for convenience sake, this plan will discuss then as distinct and separate resources; however, it should be understood that in the real world they are all interrelated and intertwined.

A. Topography

Most of Fauquier County consists of gently rolling ridges and plateaus generally trending from the southwest to northeast. The lowest elevation is located in the far southern tip of the County, at the confluence of Deep Run and the Rappahannock River. This is the point that the Rappahannock River flows out of the County. This highest elevation in the County is 2,205 feet. It is located on the County border located in the far northwest part of the County, not far off Freezeland Road. Therefore, the total elevation gain is 2,145 feet.

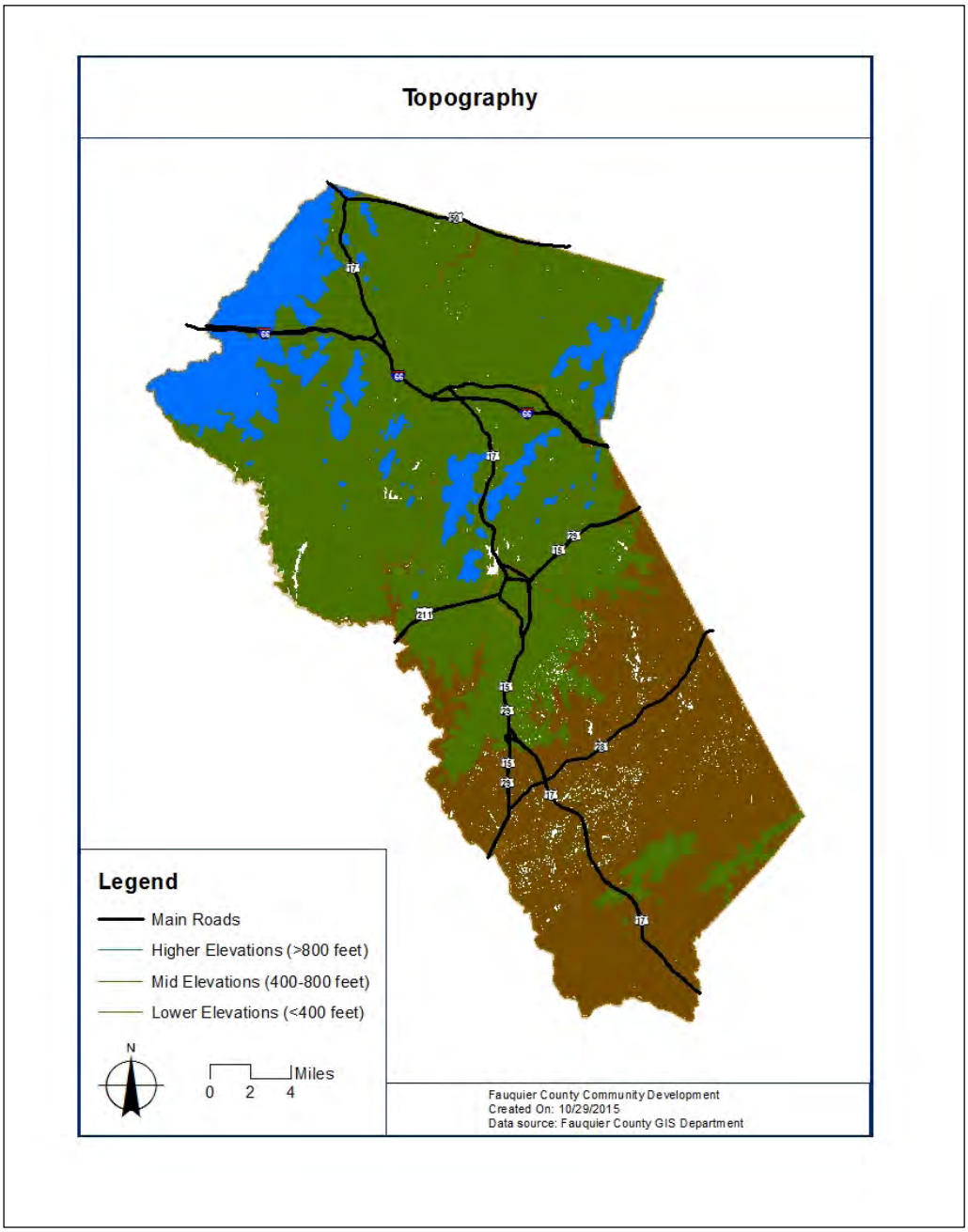

Figure 1 Generalized Fauquier County Topography

B. Geology and Mineralogy Resources

Geology usually influences, and oftentimes determines, a region's groundwater resources, vegetation cover, forest and agricultural productivity and economic vitality, the quantity and distribution of wastewater treatment facilities, land-use and development patterns, and human habitation. The importance of a region's geology cannot be overstated.

A physiographic province is a contiguous area that shares a common geologic history and underlying geologic resources, and surface topographic features and vegetation. The United States Geological Survey lists 25 physiographic provinces within the Lower 48 States. Fauquier County lies along the dividing line between two of these provinces, the Blue Ridge and the Piedmont Provinces. Further diversifying and complicating the region's geology is a series of basins known as the Triassic Basins. The Triassic Basins lie in a band of dispersed, non-contiguous units spread throughout the general Appalachian and Piedmont regions of the eastern United States. These basins were formed in the geologic time known as the Triassic period. The basins are not extensive nor are they sufficiently contiguous to be considered a separate physiographic province, but where they do appear they are distinctive from the surrounding bedrock geology and other physiographic attributes. A sizeable portion of one of these Triassic Basins, known as the Culpeper Basin, lies within Fauquier County. Although the Culpeper Basin is not recognized as an official separate physiographic province, for all practical purposes, Fauquier County's geology is divided into three separate units; from north to south they are: the Blue Ridge Province, the Culpeper Basin, and the Piedmont Province.

The old crystalline rocks of the Blue Ridge Province that have been uplifted are characterized by moderately steep folded and faulted igneous and metamorphic rocks. Cliffs and exposed rock bands are not uncommon. The Culpeper Basin is characterized by a nearly flat sediment-filled basin interspersed by a system of intrusions consisting of weather-resistant dikes. The Piedmont Province is characterized by gently-rolling igneous and metamorphic rocks buried beneath deep layers of biochemically weathered rocks.

The bedrock within Fauquier County's Piedmont and Blue Ridge regions has been highly folded and faulted, thereby producing a highly complex series of stress fractures. Structurally, the dominant stress feature in the County is the Border Fault. The Border Fault is the significant southwest-to-northeast trending fault that lies along the boundary of the Blue Ridge Province and the Culpeper Basin. The region's geology and geologic structural features has a direct impact on the County, as diverse as its economic and industrial opportunities, availability of potable water, building construction and wastewater treatment options, agricultural potential, and human safety and hazard potential considerations.

Fauquier County has a long history in mining for minerals or geologic resources. The determination of the economic viability of a geological or mineralogical resource is dependent upon a wide array of factors, such as the widely swinging nature of the commodity's price and demand, as well as technological advances, political stability and world events, transportation issues, environmental concerns, and market sustainability versus initial capital expenditures. However, over the

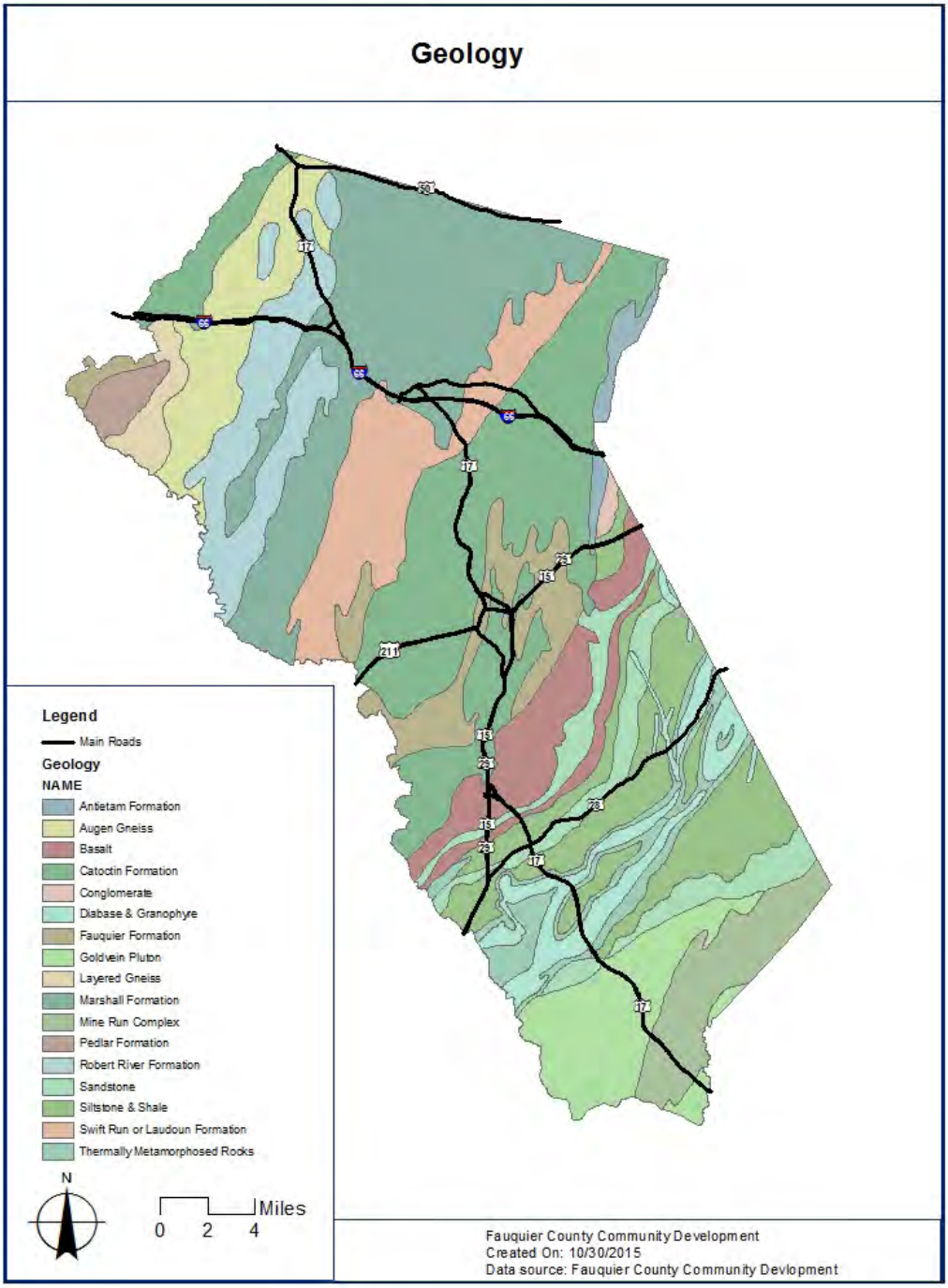

Figure 2 Fauquier County Geology

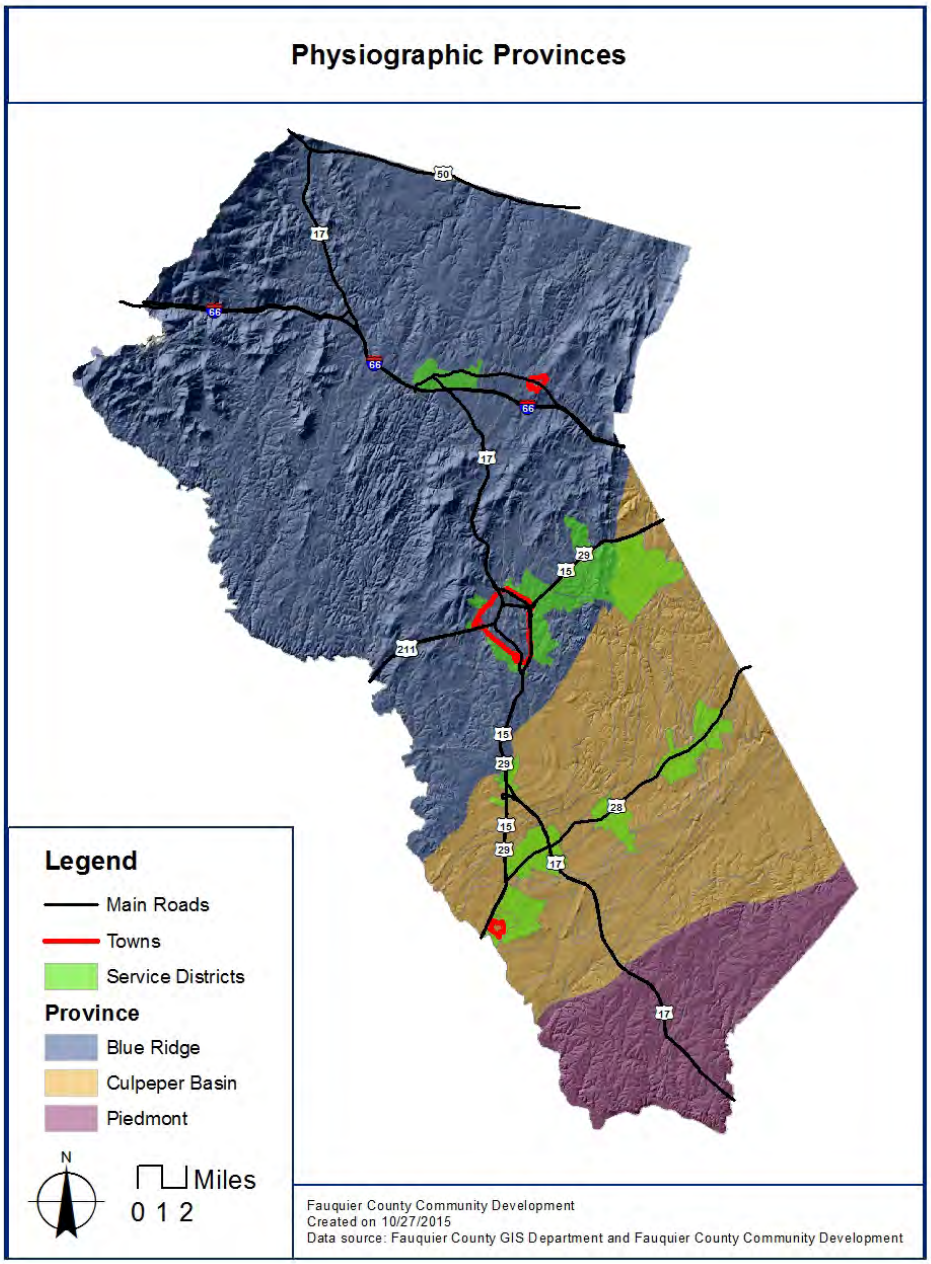

Figure 3 Physiographic Provinces of Fauquier County

years, the Fauquier County commodities which had been considered to be economically viable for extraction include: gold, shale, barite, clay, copper, uranium, dimension stone, quartzite, gravel, and crushed stone. Few of these industries are currently in operation; however, as the situations change, other commodities may become economically viable once again. A case in point involves uranium.

Due to potential environmental and health concerns, Virginia implemented a statewide ban on uranium mining in 1982 (Code of Virginia §45.1-283). Later in the 1980s, aerial radiometric data revealed the possibility of economically mineable uranium deposits located in three areas of the state, one of which was Fauquier County. This potential uranium deposit in Fauquier County is broken into several sub-areas, mostly centered in the Bealeton, Remington and Opal areas. Statewide efforts began to request this moratorium be lifted in order to pursue a few of these uranium deposits in other areas of the state, but the price of uranium dropped; therefore, the effort to lift the uranium ban was abandoned. Although these Fauquier County uranium leases have expired, if the statewide ban on uranium mining is lifted, these or other similar leases can by renewed. Perhaps a key factor affecting the issuance of new uranium leases, besides the price of uranium, is the degree of public support for continuing the ban. If the ban is rescinded, then the commercial extraction of this Fauquier County uranium deposit may be revisited in the near future.

Hydraulic fracturing, or "fracking," is an extraction process that involves injecting pressurized fluids into a geologic strata with the intent that this pressure would fracture the rock and release bound gases, such as natural gas, that could be captured and sold as a commodity. The majority of fracking occurs on deeply buried geologic units. There is currently an open debate, controversy, and much research focused on assessing the degree of impact that fracking may have on water quality, natural ecosystems, and the probability of increasing earthquakes. Fauquier County contains few, if any, of the geological units that so far have been the focus of fracking; however, there are some of these resources in adjacent counties and located within some of Fauquier County's watersheds.

There is always the potential that new technologies or world events may create a market for a commodity that no one previously considered economically viable before. Certain oil and gas or mineral resources may be present in Fauquier County but previous technologies and market prices may have prevented these resources from being exploited; however, new techniques, technologies, or processes may come along in the future that may make these resources economically viable in the future. These situations are unpredictable, but Fauquier County may benefit by the development of a broad framework to professionally manage these situations if they occur.

Fauquier County contained what was believed to be the first barite mine in the United States. Most of the barite mines in the County were located in the Catlett, Bristersburg, and Elk Run areas. Limited quantity and quality combined with persistent flooding conditions caused the last barite mine in the County to close in

1902. Remnants of these barite mining operations are still visible on the ground today.

Fauquier County also contained noteworthy historic copper mining operations in the Blue Ridge Copper District, within the Rappahannock River watershed in the far northwestern tip of the County. These Fauquier County copper mines operated from the mid-19th to the early 20th Century.

By far the most significant type of mine within the County has been related to the search for gold. In the 1800s, gold was mined at eighteen sites in the Goldvein, Morrisville and Sumerduck area. Of particular significance was the Franklin Mine which, from 1825 until the time of the Civil War, yielded over 1.2 million dollars of gold. At 300 feet deep, the Franklin Mine was the deepest mine within the County. In addition to these, there were many placer pits located in the County and there was much panning of gold within the Rappahannock River watershed.

Currently, the commercial extraction of geologic and mineral resources in the County is limited to the quarrying of dimension stone and crushed rock.

Mining can be an important and contributing factor in the County's economy. However, each mining industry with each specific proposal has the potential to impact negatively or positively, on a wide assortment of concerns in which the County would need to carefully weigh the merits of each proposal on a case by case basis in order to mitigate potential problems and maximize benefits. Such considerations must include, but not be limited to, the following issues and concerns: social and community concerns; economic considerations; environmental impacts such as surface and ground water contamination; land-use and zoning suitability and neighbor compatibility; quality of life concerns; utility usage and demands such as water and energy usage compared with current supply availability; transportation issues such as road and traffic impacts caused by slow and heavy vehicles, or human safety issues related to traffic accidents involving the transportation of toxic material; property access issues; and reclamation responsibilities to ensure the County is not saddled with future liabilities once the operation closes and the mine managers have moved on. Many of these industries would require state permitting and review, but state-level priorities do not always fully address Fauquier County needs and priorities.

C. Soil Resources

Deriving their characteristics from underlying bedrock and local climatic conditions, soils should be an integral component of the planning process, since they affect erosion characteristics, structural support for building foundations, and infiltration of sewer septic systems; in addition, soils form the basis for agricultural production, construction and economic development. For instance, development should be avoided on soils that contain steep slopes, poor drainage, and high shrink-swell potential. Development on soils that are less ideal may require special engineering measures that mitigate the consequences of this less than ideal soil condition. Development on soils with high shrink-swell potential is especially problematic, since it would require detailed geotechnical analysis and the potential need for special foundation design.

Agriculture is a significant component of the County's economy, a focus of the County's preservation goals, and a core sense of identity for many residents. In the adoption of land use plans, specific site designs, and preservation efforts, consideration has historically been made to the retention of prime agricultural soils. Prime agricultural soils consist of those soils which have been identified as Class 1, 2 or 3 by the Natural Resources Conservation Service. However, many of these prime agricultural soils are also located on gently sloping terrain, are well drained, have good drainfield potential, and are attractive sites for development. Without integrating and prioritizing the preservation and conservation of prime agricultural soils into the County's planning and review processes, then the retention of our agricultural and rural characteristics is left more to chance than design.

In non-designated growth areas of the County, the subdivision process requires the clustering of dwellings to preserve 85 percent of the aggregate in contiguous open space. This requirement benefits all non-designated growth areas including those areas which have prime agricultural soils. The County's Zoning Ordinance encourages the designation of this 85 percent to be configured to include prime agricultural soils, as well as other sensitive resources within these protected open space designations.

Currently, the County is not tracking the retention of its available Prime Agricultural Soils over time. Therefore, our ability to assess if we are attaining related goals is unknown.

Soils suitable for well-functioning septic systems/drainfields are sporadically distributed within Fauquier County. As a consequence, there are many poorly placed and poorly maintained drainfields. In many situations, suitable alternatives are cost prohibitive for typical landowners. This is believed to be a leading cause of some of Fauquier County's water quality problems. Some potential solutions include connecting more homes to community wastewater treatment facilities, and publicly-funded incentives for replacement, upgrades, cleaning support, or the funding of experimental designs. Many of these potential solutions may require additional public or private funds.

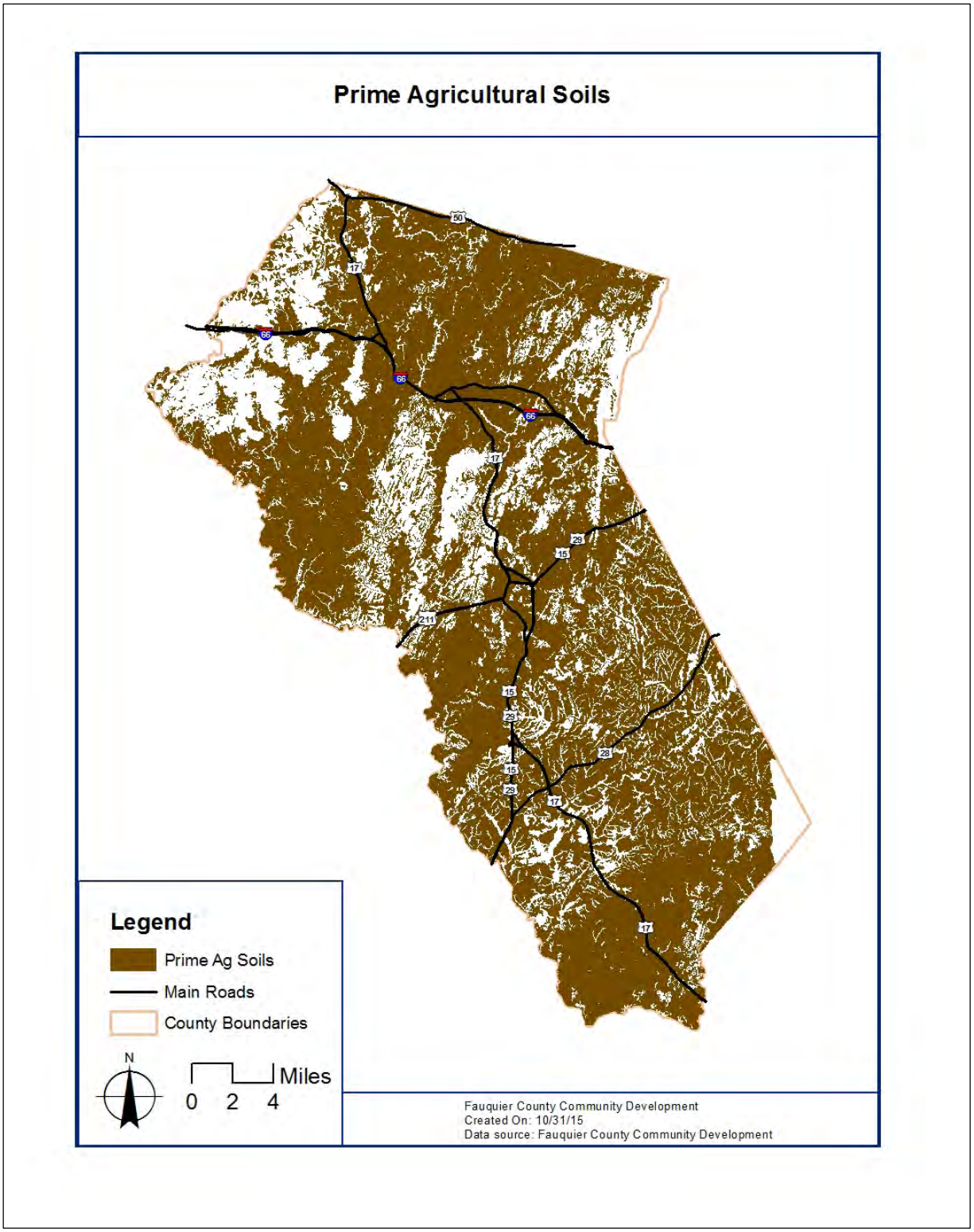

Figure 4 Prime Agricultural Soils

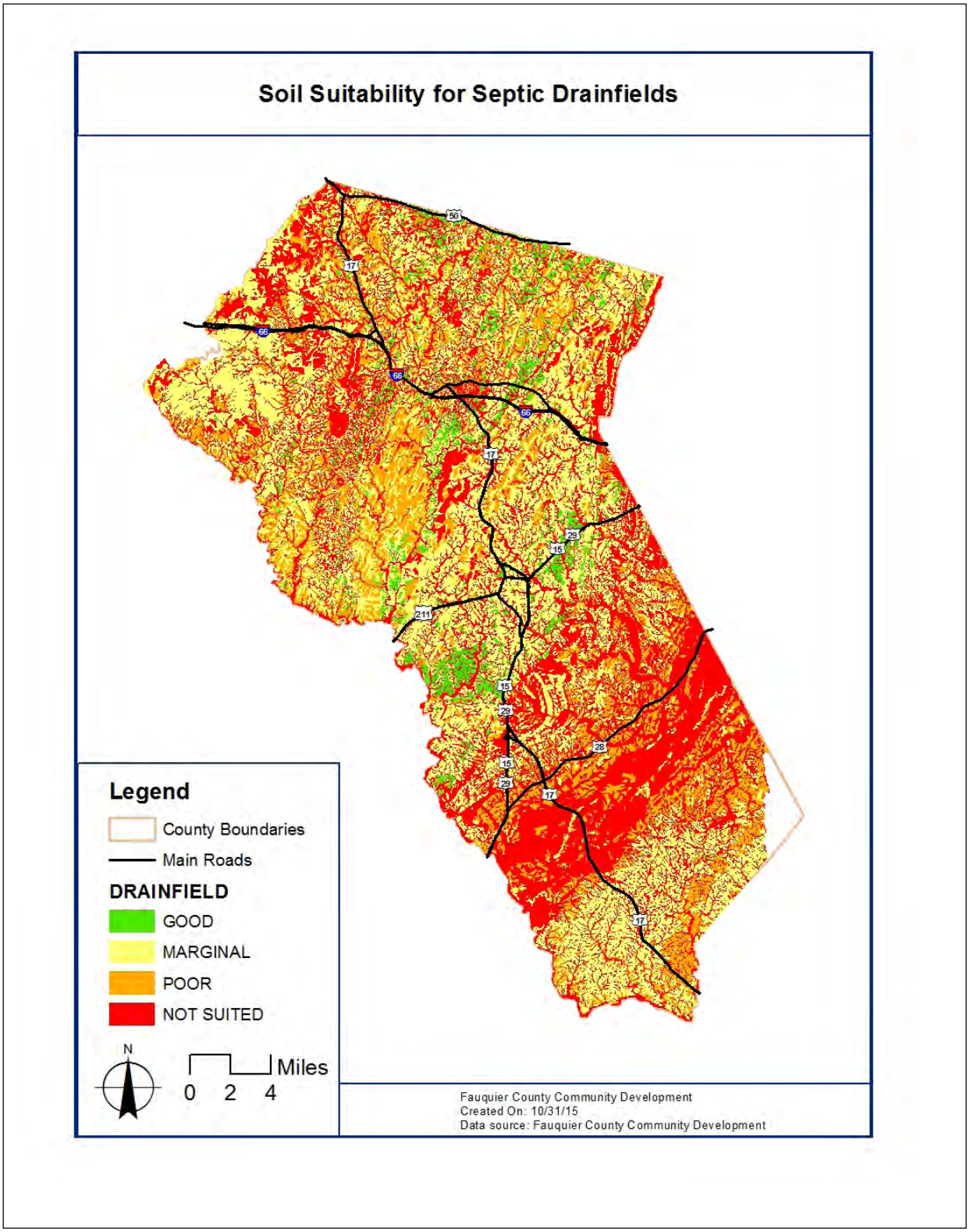

Figure 5 **Soils Suitability for Septic Systems**

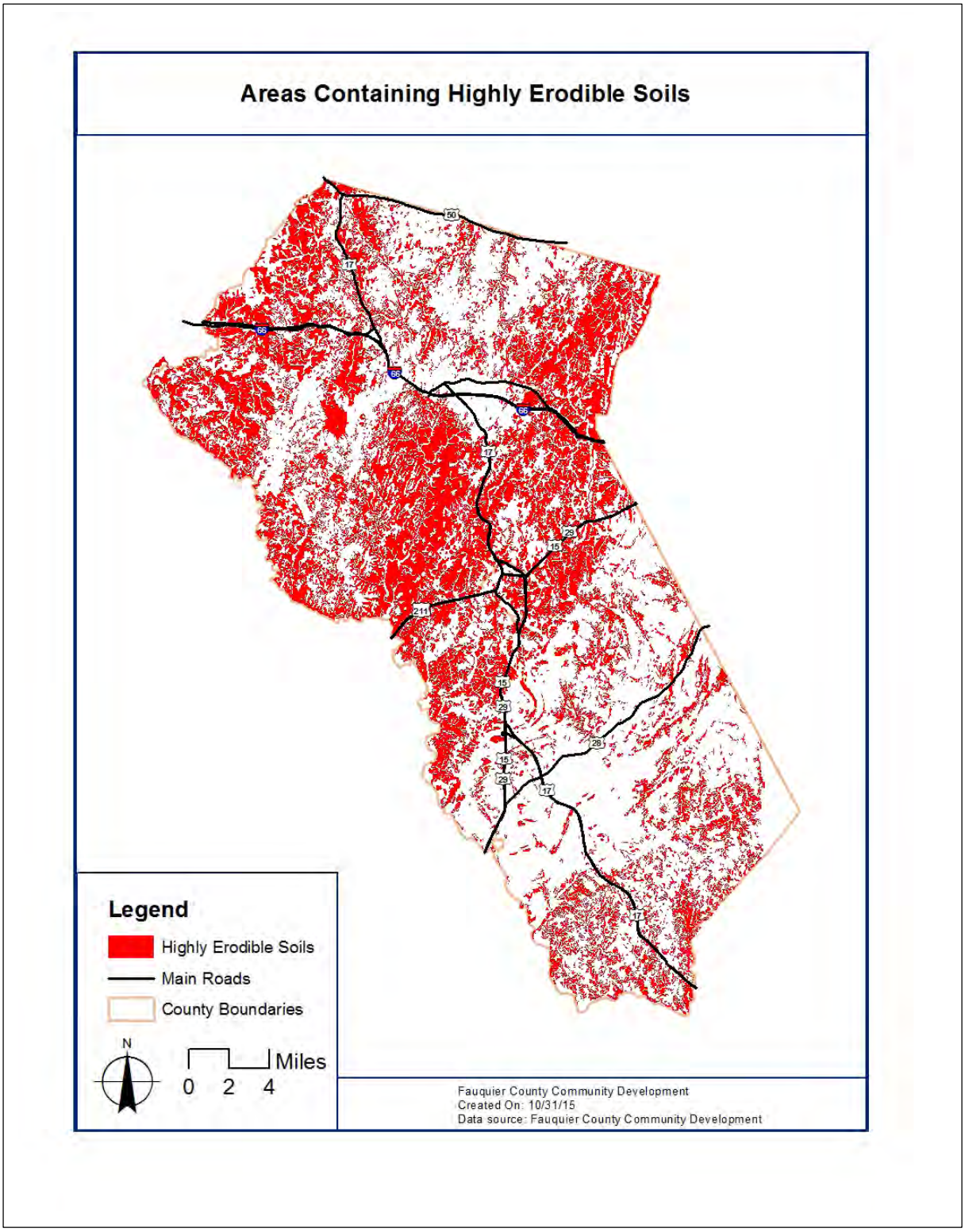

Figure 6 Areas Containing Highly Erodible Soils

D. Water Resources

1) River and Streams

The two large rivers draining Fauquier County are the Potomac and Rappahannock Rivers. The Potomac River watershed within Fauquier County contains three larger watersheds, six smaller watersheds and 17 subwatersheds. These six watersheds are the: Upper Goose Creek; Lower Goose Creek; Broad Run; Bull Run; Cedar Run; and Potomac River-Potomac Creek watersheds. Combined, the Potomac River watershed within Fauquier County contains 1,301 miles of streams draining 367.4 square miles (56.4 percent of County). The Rappahannock River watershed within Fauquier County contains one larger watershed, three smaller watersheds and 10 subwatersheds. These three watersheds are the: Rappahannock River-Carter Run; Rappahannock River-Marsh Run; and Rappahannock River-Thumb Run. Combined, the Rappahannock River watershed in Fauquier County contains 1,160 miles of streams, and drains 283.5 square miles (43.6 percent of county). This watershed information is summarized in the following table:

Potomac River		Area (Square Miles)
	Upper Goose Creek	
	Goose Creek-Crooked Run-Gap Run	59.6
	Goose Creek- Mitchells Branch	29.9
	Goose Creek-Wancopin Creek	3.1
	Cromwells Run	18.4
	Panther Skin Creek	8.6
		119.6
	Lower Goose Creek	
	Little River	30.6
		30.6
	Broad Run	
	Broad Run-Trapp Branch	37.8
	Broad Run-Catletts Branch	15.9
	Kettle Run	9.4
		63.1
	Bull Run	
	Little Bull Run	1.2
		1.2
	Cedar Run	
	Cedar Run-Mill Run	28.8
	Cedar Run-Slate Run	5.4
	Cedar Run-Owl Run	36.9
	Cedar Run-Walnut Branch	12.3
	Town Run	39.9

	Licking Run	25.5	
		148.8	
Lower Potomac River			
	Potomac River-Potomac Creek		
	Upper Aquia Creek	4.1	
		4.1	
			367.4
Rappahannock River			
	Carter Run	55.4	
	Rappahannock River-Glascock Run	6.8	
	Rappahannock River-Great Run	43.7	
		105.9	
	Marsh Run	46.6	
	Rappahannock River-Deep Run	15.8	
	Rappahannock River-Ruffans Run	20.0	
	Rappahannock River-Rock Run	27.8	
		110.2	
	Thumb Run	36.1	
	Rappahannock River-Buck Run	29.1	
	Rappahannock River-Lake Mosby	2.2	
		67.4	
			283.5

Table 1: Fauquier County Watersheds

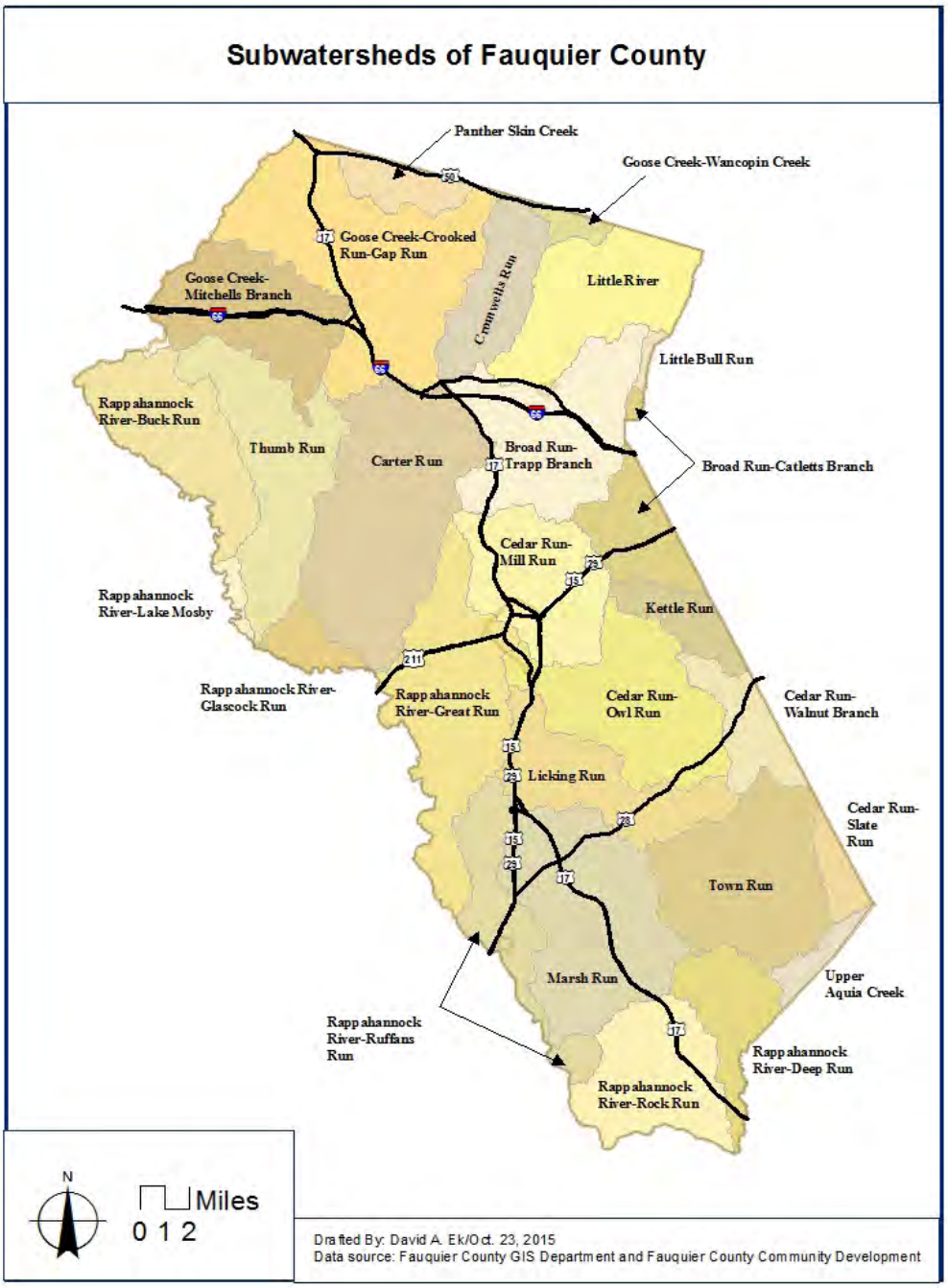

Figure 7 Subwatersheds of Fauquier County

a) Scenic Rivers

The Scenic River designation constitutes official recognition of the natural, scenic, historic and recreational values of some of Virginia's most valuable riverine resources and provides them symbolically with a measure of protection not afforded other rivers. In addition, it may provide a greater sense of local or community ownership and therefore may provide landowners and other local citizens a stronger voice in any government action or decisions that have the potential to impact 'their' river.

There are two designated Scenic Rivers in Fauquier County, the Rappahannock River and Goose Creek. This designation includes the entire length of Goose Creek and the entire length of the Rappahannock River within Fauquier County.

b) Rappahannock River

The regionally significant Rappahannock River's headwaters lie in Fauquier County[1]. Before flowing into the Chesapeake Bay, the 2,848 square mile watershed drains portions of 18 counties. Approximately 44 percent of Fauquier County drains into the Rappahannock River. Land use within the watershed is predominately rural. Many of the individual streams flowing into the Rappahannock River contain impaired water segments, mostly caused by bacteria contamination. A watershed-scale water quality improvement implementation plan for the combined Thumb Run, Carter Run, Great Run and Deep Run watershed was implemented in 2006. A similar water quality improvement plan for the combined Craig Run, Browns Run and Marsh Run was implemented in 2010.

Due to the variety and complexity of issues affecting the Rappahannock River, and since it flows through 18 separate counties, the Rappahannock River Basin Commission was established to foster a regional approach to the management of a regional resource, to facilitate coordinated activities across jurisdictions, and to assist partnerships and the sharing of information. This group has no management authority, for it is strictly advisory. The Commission is a means to coordinate efforts and communication throughout the Rappahannock River watershed.

[1] Some sources, suggest that the Rappahannock River's headwaters lies in Rappahannock County, but by other conventions it lies in Fauquier County. The upper portion of the river has two small feeder streams, one originating in Rappahannock County and the other one in Fauquier County. The one in Rappahannock County originates 140 feet in elevation higher than the one in Fauquier County. Although there is no universally accepted definition of defining headwaters, the United States Geologic Survey and other sources usually state that the headwaters is the stream that is the furthest linear distance from the mouth. If this criterion were used, then the Rappahannock River's source would lie in Fauquier County, since that branch is longer than Rappahannock County's branch. In addition, Fauquier County's branch is more in line with the main axis of the Rappahannock River, while the one that originates in Rappahannock County flows 90 degrees to the main axis to the rest of the Rappahannock River. In practical terms, both Rappahannock and Fauquier Counties are the headwaters of the Rappahannock River and should work in cooperation to ensure river goals are being met, since water and water issues do not recognize political boundaries.

c) The Potomac and Occoquan Rivers

Most of the remaining parts of Fauquier County that do not flow into the Rappahannock River flow into the Occoquan River, which in turn flows into the Potomac River, and eventually empties into the Chesapeake Bay. A small portion of Fauquier County drains into the Potomac River further downstream of the mouth of the Occoquan River. Both the Occoquan and Potomac Rivers are significant rivers that flow through a mostly urbanized landscape, and as such, the legal and policy issues tend to be different than with the Rappahannock River.

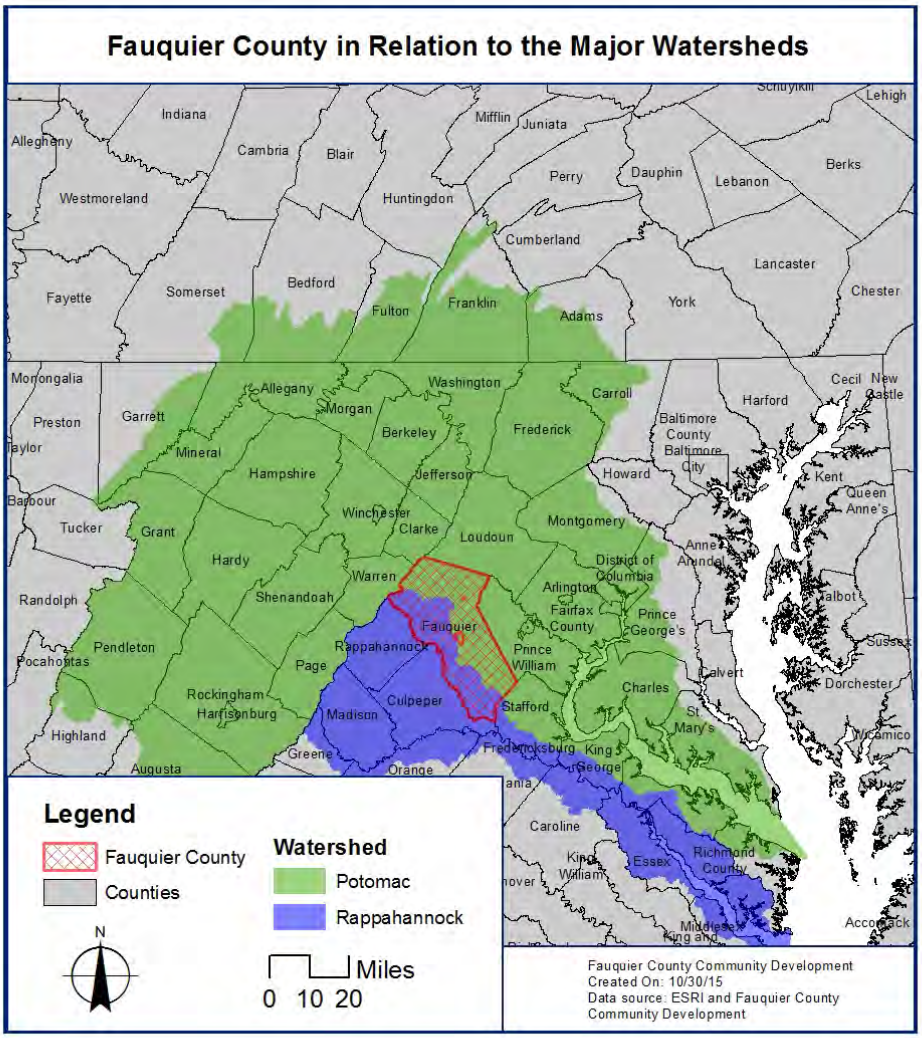

Figure 8 **Fauquier County in Relation to Potomac and Rappahannock River Watersheds**

d) Occoquan Policy

There was growing concern in the 1960s with the potential impact the large quantity of treated sewage effluent that was being discharged into the Occoquan watershed had upon surrounding communities, since this watershed was the source of drinking water for 600,000 people throughout northern Virginia. As a response to these concerns, a study of the watershed was commissioned. The results of this study highlighted that point source pollution was the primary cause of water quality degradation within the watershed, and that a higher degree of wastewater treatment would be required prior to the wastewater being discharged into the watershed. In 1971, the Virginia Water Board adopted a policy that required a higher standard of treatment from point source water treatment facilities that discharge into waters flowing into the Occoquan River. This policy became known as the "Occoquan Policy." The Occoquan Policy is one reason that there is a different water quality standard for Fauquier County wastewater treatment facilities that flow into the Occoquan River from those that flow into the Rappahannock River. Water quality conditions and sources have dramatically changed since 1971, but the basic provisions of the Occoquan Policy is still in effect.

e) The Chesapeake Bay

The Chesapeake Bay is the largest estuary in the United States. Besides its size, the Bay is also known for its productivity, its ability to support diverse species, its robust resource-based economy, as well as its renowned recreational opportunities. The Chesapeake Bay drains a large area covering portions of the states of Virginia, Maryland, Pennsylvania, Delaware, West Virginia and New York, and the District of Columbia. Although the Bay is large in extent, it is quite shallow, making it even more susceptible to impacts. River mouths and tidal zones are typically quite vulnerable to impacts since they are the down-gradient dumping ground for everything that happens in the expansive watershed. In essence, the Bay is the accumulative and aggregate collection of every impact that occurred upstream, from air pollution deposition; chemical spills; land-use changes; reduced forest and cover crops; oxygen depletion; erosion and sedimentation; improper fertilization; improper garbage disposal; leaking drainfields; run-off from streets, buildings and feed lots; stream buffer reductions; wetland losses; population growth; wastewater discharges; invasive species; and many non-point pollution issues. Any and all of these impacts that find their way into streams also find their way to, and accumulate in, the Chesapeake Bay.

Impacts to the Bay began to be noticed in the 1960s and 70s, not only for the Bay environment, but also on the many industries, economies and jobs that are dependent upon a healthy Bay environment. Since then, the focus of restoration efforts and goals were largely voluntary. For instance, in 1992 the Chesapeake Bay partners launched the Tributary Strategies effort. The Tributary Strategies approach established a series of recommendations specific to each affected tributary. It appeared as if this voluntary approach did not provide enough of an incentive for local, state and federal agencies, and the citizenry that lived in the watershed, to make the hard choices necessary. Therefore, the Tributary Strategies approach was scrapped and replaced by the more regulatory approach of the Total Maximum Daily Load (TMDL) approach that is currently in effect. To date, most

of these TMDL requirements have affected coastal Virginia more than they have Fauquier County; however, this situation may likely change in the near future, whereas, Fauquier County may be required to comply with Chesapeake Bay TMDL limits.

f) Riparian Resources

Riparian zones are the transition between aquatic and upland habitats. These fragile and valuable resources serve a multitude of functions, including but not limited to filtering sediment and nutrients from surface run-off; mitigating the impacts from storms and high water events; providing shade and cooling the water; providing habitat for diverse species; stabilizing stream banks and preventing erosion; and providing a wildlife corridor between upper watershed and lower reaches. It is for these reasons that the protection of existing riparian resources should be enhanced and the restoration of impacted riparian zones should be encouraged. Currently, there are few federal, state, or local laws or policies that legally establish any minimum protection measure for riparian resources.

g) Lakes, Ponds and Reservoirs

Fauquier County contains no natural lakes, although there are several reservoirs and hundreds of constructed livestock and recreational ponds. The largest reservoirs include Warrenton, Airlie, and Germantown Reservoirs and Lake Brittle. The primary purpose of the first two is water supply, the primary use of Lake Brittle is recreation, while the use of Germantown Lake is a combination of flood control, recreation and a back-up water supply.

An effort to construct a water supply and flood control dam in the Cedar Run watershed, known as the Auburn Dam or Cedar Run Dam #6 began in the 1970s. The first Environmental Impact Statement (EIS) for this project was completed in 1975. An updated EIS was completed in 1994. Citizen's concerns over the potential impact of the proposal coupled with the expenses of treating surface waters and the growing realization that we may have sufficient groundwater resources to meet our anticipated needs, convinced the county in 2001 to drop the permits and pursuit of the surface impoundment in favor of relying 100 percent on groundwater aquifers. In a few areas, most notably Marshall, the supply has not been sufficient to meet current demand. In pretty much all areas, anticipated future demands could not be met without additional water supply and water storage investments; however, there has been no significant calls for additional surface water impoundments to serve our water supply needs.

h) Water Impacts

Some of the biggest physical impacts to streams include changes in the stream's hydrology and streambank impairments. Streambank impairments can be caused by the removal of stabilizing shoreline vegetation and by soil compaction. Historically, livestock obtained their water directly from wading into streams. In many situations, to reach the stream, the livestock needed to climb down steep streambanks, thus creating gullies devoid of vegetation. Surface run-off from storms would then flow down these gullies making them deeper and depositing sediment into the stream. Floods and high water events would scour the

destabilized gullies and either make them bigger, triggering entire streambanks to collapse. Other related impacts were also created through the removal of riparian vegetation by plowing directly up to streambanks.

Figure 9 **Cattle in a Fauquier County Stream (photo courtesy of John Marshall Soil and Water Conservation District). Note: this stream segment has since been restored by the development of an alternative water supply for the cattle, the stream being fenced off, and the riparian area replanted.**

Another less preferred management practice is the placement of parking lots or hardened surfaces adjacent to streams. Not only does this remove stabilizing riparian vegetation, but high velocity stormwater run-off flowing off pavement directly into streams usually causes significant erosion and bank destabilization.

Whatever the cause of bank destabilization, it often becomes self-perpetuating, with each storm, flood or heavy rain, making it exponentially worse each time.

Another significant impact to streams is the change in the stream's hydrology. The amount a stream naturally cuts into the ground is heavily influenced by the quantity and velocity of water coming down from upstream sections of the watershed. The reduction of the amount of upstream wetlands and riparian zone vegetation and the construction of impervious surfaces within the watershed decreases infiltration and retention of stormwater. The resulting increase in surface water flows usually

causes the stream to cut further into the soil in order to equalize the stream channel to the new streamflow characteristics. This hydrologic adjustment often results in erosion, scour, loss of vegetation and riparian resources, filling the stream with sediment, and may cause the collapse of entire river banks or hillsides, thereby adding more sediment into County streams.

Many aquatic organisms rely upon streamside vegetation to provide sufficient shade for them to survive. This vegetation provides cover from predators and keeps the direct sun off the water, thereby preventing overheating.

j) Impaired Streams

Every two years the Virginia Department of Environmental Quality (DEQ) publishes a list of waters within the state that are "Impaired," or in other terms, have been found not meeting specific water quality standards for a particular designated use. The latest report of impaired waters was in 2012. After a particular segment is found to be "impaired," DEQ schedules a report that assesses in detail the sources and nature of the water quality issues within that particular subwatershed. The DEQ then works with the local communities in preparing a Watershed Implementation Plan (WIP) that details the suggested corrective actions that would bring the impaired stream back into legal compliance. If the source of the water quality problem was livestock in the stream, then corrective actions may include providing livestock with dedicated water away from streams so that the stream may be fenced and excluded from further livestock trespass. If the problem was leaking or non-functioning septic systems, then a corrective action may include providing cost incentives for septic system repairs or to provide assistance in connecting homes to sanitary sewer systems.

These efforts take time, often years or decades, since the goal is to bring the stream back into compliance so that it may be removed from the state's impaired listing. For instance, there have been enough corrective actions and improvements in the Carter Run watershed, that the U.S. Department of Environmental Protection Agency (EPA) announced in 2014 that Carter Run is being reviewed for potential removal from the next "impaired waters list." However, it is common that more streams are added to the list each time than being taken off, so the net result is an increase in the number of impaired waters. For instance, the 2012 list for Fauquier County added 44.91 miles of new impaired waters to the list.

Currently, in Fauquier County's portion of the Potomac River watershed, a total of 105.06 miles of impaired streams have been identified as of the 2012 DEQ inventory. This is 8.1 percent of the streams in the Potomac River watershed within Fauquier County. In Fauquier County's portion of the Rappahannock River watershed, a total of 139.7 miles of impaired streams have been identified as of the 2012 DEQ inventory, this is 12.0 percent of the streams in the Rappahannock River watershed within Fauquier County. Combined, there are a total of 73 segments and 244.76 miles of impaired streams within Fauquier County. This equals 9.9 percent of the streams within the County. Nearly every subwatershed is represented on this impaired streams list. The subwatersheds with some of the highest percentage of impaired streams include Upper Aquia Creek (70.4%),

Thumb Run (23.8%), Rappahannock River-Great Run (20.2%), Marsh Run (19.3%), and Panther Skin Creek (18.3%). There are three subwatersheds that contain no designated impairments within Fauquier County, they are: Goose Creek-Wancopin Creek, Cedar Run-Slate Run, and Little Bull Run; however, this has more to do with the small percentage of these watersheds that lie within the County than with the quality of the water. The subwatersheds with some of the lowest percentages of impaired streams include Goose Creek-Mitchells Branch (3.8%), Little River (4.3%), and Goose Creek-Crooked Run-Gap Run (4.5%).

The majority of the impairments were caused by E. coli bacteria, due to activities such as grazing in riparian areas, animal access to streams, and sewage discharges. E. coli bacteria is an index measurement that assesses the potential human health risk. Besides E. coli, other impairments, in descending order, consist of fecal coliform (another bacteria measurement as a measure of human health issues), benthic-macroinvertebrate bioassessments (limited diversity of aquatic life; it is a measure of collective water quality concerns that affect aquatic life), and dissolved Oxygen (also important for aquatic life).

It should be noted that a significant aspect of the impaired water list is that if a water body is not on the impaired waters list it does not mean it is not impaired, since there is a significant sampling bias built into the process. It may have been that that stream has not been sampled yet. In addition, what has been assessed is not conducted randomly, so relative proportion or degree of impact across the watershed cannot be determined from this data. It is for this reason, that the percent of impaired data mentioned in the preceding paragraphs is somewhat meaningless, unless you look for spatial and other relevant trends. Until monitoring of the streams becomes comprehensive, the impaired list will always have a sampling bias in it, and therefore certain assessment or comparisons cannot be made with a high degree of confidence. This bias could go in either way: the streams that are being sampled have known water quality concerns, so therefore, the list becomes biased by implying that water quality concerns may be more widespread than they are in reality; or that the streams being sampled may be the better quality streams so therefore any report would imply few water quality problems than what truly exists. To give some indication of the level of bias, one could look at the DEQ's statewide data. The Virginia DEQ's 2012 Draft Water Quality Assessment and Impaired Waters Integrated Report, dated March 12, 2012, lists that statewide, impaired waters account for 71 percent of the assessed stream segments, while only 29 percent of assessed streams met the standards and were classified as having attained the state's water quality standards. This quantification of the impaired waters in relation to the segments sampled indicate that at least at the state level, the sampling bias underrepresents the amount of impaired waters. This is consistent with verbal communications to the DEQ in 2012 with County representatives, where the DEQ stated that they have succeeded in sampling at least one segment of every significant stream in the state, but few if any streams have been assessed for the stream's entire length. Considering that with few exceptions, every stream in Fauquier County has at least one segment that is impaired, this again points to the conclusion that many more streams in Fauquier County are impaired than what are on the list. The DEQ's 2012 impaired list cites

244.76 miles of impaired streams in the County, which equates to 9.9 percent of the County's streams; however, if the state-level ratio is valid for Fauquier County, then our total miles of impaired streams would be closer to 1,567 miles of impaired streams (71 percent of County's streams). Although much volunteer efforts have been made in the County by farmers, developers and other landowners by adhering to stormwater management standards, fencing and excluding livestock from streams, providing stream buffers, and replacing failing septic systems; suffice to say that Fauquier County has a surface water quality problem, especially related to bacterial contamination. In addition, the Chesapeake Bay restoration model implies that Fauquier County also has a problem resulting from excess phosphorus, nitrogen and suspended sediment.

Perhaps a better assessment of the water quality of Fauquier County streams is the Index of Biotic Integrity (IBI) values derived by Teels and Danielson in their 2001 report. This IBI was determined through fish inventories. Various factors were used in determining the IBI for each of the 64 sites sampled in Fauquier County, factors such as: species diversity; abundance; tolerance of species, trophic level, and degree of human disturbance present. While there was only a few sampling sites within each subwatershed, assessments performed this way is perhaps more representative of the overall watershed condition than the impaired stream assessments, especially when assessing only a few select segments along each stream. To begin with, some of these stream "impairments" are based upon human recreational health concerns and not necessarily equivalent to ecosystem health. In addition, being listed as "impaired" means that the water chemistry crossed a particular threshold for one parameter, much like a pass/fail. One stream may have barely failed while another miserably failed, but both are simply reported as being "impaired." The Impairment assessment also looks at only a limited set of parameters with no attempt to assign a factor how these parameters may affect ecosystem health. For instance, a stream that failed the E. coli standard may be healthier for aquatic organisms than a nearby stream that had low levels of E. coli, but contained high levels of toxic substances that the impairment assessment does not investigate. The fish IBI value does not assess what substance is causing an ecosystem health problem, only that collectively, something is affecting the stream's health, as such, it is probably a better assessment of overall stream health.

The following two figures are graphical assessments that the Fauquier County Department of Community Development created using data from the Teels and Danielson's 2001 report. From this graphical assessment, coupled with analysis of the original data, certain trends are indicated.

The lesser IBI values obtained from the sampling sites within the subbasins draining into the Occoquan River appear to mostly be a factor of regional trends that follow population development. The very poor values obtained for the Cromwells Run Watershed may be a combination of regional impacts and local effects, while the low values obtained for the Rappahannock River-Ruffans and Marsh Run Watersheds may be caused by more local effects.

Since the habitat degradation within the Occoquan River Watershed appears to be correlated with population density, as development moves further into Fauquier County, the worsening of the stream and watershed condition is likely to progress into these same new areas. Extra stream and riparian conservation measures could mitigate these impacts to a certain degree. It would be particularly instructive if the assessment that went into Teels and Danielson's 2001 report was replicated and updated every ten years. This would allow not only spatial analysis, but also temporal as well.

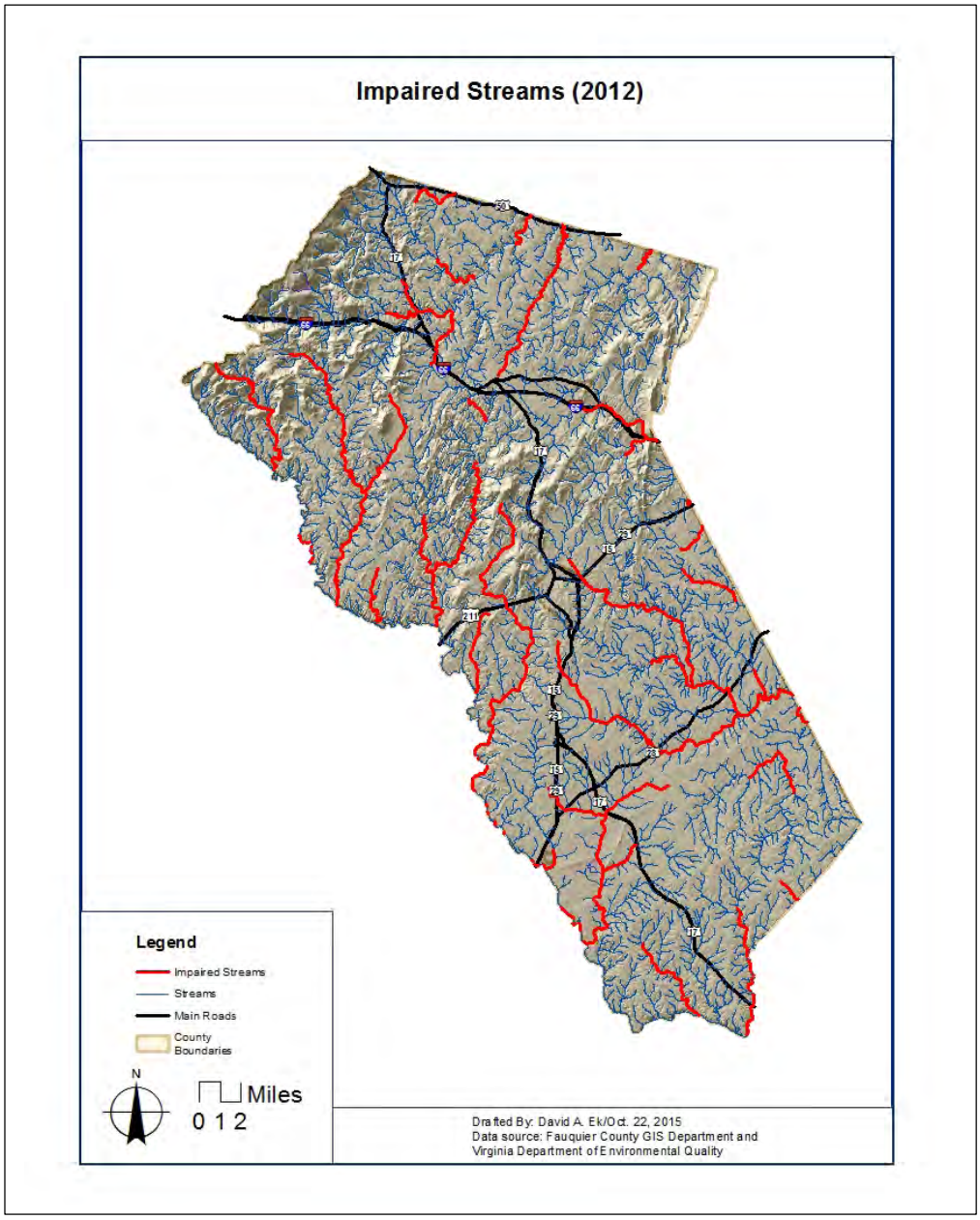

Figure 10 Impaired Waters of Fauquier County

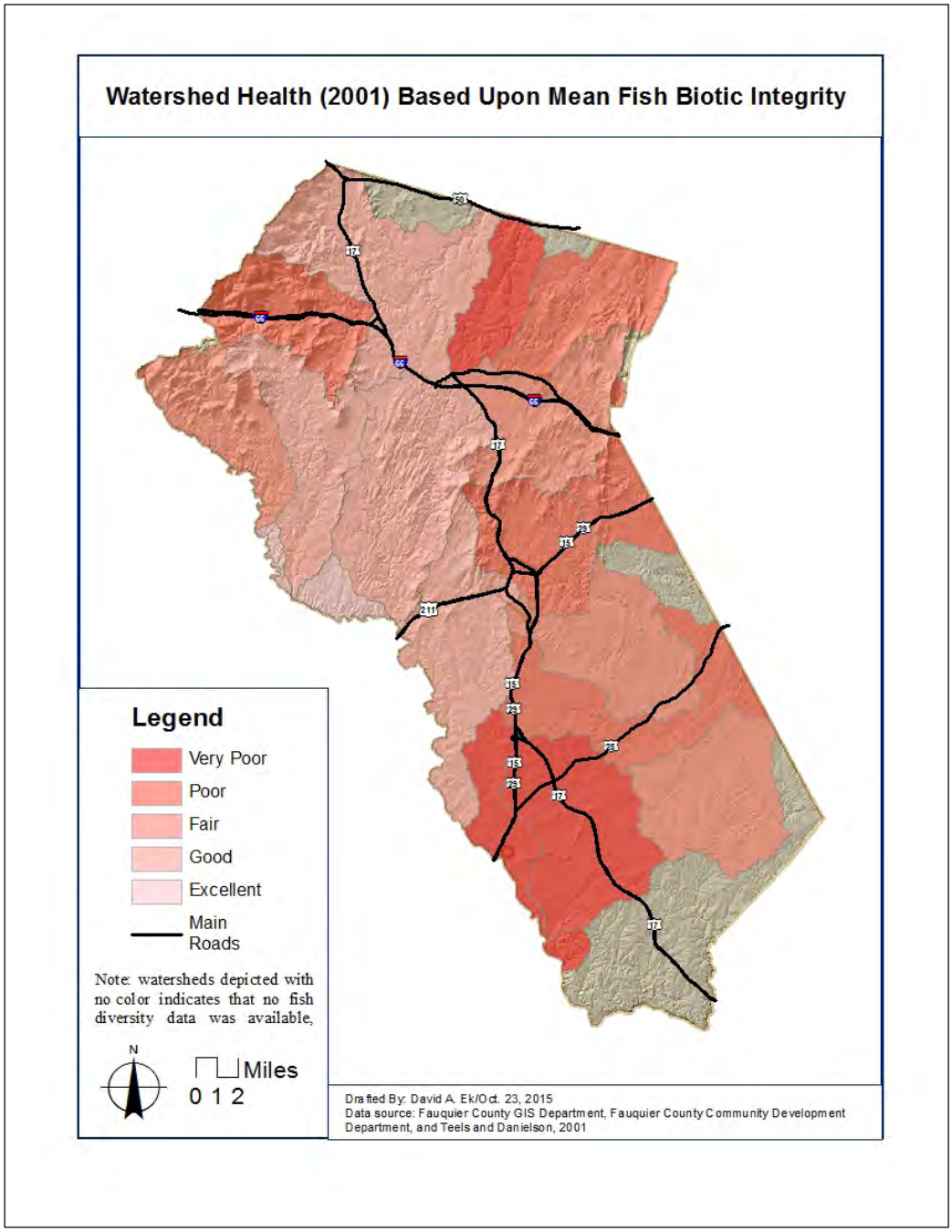

Figure 11 Stream Health/Index of Biotic Integrity Based Upon Fish Diversity

k) Water Quality Concerns

Water quality concerns often are separated into two categories based upon where the concern originated: point and non-point source. The original water quality concern that led to the passage of the federal Clean Water Act (CWA) was from point sources. An example of point sources is wastewater and contaminants from a factory being pumped into a nearby stream. Point sources that directly discharge into water often have a direct affect upon surface water quality. Since the passage of the CWA, point sources have been permitted, monitored and cleaned up. Now, many of the nation's worse point-source pollution problems have been seriously reduced since the passage of the CWA. Since this time, the extent of non-point sources is becoming more apparent. Often the source problem for a non-point contaminant is not a single entity, such as a factory, but instead is the multitude of small or chronic households and other dispersed activities occurring throughout the watershed when taken as a whole may even exceed the contaminants that came from any one point-source discharge. Non-point sources are often more difficult to correct, due to:

- locating them (instead of one or a few discharges that emit high levels of contaminants, you now have to deal with sometimes hundreds or even thousands of individual locations where each is only contributing a slightly elevated level of contaminants, but collectively the amount becomes significant);
- political will in assigning responsibility (it is easier to vilify and fine a faceless corporation for discharging contaminants than it is to point fingers at your neighbor, or oftentimes ourselves);
- habits and lifestyle are slow to change (many non-point corrective actions require us as individuals and us collectively as communities to change our lifestyle, habits, and traditional practices, including what products we buy and use in our home and in our yards);
- cultural (American's independence tradition makes it harder to accept governmental regulations telling us what we can and cannot do on our own property even if good for the community at large, or even the individual landowner).

Contaminant	Origin	Effect upon Humans[2]	Effect upon Environment
Sediment	Soil and stormwater runoff	Nausea, cramps, diarrhea and associated headaches caused by viruses, parasites and bacteria	disruption or elimination of habitat, limits breathing of aquatic organisms, clogs gills and guts, reduces food availability
Dissolved Solids	Run-off from land disturbing activities.	Hard water, water odor, corrosive water	Disrupts water balance in cells, carrier of toxic substances,
Copper	Leached from plumbing, bedrock	Gastrointestinal distress, liver or kidney damage	Plant death, interrupts decomposition, toxic
Arsenic	Older insecticides, run-off from agriculture, electronic production waste, bedrock	Skin damage or problems with circulatory systems, and may have increased risk of getting cancer.	Death, reduce growth, reduce reproduction and precipitate behavioral effects
Lead	Leached from plumbing, bedrock	Delays in infant physical or mental development, kidney problems and high blood pressure	Death, disrupts natural communities, decrease growth and reproduction, neurological effects
Nitrates	Agriculture and stormwater runoff, manure, fertilizer, and bedrock	Infant illness and even death,	Deplete dissolved oxygen, promote algae growth, aquatic organism illness to death.
Phosphorus	Agriculture and stormwater runoff, manure fertilizer	High levels may cause kidney damage and osteoporosis.	Deplete dissolved oxygen, promote algae growth, aquatic organism illness to death.
Bacteria (E. coli, Total Coliforms)	Human and animal waste	Nausea, cramps, diarrhea and associated headaches caused by viruses, parasites and bacteria	Less information on environmental impacts, but pathogens have caused as wide array of impacts to aquatic organisms and amphibians.
Pesticides	Agriculture, domestic uses, municipal uses	Varies Widely	Varies Widely

Table 2: The Effects of Contaminants in Streams

[2] Source www.epa.gov (with minor updated changes)

l) Nitrogen

Although our atmosphere is comprised of 78 percent nitrogen, this form of the element does not readily react with other earth processes or readily enter our natural waters. The typical natural pathway that nitrogen enters our lakes and streams is through a process known as nitrogen fixation. Biologic processes within some forms of blue-green algae and other micro-organisms can convert the inert atmospheric form of nitrogen into ammonia, nitrite and nitrate and other forms of nitrogen more readily absorbed by plants and natural water systems. A significant percentage of the nitrogen in natural waters comes from human-related activities such as the burning of internal combustion engines and the use of fertilizers. When nitrogen byproducts of the burning of coal, oil and gas mix with precipitation and washes into lakes and streams, it usually changes the natural chemical balance of these water bodies. A major source of nitrogen in our water also comes from excess fertilizers. Gardeners and farmers often place nitrogen-based fertilizers on their gardens and crops. If too much of this fertilizer is applied or it is applied incorrectly, a certain quantity of this reactive nitrogen is washed into lakes, streams and our ground-water supplies. There are many varieties of reactive forms of nitrogen within our water sources, such as ammonia and nitrate. All these forms together are called "Total Nitrogen." Excess nitrogen in our water is a health concern and it degrades the environment, and even alters our food supply. This is a significant reason that the Bay Act established specific nitrogen reduction targets for each watershed within the greater Chesapeake Bay system.

The best means to reduce the quantity of these negatively impacting forms of nitrogen is to prevent them from reaching water bodies in the first place. This may be done by deploying best management practices (BMPs), by planting vegetation that absorbs nitrogen, and proper fertilization (i.e., to only place the quantity of fertilizers that is needed for plants, and no more). On this last point, this is often one of the easiest ways of convincing someone to change habits, since why would any farmer or gardener want to pay for excess fertilizer that just simply washes away without benefiting their crops or plants?

m) Phosphorus

Like nitrogen, phosphorus is another nutrient that is targeted for reduction under the Bay Act. While phosphorus is not an uncommon constituent of some igneous and sandstone rocks, these sources of this nutrient is often not a significant contributing factor in the presence of phosphorus in natural waters. The presence of elevated phosphorus in natural waters is often the result of wastewater discharge or stormwater run-off carrying excess fertilizer. Too much nutrients, such as nitrogen and phosphorus, can be detrimental to aquatic fauna, can reduce dissolved oxygen, and can promote a proliferation of aquatic weeds that can seriously impede and retard fish and other aquatic growth and survival. Similar to nitrogen, the implementation of BMPs are often an effective way to reduce phosphorus levels in Fauquier County streams.

Like nitrogen, the Chesapeake Bay Act calls for specific phosphorus reductions for each watershed within the Chesapeake Bay drainage.

n) Sediment

Sediment in streams is natural, but human activity can, if not properly managed, contribute quantities of sediment well beyond the stream's ability to absorb, and as a consequence, can accumulate and contribute to significant resource impacts. Heavy sediment accumulations in natural waterbodies can smother benthic organisms and submerged aquatic vegetation, can cut off access to the proper breeding substrate for aquatic organisms, and can block or divert streamflow thereby accelerating erosion and property damage. In addition, the sediment from surface run-off may contain oil, gas or anti-freeze from roads and parking lots, pesticides, fertilizers and even heavy metals. Some of these pollutants can be retained in sediment for long periods of time. It is for these reasons that excess sediment in surface waters is considered a pollutant. The best way to prevent excess sediment from impacting streams is to keep soil and surface substances on site and prevent them from entering the stream in the first place. This is the purpose of most of the State and County's land-disturbing permits and erosion and sedimentation rules and requirements, as well as national, state and local stormwater management laws, policies and regulations.

Figure 12 Sediment in a Fauquier County Stream

There are two forms of sediment in natural waters, the heavier particles that settle out, and the finer particles that stay suspended in the water. While the heavier particles may plug local streams and cause significant localized harm to aquatic systems, these heavier particles often do not wash all the way into the Chesapeake Bay. However, the finer particles stay in solution and are often carried far from its original source. These sediments in solution produce the discolored and cloudy water that is often associated with "dirty water." This type of sediment is called "suspended sediment." All forms of suspended sediment is called "Total Suspended Sediment" or TSS. Similar to nitrogen and phosphorus, the Chesapeake Bay Act has set specific TSS reduction targets.

o) Bacteria

Fecal Coliforms are a group of bacterium that originated in the intestinal tracts of humans and other warm-blooded animals. Fecal Coliforms therefore indicates the presence or failure of wastewater management or fecal contamination resulting from humans, livestock or wildlife. Since Fecal Coliforms are natural organisms derived from the intestines of warm blooded animals, it is often not the Fecal Coliforms themselves that are the primary concern, but its presence is used as an indicator of other more harmful organisms (that may be harder to test for) that are also found in warm blooded animal intestines. The thought is that if there are high quantities of Fecal Coliforms in a stream there are also likely many forms of harmful organisms that also live within the intestines of warm-blooded animals, so fecal coliforms are used as an indicator of intestinal organisms.

E. coli is the abbreviated name (*Escherichia coli* is the full species name) for a single species bacterium member of Fecal Coliforms. It too is used as an indicator of potentially more harmful organisms. Fecal Coliforms use to be the most accepted bacteriological indicator for environmental and health regulations and water quality standards, but later studies have highlighted its limitations and therefore there has been a shift away from Fecal Coliform as an indicator in favor of *E. coli*. However, some recent studies have indicated that in some situations, *E. coli* can "naturalize" in the natural environment, meaning that they can reproduce and live outside of the intestinal tracts of warm-blooded animals. If true, then in these locations, the use of *E. coli* as an indicator of intestinal bacterial contamination could be questioned. Another problem and complication of using these indicators is that historically the presumption was that these organisms came from human intestines and therefore is an indicator of human-related impacts. However, other warm-blooded animals also harbor fecal coliforms and E. coli, so a certain percentage of bacterial contamination may be the result of livestock or wildlife sources. If so, then the nature of the problem and the range of potential corrective actions would be significantly different.

Bacterial contamination is the major cause of Fauquier County streams being listed as "Impaired" waters. Some studies have attempted to differentiate between bacteria resulting from livestock, pets, wildlife, human-related non-sanitary stormwater run-off, or failing human-related wastewater treatment facilities. The attempt to differentiate the source of the contaminant is a dominant purpose of the watershed TMDL plans that are developed after a particular stream has been determined to be "impaired." The take-home message in most of these studies is that there is usually not one single "smoking gun," to reduce bacterial

contamination; effective improvements usually require a robust, multi-functional and holistic approach.

p) Surface Water Challenges

The need for clean water permeates many aspects of our lives and quality living opportunities: examples include potable water for communities; healthy water for aquatic organisms and communities; sport fishing, swimming and other recreational economic benefits; and water for industries and to support our economic base. Therefore, it is incumbent that we maintain healthy surface and groundwater commensurate with our means and needs. Therefore, it is usually in our best interest to tackle challenging water quality issues directly.

Besides the challenges already mentioned, one significant barrier to improving surface water quality in Fauquier County, is that most of the laws, regulations, policies, goals and discussion have focused upon either TMDLs for downstream recipients, the effect and impact upon Chesapeake Bay or the Occoquan River, or other non-Fauquier County resource or value. It is harder to gain the sustained support and resources to improve surface water quality when there is not a direct link to Fauquier County receiving an equitable benefit from the shared sacrifices needed for broader watershed solutions. Perhaps a better job is needed to demonstrate the nexus and local benefits of proposed activities or projects. There is a myriad of examples that could be provided, such as the demonstrated improvements in livestock health by drinking from a clean water source separated from the parasites in fecal-rich streams in which they often wade in, or wellhead protection measures within groundwater recharge zones, or the well-documented economic benefits that are derived from implementing a more green-infrastructure type approach to land-use planning. Therefore, whatever approach is eventually taken within the County, it is incumbent that it be integrated into an active communication and educational initiative, so that the public is informed, supportive, and involved.

Another surface water challenge is that the State of Virginia has not delegated many water quality responsibilities to local governments; therefore, the approach is regulatory-based and top-down implemented. However, sometimes, the most effective water quality solution is derived from local efforts and a bottoms-up approach. Besides the effectiveness issue, often the most sustainable solution needs to include local engagement and the development of a local stewardship ethic, so impacts are to “their” stream and “their” resource, and not dismissed as “someone else’s problem.” Given the legal and jurisdiction realities, it should be incumbent upon local governments and citizen groups to explore means to maximize citizen involvement, engagement, and sense of ownership of the streams within Fauquier County, while at the same time being respectful and sensitive to private property rights and independence issues that run strong throughout much of the County.

2. Groundwater

Groundwater is simply water that lies below the Earth’s surface, whether held by the soil or lying in voids contained in the bedrock. The source of groundwater is precipitation that fell on the Earth’s surface. Some of this water evaporates, some

is consumed by plants and animals, some runs off the surface and washes into lakes and streams, and some sinks and enters the local groundwater. Groundwater in one location may be connected to groundwater in another location, perhaps through a system of interconnected cracks. A particular system of interconnected groundwater is called an aquifer.

Some bedrock voids are so small they are microscopic. For instance, a brick contains microscopic pores. A brick placed in water will slowly absorb some water and begin filling these pores. Water moves through these aquifers slowly. If this same brick contained a large crack, then water may rapidly move along the crack, but move slowly in directions away from the crack. This is not unlike most of Fauquier County's aquifers.

Fractured bedrock aquifers are the most common aquifer type within Fauquier County. Water flow in fractured rock aquifers is highly variable, depending upon the size of the cracks, their linear extent, and their degree of interconnectedness.

Most Fauquier County aquifers have not been delineated, but they are likely to be fairly small. While each aquifer is unique, there are certain general characteristics that are shared with other aquifers within the same physiographic province. In general, aquifers in the Blue Ridge Province are small and limited in extent. The usually steeper slopes coupled with the region's thin soils, and rapid run-off, means that little of the remaining precipitation is left to recharge the aquifers. When water is found, it would likely be low-yield and good quality.

Figure 13 Well Drilling in Fauquier County

The aquifers of Fauquier County's Piedmont region is similar to that of the Blue Ridge, but the slopes tend not to be as steep, soil depth can be deeper, and the bedrock can be more fractured. This means that aquifers and recharge in the Piedmont tends to be variable, but yield is likely to be only moderate at best. Water quality is variable in these aquifers, depending upon a variety of local conditions.

Aquifers in the Culpeper Basin (also known as the Triassic Basin) tend to have deeper soils, and the slopes are shallow. This encourages higher recharge rates and potentially higher water yield, but the quality of the water can be poor, due to the highly mineralized 'hard water' pervasive common to this region.

The Town of Warrenton receives most its water from the Warrenton and Airlie Reservoirs. The rest of the County receives potable water from groundwater sources. For many years as water demand increased, Fauquier County attempted to resolve where additional water supply should come from. As mentioned earlier, the County chose to abandon the development of surface-water in favor of ground-water sources.

Due partly to the inherently low permeability of typical bedrock within Fauquier County coupled with the high degree of fractures throughout the rock, the groundwater aquifers in the region tend to be of small extent and highly variable from place to place.

The majority of County residents living within one of the nine identified Service Districts obtain their water from public wells managed and maintained by Fauquier County Water and Sanitation Authority (WSA). WSA is not administered by Fauquier County, its authorities are derived from the State and it has its own separate Board. There are privately managed and maintained community water supplies that also utilize groundwater for their water supply needs. Most rural County residents have their own private water supply well located on their respective properties. A summary of Fauquier County's water supply and water availability is contained in the *Fauquier County Regional Water Supply Plan* (approved September 29, 2011). Some key points contained in that plan include the following:

- The surface area that forms the recharge zone for each of the wells supplying water to the Service Districts is larger than the land area of the Service District; therefore, each Service District depends on lands outside of the District to serve its recharge zone and for the protection of the water supply;
- The demand for water within several Service Districts is approaching the current supply capability, and anticipated future demand appears to exceed current supply availability in most Service Districts; and
- Finding suitable new groundwater sources takes time, due not only to funding issues, but also due to the nature of our aquifers, planning and permitting considerations, geophysical study constraints, public acquisition of real estate and easements, and water quality and water treatment concerns.

Therefore, until new wells go on line, the County has very little flexibility in meeting supply restraints brought on by drought or other related water supply complications, let alone a significant increase in population or water demand.

The recharge zone for an individual well may extend beyond the watershed divide of the surface in which the well is located. On the other end of the spectrum, many surface watersheds may contain a multitude of smaller groundwater aquifers. In addition, aquifer boundaries are not static; they may significantly change throughout the seasons and under different hydrologic conditions. Few aquifers have been delineated within Fauquier County. Lacking more precise delineations, for the purpose of this plan, it will be assumed that the aquifer's boundary lies along the same watershed boundary in which the surface well is located. It is important to recognize that the County's public water supplies are not located evenly across the land. There is a disproportionally high reliance upon water within the Cedar Run watershed, as depicted in the following figure.

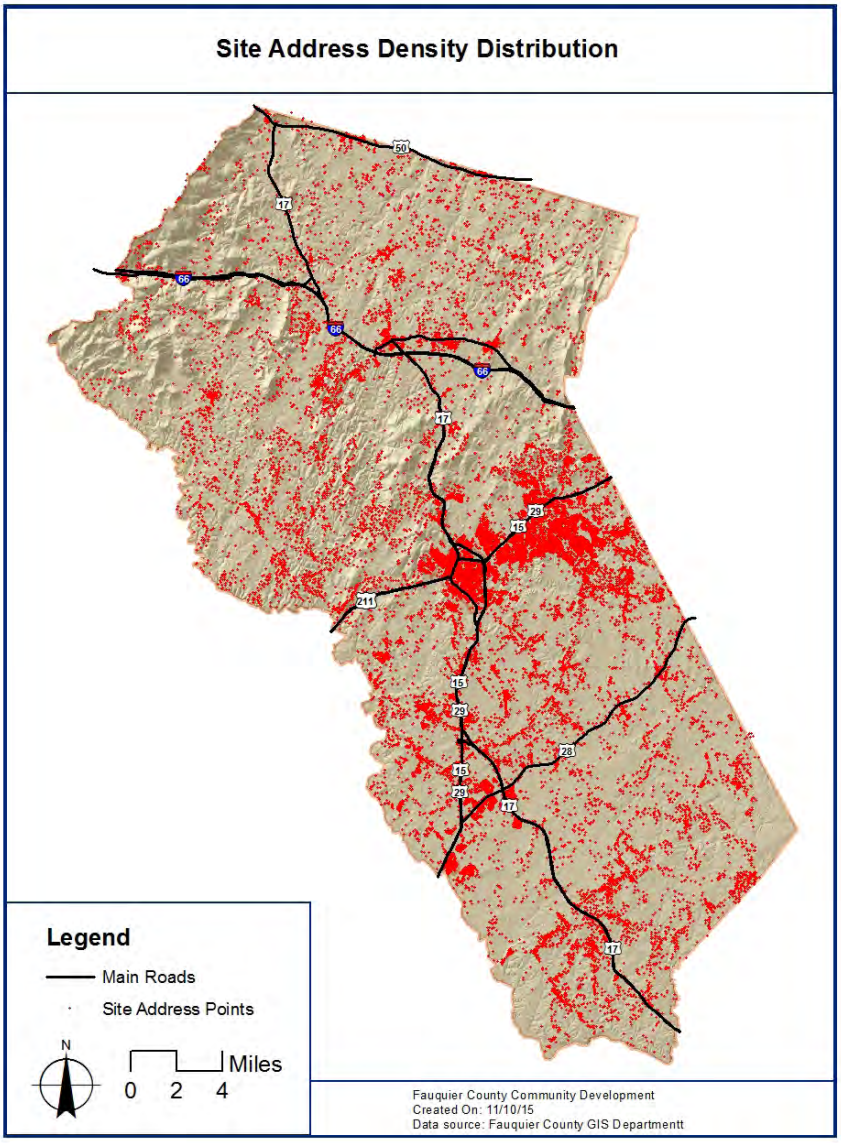

Figure 14 Site Address Density Distribution

Subwatershed	Square Miles	Number of Site Addresses	Estimated Population	Estimated Population per Square Mile of Watershed
Cedar Run-Mill Run	28.8	5539	13,100	454.9
Kettle Run	9.4	1397	3,304	351.5
Broad Run-Catletts Branch	15.9	1660	3,926	246.9
Rappahannock River-Ruffans Run	20	1430	3,382	169.1
Marsh Run	46.6	2828	6,688	143.5
Cedar Run-Owl Run	36.9	2217	5,243	142.1
Rappahannock River-Great Run	43.7	2385	5,641	129.1
Licking Run	25.5	994	2,351	92.2
Upper Aquia Creek	4.1	146	345	84.2
Goose Creek-Wancopin Creek	3.1	106	251	80.9
Rappahannock River-Rock Run	27.8	923	2,183	78.5
Cedar Run-Walnut Branch	12.3	389	920	74.8
Carter Run	55.4	1729	4,089	73.8
Panther Skin Creek	8.6	258	610	71.0
Rappahannock River-Deep Run	15.8	391	925	58.5
Rappahannock River-Glascock Run	6.8	152	359	52.9
Cromwells Run	18.4	404	955	51.9
Rappahannock River-Lake Mosby	2.2	46	109	49.5
Little River	30.6	638	1,509	49.3
Town Run	39.9	818	1,935	48.5
Broad Run-Trapp Branch	37.8	751	1,776	47.0
Little Bull Run	1.2	22	52	43.4
Goose Ck.-Crooked Run-Gap Run	59.6	1048	2,479	41.6
Thumb Run	36.1	562	1,329	36.8
Goose Creek-Mitchells Branch	29.9	430	1,017	34.0
Cedar Run-Slate Run	5.4	52	123	22.8
Rappahannock River-Buck Run	29.1	263	622	21.4
	650.9	27,578	65,222	100.2

Table 3: Subwatersheds of Fauquier County

Summarizing County population per watershed (Table 2 and Figure 2) required assumptions and generalizations; however, these appear valid given the context of this document. To begin with, the County does not collect population per watershed data, so certain surrogates were evaluated. The two explored in greatest depth were the number of individual tax parcels contained in a particular watershed and the number of "site addresses" contained in the County's Geographic Information System (GIS) database. This "site addresses" GIS database lists the official mailing addresses for buildings within the County. There are 35,717 individual tax parcels in the County, and 27,578 site addresses. Using the 2010 County population of 65,203 people, this would equate to 1.826 people per tax parcel within the County, and 2.364 County residents per site address of record. Since there are many tax lot parcels that do not contain inhabited buildings, it was felt that the site addresses data was more reflective of the number of actual inhabited buildings. The next significant assumption that was made was the number of people per site address. For this figure, the total 2010 population was divided by the number of site addresses. An assumption in this approach is that the number of people per site address (such as the number of people per home) is consistent throughout the County. This may or may not be the case, since more people would likely live under one apartment complex address than a single-family home address. However, reliable objective alternatives do not exist within the County at this time. The main purpose of this data for this analysis is to identify the concentrated population densities per watershed and relate that to the uneven distribution of water demand. For this purpose, underestimating the population within these apartment and other higher density units would not affect the overall analysis. The main effect of errors on this assumption would be the intensities of the population distribution and the total number of people per unit area, and not the locations and distributions of the population clusters. Therefore, these assumptions appear valid for this purpose.

This information is pertinent for surface water streams as well as groundwater. In lieu of specific groundwater basin delineation, one may have to fall back on surface hydrological divides to make a gross approximation of groundwater basins. It is realized that this assumption is likely not valid, but considering the County's groundwater basins have not yet been delineated, such an approach is the closest we have for analytical purposes. There may be some groundwater basins that cross surface hydrologic divides, but the presumption is that there are multiple smaller groundwater aquifers for every surface watershed.

As Table 2 and Figure 2 highlight, the dominant population, and therefore the dominant water demand, is coming from a relatively small area of the county. Since groundwater recharge (supply) is fairly consistent throughout the County, but water usage (demand) is not, then everything else being equal, the areas of higher demand will likely suffer greater water shortages, especially during droughts. In addition, the areas with higher population densities are more likely to be depleting the aquifers at a greater rate, perhaps even beyond the point of sustainability. This analysis is also relevant since the placement of additional water supply wells within the same recharge zones of existing wells, may not serve an actual gain in water availability.

The Board of Supervisors for Fauquier County and the Fauquier County Water and Sanitation Authority, the Town of Warrenton's Town Council, and the Fauquier County Planning Commission organized and hosted a Fauquier County Water Summit on September 23, 2014. Prior to this Summit, Fauquier County staff prepared a white paper that summarized major broad water issues and challenges. These listed challenges are as follows:

1) We meet our current water supply needs, but there is not much extra capacity to meet situational or operational needs, or to meet anticipated future needs.

2) Our current paradigm of where we locate community water supply wells may not be the most effective given all our existing constraints, as well as future needs.

3) Planning and decision-making is complicated by the lack of formalized roles and responsibilities between Fauquier County and Fauquier County Water and Sanitation Authority (WSA).

4) Short-term operational needs are not based on strategic and comprehensive studies and investigations.

5) Long-term strategic needs often take lower priorities to short-term operational needs.

6) Groundwater programs and protocols should be flexible and dynamic, since groundwater needs have evolved over the years, and our institutional understandings of groundwater has increased.

7) Most groundwater efforts are dependent upon multiple organizations, each with its own agenda, goals, policies, priorities, and viewpoint towards groundwater.

8) Groundwater monitoring and wellhead protection have both strategic and operational benefit, as such, there is a general unwillingness to overcome inertia due to the multiple functions required, and uncertainty in who should be the lead organization, and who should fund what.

9) There is an inherent conflict between the rights and needs of individuals living in groundwater recharge areas with the needs of the communities depending upon the recharge to that aquifer.

10) We currently have little understanding of the extent of our groundwater aquifers and their long term sustainability.

11) Many County policies may have unanticipated consequences upon groundwater quality and quantity, since these considerations may or may not have been evaluated when the policy was adopted.

12) There are some inconsistent policies relative to groundwater resources, such as community water systems.

13) We currently have little understanding how our groundwater may be managed in a way that promotes or supports other county initiatives and emphases, such as economic development.

14) Water re-use is an approach to be explored for our supply needs over time.

15) The County has invested large sums of money developing groundwater resources, but we have committed little resources in protecting those investments from threats.

- Continued -

16) Land-use decisions affecting a potential well site's suitability are often made long before a community explores its water supply expansion options.

17) Groundwater supplies from wells are not static, they change over time and the influence of outside events. They rarely improve with time. Understanding our groundwater supply is not finite, and this is important to the long-term sustainability of these resources.

18) Once an individual private well is approved and developed, there is very little in the way of public support to that well owner.

19) The County has no active plans or programs focused on groundwater protection.

20) There are currently discrepancies between the Comprehensive Plan and the Zoning Ordinance regarding centralized water systems versus individual wells. Specifically, should the County's policy encourage or discourage central water systems over individual wells for Fauquier County residents located outside of a Service District?

21) The County's Comprehensive Plan currently does not treat water in a unified holistic and integrated matter. There are multiple chapters that deal with water, but there is little integration or consistency.

One of the principal speakers during this Summit was a hydrogeologist who worked for a private hydrogeologic consulting firm that has completed groundwater studies within the County. This hydrogeologist cited six key issues and six recommendations. They are as follows:

- Certain Service Districts within the County are potentially threatened by either the presence of land uses that could, or have, adversely impact groundwater quality and/or are within areas where groundwater withdrawals (needed to meet future growth) may exceed groundwater recharge rates. Those areas designated as "Sensitive" will require additional and detailed investigation.

- Fauquier County has not defined the Groundwater Recharge Areas for their Existing Groundwater Production Wells.

- Fauquier County has few land use policies that serve to protect the groundwater resources that the County depends entirely upon for potable water supply.

- Spills and leaks of chemicals into the ground can go unnoticed until they contaminate public water sources.

- Changes in land use can adversely impact groundwater quality.

- It is necessary to understand the impacts that land uses can have on groundwater quality and use Best Management Practices to the extent that is reasonable/possible to prevent spills and leaks of contaminants into the groundwater system.

Furthermore, he described the process that Augusta County used to develop a groundwater monitoring plan to assure that contaminated groundwater is not migrating to production wells, and recommended that Fauquier take similar steps with their production wells.

He noted that potential contaminant threats within groundwater development areas are moderate to high in the Marshall area, high in the Opal area, and moderate in the Bealeton, New Baltimore, and Warrenton areas.

He emphasized that the County needs to ensure that groundwater is sufficiently available to meet the already determined build-out needs of the Service Areas. Also, if you are spending money on evaluating sewer service, you should have an equal understanding of the potential for developing groundwater sources. We cannot change the geology but we can plan land use to protect resources.

Based upon this information, he recommended that during the next five years, the County:

- Commit to a long range plan of water supply management and protection.
- Define specific groundwater recharge zones surrounding key production wells located in "Sensitive Water Supply Areas."
- Carry-out groundwater protection studies at key public groundwater withdrawal sites and incorporate such data into the County's Land Use Management Plan in order to protect the County's infrastructure assets.
- Groundwater studies should first be completed in the Marshall, Bealeton, New Baltimore and Opal Service Districts as these have been designated as the most "Sensitive Groundwater Protection Areas" as part of the Water Resource Management Plan.
- Identify remaining groundwater resources that can be developed both within and directly outside the existing Service District boundaries to meet future water supply demands.
- Develop a County-wide groundwater monitoring program and establish a drought water supply management plan.

1. Wellhead Protection

The source of groundwater is water falling on the ground surface; a portion of that water finds its way into the groundwater. This is called groundwater recharge. In some cases the infiltration that is needed for recharge can take decades, and on the other extreme sometimes it happens instantaneously. The longer it takes to infiltrate the more opportunities the water has to be cleansed of any contaminants that it may have picked up on the surface. Not much is known about specific recharge rates within Fauquier County aquifers, but they are variable and indications are that they are towards the quick-end of the spectrum (low filtration). Aquifers that are on the rapid end of the recharge spectrum are often especially vulnerable to groundwater contamination. However it is important to note when discussing potential threats to groundwater quality, that there are two factors: the

aquifer's vulnerability and its risk. Specific efforts have not been made to quantify these two elements, but indications are that Fauquier County aquifers may have high vulnerability but low risk. The vulnerability rating is related to the nature of the aquifer and recharge zones and its inherent ability to transfer contaminants from the surface into the groundwater, and there is little that could be done to affect this. The risk rating is related to the probability of contaminants being in the recharge zone in the first place. Think of it like nuclear weapons. Nuclear weapons have a tremendous ability to do harm, but the risk is seriously reduced by maintaining strong controls over who has access to nuclear weapons. Similarly, even though a particular region may have a high ability to transmit surface contaminants into the groundwater, through tight control over the use of contaminants on the surface you can significantly reduce the potential of them getting into the groundwater. Measures to control use, access, handling and managing contaminants on the surface within the zone of an aquifer's recharge zone is called wellhead protection. The wellhead refers to the actual well structure that draws water from the aquifer. The recharge zone for that specific wellhead may be small (on the order of only thousands of square feet) or it may be large (on the order of multiple states). Fauquier County groundwater recharge zones have not been mapped, but all indications are that they are on the small side of the spectrum.

Proper wellhead protection usually includes delineation of the recharge zones for specific wells, designing and implementing management practices within this zone to reduce or eliminate potential contaminants being placed on the ground or in any surface waters, thus reducing its ability to pollute groundwater aquifers. These practices may take many forms. In order to represent the wide range of things that could be implemented in a wellhead protection program the following examples are provided (note: these are ONLY examples; it does not imply that any of these will or should be implemented within Fauquier County):

- Permit the placement of parks, conservation easements or other low-risk land uses in this zone;
- Pursue grants to assist homeowners to pump-out, replace or upgrade septic tanks and older leaking sewer lines;
- Install sewer systems and wastewater treatment facilities to replace septic systems and drainfields;
- Change the zoning to accommodate compatible uses and discourage incompatible uses;
- Implement free or reduced price household hazardous waste collection events;
- Implement tighter standards and controls on various permitted activities that regulate and perhaps safeguard potential contaminant usage (for instance, require a more rigorous review of pesticide application permits within the recharge zone);
- Locate wells outside of Service Districts for those Districts in which the highest risk of contaminants is located, and locate wells within those Service Districts in which the highest risk of contaminants come from outside District boundaries (in other words, strategically place the wells to separate them from the highest risk of contaminants).
- Build redundancy into water sources so that flexibility and adaptability may be deployed. For instance, if there is a spill in one well's recharge zone, you may quickly switch to using the back-up well in a separate recharge zone, while the

spill is being contained and cleaned up and readied for putting back on line;

- Since many contaminants are released unknowingly, a wellhead protection program may include a strong and active educational component, ranging from public demonstrations, exhibits, and brochures and announcements, to special school programs that communicate things we can do to make a positive impact to our groundwater quality;
- Deploy regulations and requirements or restrictions; and
- Implement a host of homeowner and business volunteer incentives to encourage better practices.

2. Water Use Management

Whether water comes from the ground or surface, one of the most effective ways to save money and precious commodities such as water, is to find ways to manage what you already have more efficiently and wisely. It costs money to increase the water supply capacity of a surface water or groundwater source. Therefore, strategies to find and repair leaks in existing water sources would be an inexpensive solution to increase water capacity and supply. In addition, most of Fauquier County's water distribution network and infrastructure is designed around having the water source, such as a well, in relatively close proximity to the users; however, the distribution of the natural water supply does not necessarily correspond to the distribution of population density and water demand. Therefore, we can be left with a situation in which one area of the County has excess water supply and other areas of the County are in severe deficit. One way that the County could correct this without the addition of new water supplies, is the investment in an integrated water distribution system that would enable water sharing in different parts of the County.

Another potentially effective water management strategy is the efficient re-use of water. In some water use applications, only a portion of the water that is piped in is used, with the rest returned to a stream or sent into an already overloaded wastewater treatment plant. If this unused water could be captured and placed in more effective and efficient use, then considerably less new water sources would need to be tapped. Similarly, some water, such as stormwater run-off, may have been partly tainted for certain usage by the absorption of substances lying on the ground or on roads and parking lots. If this water could be treated or used by certain entities not concerned with these other products in the water, then a lot of existing water could be reallocated to different usages. For instance, approximately 50 percent of potable drinking water in Florida is used for agricultural purposes. If Florida could use stormwater run-off or other currently "unused" water sources for agriculture that does not require the same level of treatment as drinking water does, they would instantaneously double its drinking water supply without drilling a single new well. These options of being more efficient with water could be explored for Fauquier County.

E. Biologic Resources

From its agricultural and forestry roots, to the scenic open-space vistas, hunting traditions, to its rural characterization and sense of self, Fauquier County has long recognized and appreciated the County's biological resources.

1. Forest Resources

Fauquier County supports a wide variety of flora and fauna. There are 17 different forest cover types found in varying degrees within the County. According to the United States Forest Service 1992 Forest Survey, Fauquier County has 175,188 acres of forested land all of which is classified as commercial forest land. This land is distributed throughout the County in tracts ranging from a few acres to hundreds of acres in size.

The forest lands within the County not only provide raw materials for forestry-related industries and an income for forest landowners, they also provide environmental benefits to all of the people residing within the County. These benefits include watershed protection, soil erosion and stream sedimentation control, recreational opportunities, air pollution and noise mitigation, screening for privacy, wildlife habitats, and general visual beauty.

Approximately 17,000 acres of forest land has been lost to other uses since 1976. Decreases in forest land can be attributed to development pressure, increased housing needs, and population growth. All of these elements contribute to, and influence, land use, ownership patterns, owner tenure, and other management objectives.

Forest fragmentation and incongruent land uses are also important issues. Forest fragmentation negatively affects Fauquier County in many ways, such as: limiting the scale and thus the suitability for commercial forest harvesting; wildlife habitat loss and loss of migration connectivity; increases the susceptibility of wind-throw damage; and increasing the potential for adjacent non-compatible uses. Good land-use planning usually attempts to avoid having small residential lots surrounded by high-use commercial lots, agricultural operations, commercial forestland, and heavy industrial lands. Without active land-use planning, forest fragmentation can encourage the shift to other, sometimes, incompatible uses.

The uses of the 175,188 acres of County forest land, as reported in the 1992 Forest Survey, are gradually shifting from the traditional production of forest products, sawtimber, and pulpwood, to a blend of forest products and environmental benefits.

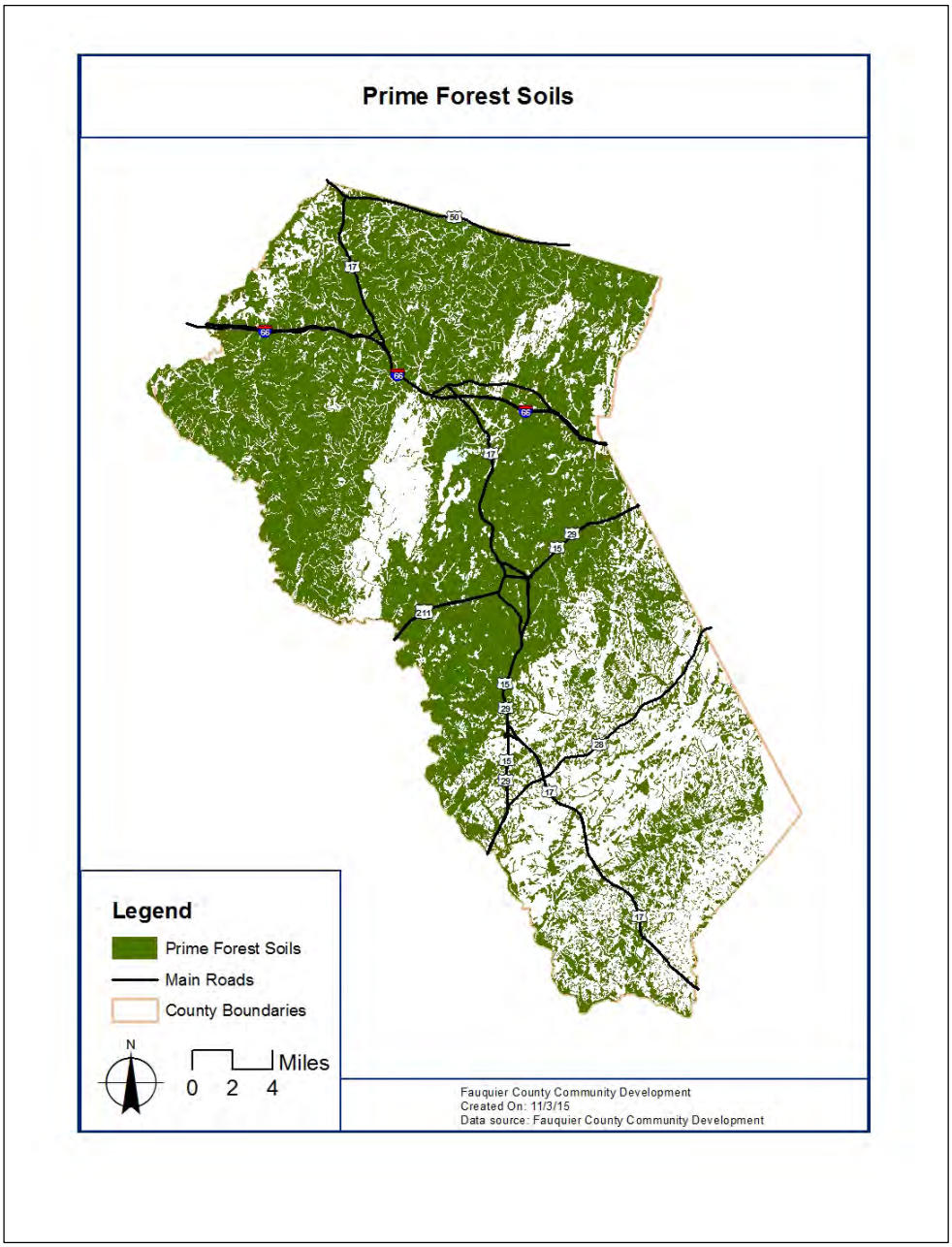

Figure 15 Prime Forest Soils

2. Agricultural Resources

Agriculture remains an important and vital industry within Fauquier County. Some of the major agricultural and agricultural-related industries within Fauquier County include: beef; dairy; horse; corn; soybean; hay; pasture; crops; fruit, tree nut and berry; and wineries. It should be noted that the County's natural resources, such as its soil, water and open space elements are integral components supporting this industry, and as such, efforts should be implemented to sustain these resources

and other related beneficial values. In addition, it was mentioned in the Soil Resources section, the management, conservation and retention of prime agricultural soils is important for the long-term sustainability of agriculture within Fauquier County.

3. Fisheries

There are no significant commercial fisheries within Fauquier County, but there is a well-regarded recreation fish industry. Fishing in the County's lakes and ponds for warm water fishes such as largemouth bass, bluegill, redear sunfish, black crappie and channel catfish remain popular for many local residents, the fishing in Upper Rappahannock River for smallmouth bass, and striped bass attract more wide-ranging interest. Some threats to fish communities include water quality problems, lack of stream cover, siltation, an overabundance of aquatic vegetation, and predation from non-native species.

Since fish live in the water it is easy to image how water quality may affect them. Poor water quality affects not only the health of the fish, but also the health of the people consuming the fish, since fish tissue can hold and even concentrate a variety of contaminants that could create illness to people eating the fish.

The removal of stream cover, or the vegetation lining stream banks, can have serious consequences along three broad categories: promote erosion, increase temperature and the reduction of protective cover. Vegetative buffers often help shade the water keeping it cooler during the intense mid-day sun. The vegetative buffer also gives aquatic organisms hiding cover and it helps stabilize stream banks from erosion.

An excess quantity of silt emptying into streams can have a severe negative impact upon fish, including the smothering of natural substrate, the interruption of food dynamics, and a host of other habitat and bodily function complications.

An abundance of aquatic vegetation, especially from non-native species, is often the result of high nutrient levels entering the water. This combination can have significant impact upon fish and other aquatic organisms by altering the habitat and the depletion of dissolved oxygen levels in affected waters.

Non-native species often compete or outright prey on native or target fish species, thereby disrupting the natural community dynamics in the residual fish species.

The situation with the migratory American shad provides an important case study in how interconnected natural resources are, and the importance of factoring natural resources into decision-making processes.

The Rappahannock River once had a vibrant American shad population that attracted wide-spread recreational fishing interest, and the American shad was once the dominant commercial fishery in the Chesapeake Bay. However, the construction of the Embrey Dam on the Rappahannock River in Fredericksburg in the 1800s cut off access to the shad's up-river spawning grounds. The population plummeted, as well as the industries and recreational opportunities dependent on the shad. Interests in restoring the shad population led the public to remove the

Embrey Dam in 2004. However, the remnant fish were no longer imprinted to return and spawn in the upper river. Intervention was required. Through a multi-agency and multi-disciplinary partnership, millions of shad fry were raised in a hatchery and released in the upper river. Consequently, the population is slowly beginning to recover.

4. Hunting

Fauquier County has a long history in supporting hunting activities. Some of the popular hunted species include: turkey, waterfowl, deer, dove, quail, woodchuck and rabbit.

Fauquier County has an important and vibrant hunting with hounds tradition that continues to be an important contributor to the County's economy. In 2008 the County's Board of Supervisors approved a resolution that adopted recommendations provided the Hunting with Hounds Stakeholder Advisory Committee. This resolution reinforced the importance that hunting with hounds is to Fauquier County residents, and clarified and resolved important issues, such as access and safety.

Non-native species often compete or outright prey on native or target species, thereby disrupting the natural community dynamics in the residual populations.

5. Threatened and Endangered Species

The U.S. Fish and Wildlife Service is the lead agency for Threatened and Endangered (T&E) species at the national level. The Virginia Department of Game and Inland Fisheries and the Virginia Department of Agriculture and Consumer Services share lead responsibilities for state-level threatened and endangered species within Virginia. Virginia Code §3.2-1000 through 1011 provides the direction for Virginia Department of Agriculture and Consumer Services' management of state-level endangered and threatened species of plants and insects, while Virginia Code 29.1-563 through 570 provides the direction for Virginia Department of Game and Inland Fisheries for the management of state-level threatened and endangered fish and wildlife.

The County's land management and stewardship responsibilities towards threatened and endangered species should support and complement these national and state efforts. The County recognizes that while the protection and conservation of rare, threatened and endangered species are worthy and mandated goals, such efforts can be expensive and labor intensive. Therefore, responsible land stewardship responsibilities should also include having the County support and complement state and national efforts to professionally manage and conserve other non-threatened and endangered species. It is much more cost effective to keep species populations stable than to bring them back from the point of near extinction.

The following table outlines the species that hold special state or national level legal protections:

		State Status	Federal Status	State Ranking
Legal Status Species				
Vertebrates				
Mammals				
Northern Long-eared Bat	*Myotis septentrionalis*	-	T	?
Reptiles				
Wood Turtle[3]	*Glyptemys insculpta*	T	-	S2
Amphibians				
Shenandoah Salamander[3]	*Plethodon shenandoah*	E	E	S1
Birds				
Upland Sandpiper	*Bartramia longicauda*	T	-	S1B
Loggerhead Shrike	*Lanius ludovicianus*	T	-	S2B,S3N
Peregrine Falcon	*Falco peregrinus*	T	-	S1B,S2N
Henslow's Sparrow[3]	*Ammodramus henslowii*	T	-	S1B
Invertebrates				
Bivalves				
Dwarf Wedgemussel[3]	*Alasmidonta heterodon*	E	E	S1
Brook Floater[3]	*Alasmidonta varicosa*	E	-	S1
Green Floater	*Lasmigona subviridis*	T	-	S2
Lepidoptera				
Appalachian Grizzled Skipper	*Pyrgus wyandot*	T	-	S1
Heteroptera				
Virginia Piedmont Water Boatman[3]	*Sigara depressa*	SOC	E	S1,S2
Plants				
Sensitive Joint-vetch[3]	*Aeschynomene virginica*	-	T	S2
Harperella[1]	*Harperella vivipara*	E	E	S1
Small Whorled Pogonia[3]	*Isotria medeoloides*	E	T	S1
Ginseng	*Panax quinquefolius*	T	-	?

Table 4: Legal Status Species

Note regarding the table of threatened and endangered species: as the footnote indicates, not all of these species have been confirmed in Fauquier County. A good example is the small-whorled pogonia. The small-whorled pogonia (*Isotria medeoloides*), is a small, federally and state-listed Threatened plant species potentially located in southern Fauquier County. Virginia's Department of Conservation and Recreation's Natural Heritage Program has identified the

[3] Habitat may occur in Fauquier County, but so far this species has only been confirmed in adjacent counties.

plant's existence in nearby counties and have identified potentially similar habitat within the extreme southern portions of the County, but to date, no surveys have yet attempted to verify the plant's presence in Fauquier County.

Small-whorled pogonia occurs on upland sites in mixed-deciduous or mixed-deciduous/coniferous forests that are generally in second or third-growth successional stages. Characteristics common to most site occurrences include sparse to moderate ground cover in the species' microhabitat, a relatively open understory canopy, and proximity to features that create long-persisting breaks in the forest canopy. Soils at most sites are highly acidic and nutrient poor, with moderately high soil moisture values.

The seven action items identified in the small-whorled pogonia recovery plan are: 1) protect known populations and habitat; 2) manage protected habitats; 3) monitor existing populations; 4) survey for new populations; 5) investigate population dynamics; 6) investigate species biology; and 7) provide public information and education.

The Endangered Species Act requires an evaluation of potential harm to listed species. This potential harm includes harming listed species even if you knew they were there or not. Reasonable efforts must be demonstrated that the species is not present or that your proposed activity will not harm them. Therefore, for proposed projects within suitable habitats of listed species, professional surveys are often considered the first of perhaps several steps that must be taken to demonstrate reasonable effort to assess potential harm. Besides these legal issues associated with compliance with federal and state threatened and endangered species laws, many people believe that Fauquier County as a land steward has a responsibility to not unknowingly degrade the resources and values entrusted to our care and stewardship. It is for these reasons that efforts to explore opportunities and partnerships that would further the inventory and assessment of this and other protected species within the boundaries of Fauquier County should be pursued.

6. Natural Heritage Resources

Natural heritage resources as defined by the Virginia Department of Conservation and Recreation – Division of Natural Heritage (DCR) are the habitat of rare, threatened, or endangered plant and animal species, unique or exemplary natural communities, and significant geologic formations such as caves and karst features. Fauquier County is currently home to 59 distinct types of natural heritage resources with 103 total occurrences throughout the county. In addition, DCR has identified 32 terrestrial and aquatic conservation sites as areas necessary for their survival.

DCR identifies and protects natural heritage resources statewide and maintains a comprehensive database of all documented occurrences of natural heritage resources in Virginia. DCR has developed conservation sites that contain known populations of natural heritage resources and include adjacent or surrounding habitat vital for their protection. Conservation sites do not represent protected lands. They are recommended for protection and stewardship because of the natural heritage resources and habitat they support, but are not currently under

any official protection designation. Conservation sites are polygons built around one or more rare plant, animal, or natural community designed to include the element and, where possible, its associated habitat, and buffer or other adjacent land thought necessary for the element's conservation. Conservation sites can be used to screen development projects for potential impacts to natural heritage resources, aid local and regional planning, identify targets for acquisitions and easements and guide priorities for restoration activities.

The last table listed the legally-protected species. This special legal status has been determined to be valuable in the protection of imperiled species. However, conservation measures for imperiled species are costly, due to the few available options; and they are disruptive to local communities, due to legal mandates providing little flexibility. Therefore, the approach some localities take is to voluntarily provide conservation measures for species that may be on the verge of having the more restrictive legal status imposed, on the thought that it is easier and less expensive to keep a species off the Threatened Endangered list than getting them off the list once they are on it. Under this philosophy, the following table of Fauquier County species that may warrant some form of additional measures to assist their sustainability. Reminder, these species do not have ANY legal protection or requirement.

		State Status	Federal Status	State Ranking
Non-Legal Status Species				
Invertebrates				
Bivalves				
Yellow Lance	*Elliptio lanceolata*	-	SOC	S2,S3
Yellow Lampmussel[3]	*Lampsilis cariosa*	-	-	S2
Eastern Lampmussel[3]	*Lampsilis radiata*	-	-	S2,S3
Insects				
Frosted Elfin[3]	*Callophrys irus*	-	-	S2?
Northern Barrens Tiger Beetle	*Cicindela patruela*	-	-	S2
Mottled Duskywing	*Erynnis martialis*	-	-	S1/S3
Regal Fritillary	*Speyeria idalia*	-	-	S1
Caddis Flies				
A Philopotamid Caddisfly[1]	*Wormaldia thyria*	-	-	S2
Vertebrates				
Birds				
Bobolink[3]	*Dolichonyx oryzivorus*	-	-	S1B
King Rail[3]	*Rallus elegans*	-	-	S2B/S3N

Plants

Non-vascular Plants				
Appalachian Fir Clubmoss[3]	*Huperzia appressa*	-	-	S2
Northern Bog Clubmoss[3]	*Lycopediella inundata*	-	-	S1
Carolina Peatmoss[3]	*Sphagnum carolinianum*	-	-	S2
Vascular Plants				
Earleaf False Foxglove[3]	*Agalinis auriculata*	-	-	S1
Pearly Everlasting	*Anaphalis margaritacea*	-	-	S1
Spreading Rock Cress[3]	*Arabis patens*	-	-	S2
Short's Rockcress[3]	*Arabis shortii*	-	-	S2
Bristly Sarsaparilla[3]	*Aralia hispida*	-	-	S2
Purple Milkweed	*Asclepias purpurascens*	-	-	S2
Red Milkweed	*Asclepias rubra*	-	-	S2
Bradley's Spleenwort[3]	*Asplenium bradleyi*	-	-	S2
River Bulrush[3]	*Bolboschoenus fluviatillis*	-	-	S2
American Bluehearts	*Buchnera americana*	-	-	S1/S2
Carolina Fanwort[3]	*Cabomba caroliniana*	-	-	S2
Brown Bog Sedge	*Carex buxbaumii*	-	-	S2
Crested Sedge[3]	*Carex cristatella*	-	-	S1?
Variable Sedge[3]	*Carex polymorpha*	-	-	S2
Velvety Sedge[3]	*Carex vestita*	-	-	S2
Purple Clematis[3]	*Clematis occidentalis* var. *occidentalis*	-	-	S2
Round-leaf dogwood[3]	*Cornus rugosa*	-	-	S1
Pear Hawthorn	*Crataegus calpodensron*	-	-	S1
Hazel Dodder[3]	*Cuscuta coryli*	-	-	S2?
Beaked Dodder[3]	*Cuscuta rostrata*	-	-	S2
Flat-stem Spikerush[3]	*Eleocharis compressa* var. *compressa*	-	-	S2
Parker's Pipewort[3]	*Eriocaulon parkeri*	-	-	S2
White Trout-lily[3]	*Erthronium albidum*	-	-	S2
Spotted Joe-pye-weed[3]	*Eutrochium maculatum* var. *maculatum*	-	-	S1
Queen-of-the-Prairie	*Filipendula rubra*	-	-	S2
Rough Avens	*Geum laciniatum*	-	-	S2
Appalachian Quillwort[3]	*Isoetes appalachiana*	-	-	S2
Black-footed Quillwort[3]	*Isoetes melanopoda*	-	-	S1?
Marsh Pea[3]	*Lathyrus palustris*	-	-	S1
Winged Loosestrife[3]	*Lythrum alatum*	-	-	S2
Starflower Solomon's-plume[3]	*Maianthemum stellatum*	-	-	S2
Marsh Muhly[3]	*Muhlenbergia glomerata*	-	-	S2
Bog Fern	*Parathelypteris simulata*	-	-	S1,S2
Downy Phlox[3]	*Phlox pilosa*	-	-	S1
Large Purple Fringed Orchid[3]	*Platanthera grandiflora*	-	-	S1
Purple Fringeless Orchid	*Platanthera peramoena*	-	-	S2
Bog Bluegrass	*Poa paludigena*	-	-	S2
Canada Plum	*Prunus nigra*	-	-	S1?
Basil Mountain-mint	*Pycnanthemum clinopodiodes*	-	SOC	S1
Torrey's Mountain-mint	*Pycnanthemum torreyi*	-	SOC	S2?

Shinleaf	*Pyrola elliptica*	-	-	S2
Bur Oak[1]	*Quercus macrocarpa*	-	-	S1
Stalkless Yellow Cress[3]	*Rorippa sessiliflora*	-	-	S1
Climbing Prairie Rose	*Rosa setigera*	-	-	S1
Stiff Goldenrod	*Solidago rigida* var. *rigida*	-	-	S2
Rand's Godlenrod[3]	*Solidago randii*	-	-	S2,S3
Tall Dropseed[3]	*Sporobolus compositus* var. *compositus*	-	-	S1,S2
Hairy Hedge-nettle[3]	*Stachys arenicola*	-	-	S1
Epling's Hedge-nettle	*Stachys eplingii*	-	-	S1
Short's Aster[3]	*Symphyotrichum shortii*	-	-	S1
Western Poison Ivy[3]	*Toxicodendron rydbergii*	-	-	S1
Narrowleaf Bluecurls	*Trichostema setaceum*	-	-	S2
Buffalo Clover[3]	*Trifolium reflexum*	-	-	S1
Nodding Trillium	*Trillium cernuum*	-	-	S2
Pink Valerian[3]	*Valeriana pauciflora*	-	-	S2
Sand Grape[3]	*Vitis rupestris*	-	-	S1?

Historic (removed historic listings for adjacent counties (if not previously been found in Fauquier County))

<u>Plants</u>

Yellow Avens	*Geum aleppicum*	-	-	SH
Long-beaked Buttercup	*Ranunculus longirostris*	-	-	SH
Long-leaf Wedgegrass	*Sphenopholis filiformis*	-	-	SH

Key to Species List:

State and Federal Status

- **E -** Endangered
- **T -** Threatened
- **SOC** - Species of Concern; an informal term that refers to those species which might be in need of concentrated conservation actions. Such conservation actions vary depending on the health of the populations and degree and types of threats. At one extreme, there may only need to be periodic monitoring of populations and threats to the species and its habitat. At the other extreme, a species may need to be listed as a Federal threatened or endangered species. "Species of concern" receive no legal protection and the use of the term does not necessarily mean that the species will eventually be proposed for listing as a threatened or endangered species.

State Ranking

- **S1 -** Critically imperiled in the state because of extreme rarity or because of some factor(s) making it especially vulnerable to extirpation from the state. Typically 5 or fewer populations or occurrences; or very few remaining individuals (<1000).
- **S2** - Imperiled in the state because of rarity or because of some factor(s) making it very vulnerable to extirpation from the state. Typically 6 to 20 populations or occurrences or few remaining individuals (1,000 to 3,000).
- **S3 -** Vulnerable in the state either because rare and uncommon, or found only in a restricted range (even if abundant at some locations), or because of other factors making it vulnerable to extirpation. Typically 21 to 100 populations or occurrences (1,000 to 3,000).

- **S#B** - Breeding status of an animal within the state
- **S#N** - Non-breeding status of animal within the state. Usually applied to winter resident species.
- **S#?** - Inexact or uncertain numeric rank.
- **SH** - Possibly extirpated (Historical). Historically known from the state, but not verified for an extended period, usually > 15 years; this rank is used primarily when inventory has been attempted recently.
- **S#S#** - Range rank; A numeric range rank, (e.g. S2S3) is used to indicate the range of uncertainty about the exact status of the element. Ranges cannot skip more than one rank.

Table 5: Non-legal status Species

Figure 16 **Spotted Turtle in Fauquier County. This is an uncommon species in the County. Note: the two puncture holes on the top of the shell may indicate tooth marks from a dog or other predator.**

7. Exotic Species

Species not native to Virginia can have significant impact to our economy and our natural ecosystems. These exotic organisms can and do contribute to the extirpation of entire species. Most of these species were introduced to Virginia either intentionally, such as releasing exotic pets to the wild, or else accidently. Accidental releases may range from insects that may have hitched a ride in an order of exotic fruit bought at the store, transported inside fire wood collected elsewhere, attached on our clothing only to fall off later, to hitching a ride on our boats and other outdoor equipment that is used in different habitats. Education is an effective means to manage these impacts.

Where appropriate, County policies should promote native species and reduce the negative affect of non-native species. Some non-native species are fairly benign and do not cause much harm to Fauquier County ecosystems. Some non-native plant species are known as noxious weeds. Noxious weeds are defined as a plant not widely disseminated which is detrimental to crops, surface waters, including lakes, or other desirable plants, livestock, land, or other property, or to be injurious to public health or the economy. Guidance in pest management may be found in the Virginia's Noxious Weed Law 2VAC5-317, Code of Virginia 15.2-902, and Code of Virginia 3.2-700.

The Virginia Department of Agriculture and Consumer Services is authorized to provide financial and technical assistance to, and enter into agreements with, any locality which adopts an ordinance for the control of Johnson grass or multiflora rose.

Any locality may by ordinance control the growth of musk thistle, the weed designated as *Carduus nutans* L., a biennial weed of the Compositae family, or curled thistle, the weed designated as *Carduus acanthoides* L., an annual and biennial weed of the Compositae family. Any such musk thistle or curled thistle growing in the locality may be declared a public nuisance and noxious weed, harmful to plant and grass growth and to pastures.

In 2000 the Virginia General Assembly listed purple loosestrife as a noxious weeds.

Among other things, the Virginia Noxious Weed Law provides localities authority to develop ordinances and control certain noxious weeds (Johnson grass, multiflora rose, and musk or curled thistle).

2VAC5-317-20 established Tier 1 and Tier 2 noxious weeds:

Tier 1:

beach vitex	*Vitex rotundifolia*
giant salvinia	*Salvinia molesta*
tropical soda apple	*Solanum viarum*
giant hogweed	*Heracleum mantegazzianum*
wavyleaf basketgrass	*Oplismenus hirtellus undulatifolius*

Tier 2:

Cogon grass	*Imperata cylindrica*
Purple loosestrife	*Lythrum salicaria*
Water spinach	*Ipomoea aquatica*

Johnsongrass is a non-native plant brought to the United States as potential hay and pasture grass; however, in some situations, it can be toxic to livestock. In addition, can quickly infest landscapes and choke-out desirable species. It is considered a significant pest. A 2004 survey indicated that Fauquier County had 17,600 Johnsongrass-infested acres. This monitoring indicated that Fauquier County had a significant Johnsongrass problem, and that it was growing. This led to the creation of a Johnsongrass control program and the adoption of an ordinance specific to Johnsongrass.

F. Air Resources

The overriding law governing air quality standards is the Clean Air Act. The federal agency responsible for implementing and enforcing this Act is the Environmental Protection Agency (EPA). At the state level, the Department of Environmental Quality (DEQ) has the primary responsibility for regulating air quality and implementing the regulations under the Virginia Air Pollution Control Board. County governments have the responsibility to implement local land-use plans consistent with meeting these broader state and national standards.

Fauquier County generally has good air quality. To date, the County has received no air quality standard exceedances and we are not in any designated non-attainment area. In 2012, the American Lung Association gave Fauquier County a rare "A" grade for air quality, partly due to having no high ozone days the previous year. However, we should not take air quality for granted. Areas in Virginia to the east and north have significant air quality issues that they have been grappling with for years, especially related to ozone and particulate matter. Air quality problems in neighboring counties and the Washington, D.C-MD-VA Region non-attainment area have the potential to expand and create problems in Fauquier County, since air pollutants do not recognize county and political boundaries. Air quality degradation within Fauquier County may likely get worse in the future if the demographic trend of Fauquier County residents finding jobs outside of the County continues and the County becomes increasingly a community of commuters.

G. Climate and Weather Resources

The most important environmental factor controlling drought conditions is precipitation. Most of the National Oceanic and Atmospheric Administration (NOAA) weather stations located in Fauquier County, such as Marshall, Remington, The Plains, Delaplane and Warrenton, have been discontinued. Fortunately, two of these stations (The Plains and Warrenton) were only recently discontinued, so data from these stations were included in NOAA's recent 30-year Normal determinations.

"Normal" precipitation is a statistical mean of a moving 30-year interval. Therefore, mean precipitation for the year 2011 would be 1982 through 2011, while the mean precipitation for the year 2012 would be 1983 through 2012. However, these 30-year Normal values are updated only once every ten years, so the most recent of these "Normal" 30-year periods was from 1981 to 2010.

These 30-year Normal precipitation data lists the Normal annual precipitation for Warrenton as 40.7 inches, and 42.24 inches for The Plains.

Data from these stations are no longer being collected, however, this data can be used to assess which other nearby stations best represents precipitation totals within Fauquier County. To assess the current weather stations proximity and potential representative of Fauquier County's climate variables, the stations that passed the initial screening and analysis are as follows:

- Boston, VA
- Mount Weather VA
- Washington, DC International Airport at Dulles

The 30-year Normal data for each of these three sites were tabulated, graphed and assessed in comparison with the 30-year Normal precipitation data for The Plains and Warrenton. A summary of this data is depicted in the following table and figure.

Month	Warrenton [el. 500 ft.]	The Plains [el. 530 ft.]	The Dulles [el. 290 ft.]	Mt. Weather [el. 1,659 ft.]	Boston [el. 590 ft.]
	inches	inches			
January	3.02	3.04	2.68	2.88	2.70
February	2.78	2.86	2.74	2.96	2.58
March	3.52	3.68	3.38	3.56	3.70
April	3.68	3.56	3.47	3.69	3.44
May	4.56	4.72	4.55	4.48	4.35
June	4.23	4.01	3.98	4.24	4.25
July	4.27	3.71	3.67	3.81	5.20
August	3.77	3.88	3.53	3.45	3.56
September	4.50	4.37	3.92	4.52	4.35
October	3.22	3.46	3.25	3.43	3.48
November	3.53	3.72	3.41	3.51	3.97
December	3.40	3.04	2.96	2.95	2.98
Total	44.48	44.05	41.54	43.48	44.56

Table 6: Normal Precipitation (in inches) of Weather Stations near Fauquier County

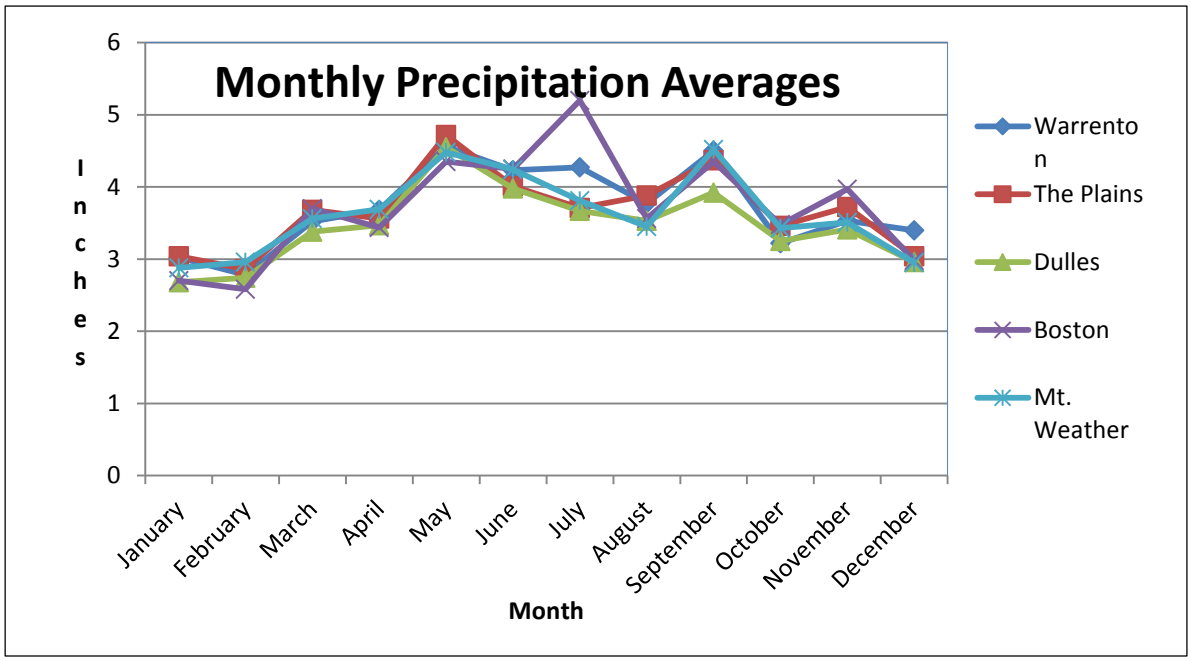

Figure 17 Monthly Precipitation Averages for Weather Stations near Fauquier County

The Warrenton-Fauquier Airport and the Culpeper Airport have automated weather stations in which data is accessible over the Internet for a maximum of three days. In these stations, data going back more than three days is not retrievable, therefore, is of limited use for many County analysis and planning purposes.

Whether due to natural processes, human influence or a combination of the two, there is little doubt that global climate processes are in flux. Global models indicate that the effect of climate change is likely to be distinctly different in various parts of the world. At this stage, it is challenging to accurately predict how these complex changes may influence Fauquier County. As these models and predictions become more refined, it may be beneficial for the County to explore options and actions that we could take to transition us into the new climate regime in a manner less impactful to Fauquier County residents, businesses and economies. The more effective measures are more likely to come from local strategies from Fauquier County leaders, communities, businesses and residents, rather than wait for some top-down approach.

H. Scenic Resources

Scenic beauty is a resource which is often difficult to quantify, yet once disturbed, it is often impossible to recapture. Areas of scenic beauty abound within Fauquier County. Some scenic areas are undisturbed, rugged, and in their natural state. Other areas of scenic beauty are human-made and many include settlement areas. Still other areas of such beauty are a combination of natural and human-made forces such as farmlands.

In an attempt to identify those places and areas considered most scenic, a Scenic Analysis Study was conducted by the County in 1974 to determine if there was any basis for general agreement as to what constituted scenic wild lands, agriculture lands, and settlement areas. Through a photographic analysis and a comparison made of these photographs by a number of laymen and professionals, it was determined that there was a substantial amount of agreement as to what constituted the best and worst in each of the above-mentioned categories. There was much less agreement in determining the boundaries or criteria between categories. Based on the results of this study, the entire County was inventoried and those areas ranking in the top categories were delineated as scenic areas.

The 1974 study has also been utilized to determine the impact of major residential developments in rural areas. Such developments are considered in terms of their impact on areas with a 'scenic rating.' Where impacts are deemed to exist, site improvements including streets and lot layout must take advantage of topography so as to diminish adverse visual impacts and maintain, to the best extent possible, the scenic qualities of the area.

So many things have changed in the County since 1974. It is recommended that a new Scenic Analysis Study be performed since a number of physical changes in the landscape which have occurred since the time of the original study. Specific development and design standards could be included in County ordinances and regulations to ensure development which results in the lowest impacts on these scenic areas.

The County could explore the possibility of establishing rural scenic areas in the form of zoning overlay districts. These districts would assure the protection of existing significant viewsheds and vistas.

I. Open Spaces

With the intent of maintaining the rural characterization of Fauquier County, aggressive Open Space initiatives and programs have been implemented by the County, primarily through the use of land-use planning efforts and the establishment of conservation easements.

1. Conservation Easements

Land in conservation easements is typically privately held, but the landowner has sold or conveyed a restriction on the property. That restriction is usually a commitment to not develop the land any further than it currently is. Usually the owner can still continue living on the land, maintaining their livelihood from the land as they had been doing, but they have sold some of their rights to change the land in certain manners. This partial transfer of rights is usually permanent and follows the land regardless of the owner or any subsequent land sales. These easements may take many forms, such as: an agreement not to add any more buildings to the parcel, or an agreement not to interfere with the viewshed from a historic property.

As of December 2015, most of the conservation easements in the County were held by Virginia Outdoors Foundation. Other easement holders include Fauquier

County, Land Trust of Virginia, The Nature Conservancy, Piedmont Environmental Council, Marsh Resources Inc., and the Virginia Department of Historic Resources. As of December 2015, there was a total of 104,596 acres of conservation easements held within Fauquier County. This represents approximately 25 percent of the total land area of the County. Most of these easements were located in the northeastern part of the County, and to a less extent the northwestern portion of the County. There are fewer easements in the southern parts of the County.

2. Non-common Open Space

The Zoning Ordinance defines "Non-common Open Space" as "that open space that is designed and set aside for the ownership, use and enjoyment of a person not necessarily a resident of occupant of the development, the homeowners association or condominium…" These open spaces usually are confined to housing developments, and are companions to "Common Open Space." Both of these open space types are undeveloped open spaces within housing developments, but the Common Open Space is accessible only to residents of the entire housing development, while the Non-Common Open Space is open to only to the specific and individual land/lot owner. As of December 2015, there were 12,494 acres of Non-common Open Space (note: these acres were include in the 104,596 acres of total conservation easements held in the County). This represents 3.0 percent of the entire County, spread out fairly even across the landscape.

J. Public Conservation Land

The majority of land in Fauquier County is under private ownership (approximately 96 percent). The principal public lands containing notable natural resources include the following:

Name	Acres	Management
Chester Phelps Wildlife Management Area	4,068	VDGIF
G. Richard Thompson Wildlife Management Area	4,000	VDGIF
Bull Run Mountain Natural Area Preserve	2,486	VOF/VDCR
Sky Meadows State Park	1,864	VDCR
Wildcat Mountain Natural Area	655	The Nature Conservancy
Weston Wildlife Refuge	271	VDGIF
CM Crockett Park	152[1]	Fauquier County
Whitney State Forest	147	VA Dept. of Forestry
Ovoka Farm (Appalachian Trial NST)	139	National Park Service
White's Mill	70	FCPRD

Key
1 This figure only includes the land acres. The reservoir's acreage is even larger.

VOF = Virginia Outdoors Foundation
VDGIF = Virginia Department of Game and Inland Fisheries
FCPRD = Fauquier County Parks and Recreation Department
VDCR = Virginia Department of Conservation and Recreation

Table 7: Public Areas of Fauquier County

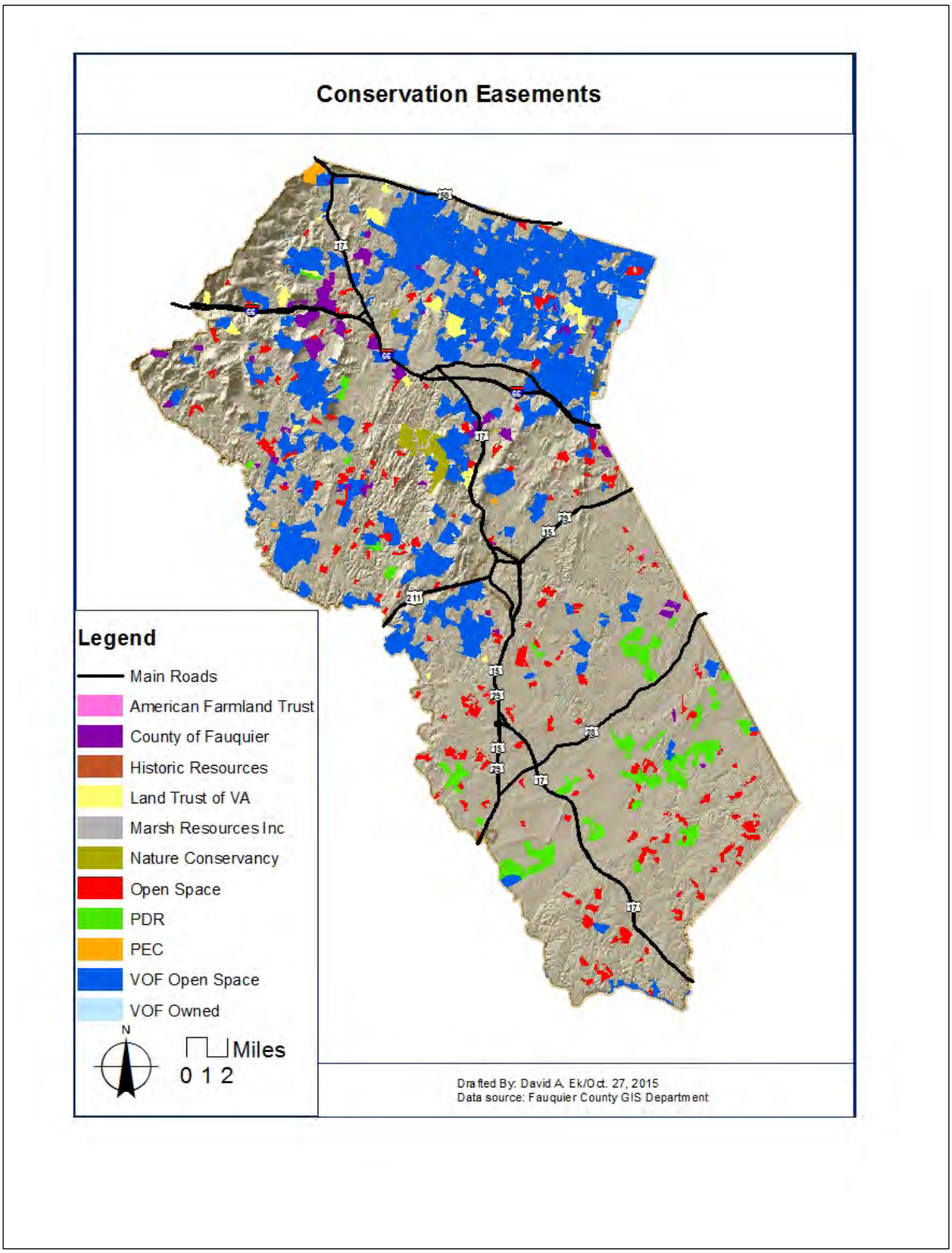

Figure 18 Conservation Easements of Fauquier County

K. Contaminated Sites

The federal government's primary avenue for managing and cleaning abandoned hazardous waste sites is through the provisions of the Comprehensive Environmental Response, Compensation and Liability Act of 1980. These sites are commonly called "Superfund" sites.

There have been three "Superfund sites" within Fauquier County, the "Warrenton Training Center" site northwest of Warrenton, the "Warrenton PCE" site (a private farm/residence) just east of Warrenton, and the "Vint Hill Farms Station" site in New Baltimore. The main contaminant at the Warrenton Training Center was trichloroethylene. The main contaminant at the "Warrenton PCE" site was tetrachloroethylene. The main contaminants at the Vint Hill Station site was lead, total petroleum hydrocarbons (crude oil), chlordane, DDT, mercury, silver, polychlorinated biphenyl (PCB), dioxin/furans, benzo(a)pyrene and selenium. The source of this material was military operations for two of the sites and an informal permission to dump waste in a ravine for one of the sites. Remediation and water monitoring have subsequently occurred and continues to the present. Although mitigation and restoration has occurred in all three sites, all three are still considered active Superfund sites. The federal Environmental Protection Agency (EPA) turns over all "non-priority" superfund sites to the state to manage and monitor. As of 2015, these three Fauquier County superfund sites are listed as "non-priority" sites; therefore, they are managed by the Virginia Department of Environmental Quality (DEQ).

L. Wastewater Management

There are four public wastewater treatment facilities in Fauquier County: the Fauquier County Water and Sanitation Authority (WSA) operates three of them: Vint Hill, Remington, and Marshall. The Town of Warrenton owns and operates the other facility. The WSA has proposed the addition of several new facilities or upgrades. Each of these four sites operate under separate permits issued by the Virginia Department of Environmental Quality (DEQ).

Due to the Chesapeake Bay Act and the Occoquan Policy nutrient load requirements, DEQ established specific nitrogen and phosphorus limit requirements as conditions of each permitted facility. Within these permits, two separate limits were established for each nutrient, for each facility. The two limits are for specific concentration at any one time (expressed as milligrams per Liter) and the total pounds of the nutrient per year (expressed in pounds per year). A note regarding this data: current state law allows nutrient limits for certain wastewater treatment facilities to be combined with the limits of another facility; such an arrangement is involved in the Marshall and Remington sites, they have been combined for Total Load (pounds per year) values, but they are separated in the individual concentration limits, since Marshall does not flow to the Occoquan River, it is therefore not subject to the provisions of the Occoquan Policy. Lastly, regulations allow the two facilities that Fauquier County empties into the same watershed (the Remington and Marshall facilities both empty into the Potomac River Watershed), to combine the totals for these facilities. Allowing the combining of the limits of more than one facility gives the entity (in this case

WSA) the flexibility to trade nutrients between facilities. For instance, if one facility is over the limit but another is under the limit, an applicant may average the two facilities, perhaps both would be in compliance where otherwise one would have exceeded the limit.

The 2013 nutrient limits of the WSA sites are as follows:

Vint Hill facility:
- Total Nitrogen concentration of 4.0 mg/L
- Total Load of Total Nitrogen of 6,712 pounds per year
- Total Phosphorus concentration of 0.3 mg/L
- Total Load of Total Phosphorus of 382 pounds per year

Remington facility:
- Total Nitrogen concentration of 8.0 mg/L
- Total Phosphorus concentration of 1.5 mg/L

Marshall facility:
- Total Nitrogen concentration of [not applicable]
- Total Phosphorus concentration of [not applicable]

Combined Remington and Marshall facilities:
- Total Load of Total Nitrogen of 19,618 pounds per year
- Total Load of Total Phosphorus of 2,412 pounds per year

Based upon this data and the 2013 approximation of current nutrient contained in discharges, the following status of discharge relative to the established caps is provided in the following table (it should be noted that this data cannot be used to estimate the total available capacity):

Vint Hill facility:

Total N Load	438/6,712
Total P Load	64/382

Remington facility:

Total N Load	5530/9,809
Total P Load	512/1,206[1]

Marshall facility:

Total N Load	1,732/9,809[1]
Total P Load	115/1,206[1]

The Discharge (average daily flows, expressed in MDG) for these facilities for the July-September 2015 period is as follows:

Vint Hill	=	0.820 (capacity 0.950)
Marshall	=	0.1820 (capacity 0.640)
Remington	-	0.7040 (capacity 2.000)

Key:

1= the capacity values for the Marshall and Remington facilities (since the limits for the Total Loads were allowed to be combined) were obtained by dividing the actual 2013 discharge valued by one-half of the limits for the combined two facilities (or one-half of 19,618 for Total Nitrogen, and one-half of 2,412 for Total Phosphorus)

As can be seen from this data, the closest to capacity, with respect to nutrient caps, is Total Phosphorus concentration, since it is currently operating at 75% of the cap; however, the lowest is the Total Nitrogen load for the same facility.

Overall, all three of these facilities are operating far below the nutrient limits/caps established by their DEQ permits and all Service Districts served by these facilities have room to grow without established nutrient limits being a barrier.

Perhaps a bigger barrier to growth related to wastewater treatment capacity, is due to the high quantity of stormwater inflow and infiltration into the wastewater treatment facilities. Typical wastewater treatment plants are designed to treat not only the actual sewage sent to the plant, but also to accommodate approximately 2.5 times that quantity of stormwater that infiltrates into the sewage delivery system. The Remington, Marshall and Vint Hill plants have as much as four to five times the quantity of stormwater relative to the quantity of sewage being treated. This means that the plants cannot treat as much sewage in need of treatment, since significant treatment capacity is being spent on treating stormwater that does not need treatment if it had not infiltrated into the sewage treatment pipes and distribution systems. Redirecting this infiltrating stormwater is expensive, but the WSA is currently exploring ways in which they could reduce the quantity of infiltrating water, thereby increasing the quantity of sewage treatment capacity.

The Catlett, Midland, and Calverton Service Districts generally have poor soils for septic drainfields. This coupled with the age of most of the drainfields in the area has resulted in many septic system failures. The Fauquier County Board of Supervisors is currently in the process of resolving this problem by the construction of a community sewer system that would serve part of the Catlett and Calverton region. Some of the older homes and drainfields in the New Baltimore Service District appear to be showing signs that this community may in the near future experience the same type of problem as the Catlett, Calverton, and Midland area; however, within New Baltimore the scale of problem would be much greater.

M. Other Concerns

1. Biosolids

Biosolids are solid, semi-solid, or liquid materials, resulting from treatment of domestic sewage, that have been sufficiently processed to permit these by-products to be safely land-applied. Various levels of treatment enables biosolids to be used as soil conditioners and fertilizers for agriculture, mineland reclamation, and urban landscape enhancement. The use of biosolids often evokes strong emotions due to

the presence of potentially environmentally and health-impairing constituents, such as pathogenic microorganisms, heavy metals, and anthropogenic organic compounds.

In order for sewage sludge to become biosolids it must be treated to meet the standards established in state and federal regulations for use of biosolids for land application, marketing, or distribution. These regulations require that the sewage sludge undergo established treatment to meet the pathogen control levels, established treatment and management practices to meet the vector attraction reduction, and contain concentrations of regulated metals below established limits. The properly treated and processed sewage sludge becomes "biosolids" which can be safely recycled and applied as fertilizer to improve and maintain productive soils and stimulate plant growth.

In 2008 the Virginia Department of Environmental Quality (DEQ) assumed regulatory oversight of all land application of treated biosolids. At this same time, the General Assembly changed the law that added requirements to further protect human health and the environment. Among these changes are the requirement for having and following nutrient management plans for all fields receiving biosolids, unannounced inspections of the land application sites, certification of persons land applying biosolids, and the payment of a fee based on the tons applied.

2. Transmission Pipelines and High Voltage Electric Transmission Lines

There are several transmission pipelines that carry petroleum products in or through the County. There are also several high voltage electric transmission lines that traverse the County, mostly in the Southern parts of the County; however, there is currently a proposal for one that would traverse the north-central region of the County and the New Baltimore Service District.

These features are necessary to support local and societal needs, but they can cause local visual and resource impacts. The County should have input in the siting of these facilities.

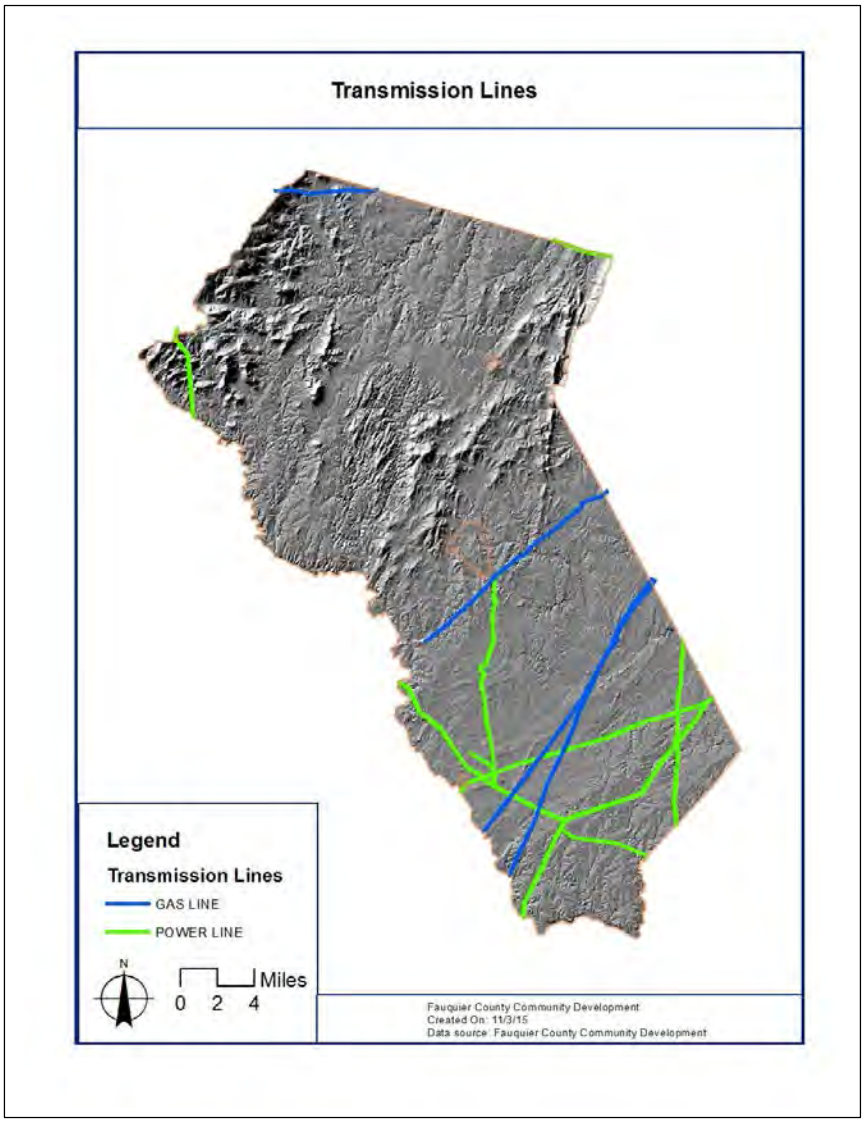

Figure 19 Transmission Lines in Fauquier County

N. Special Habitats

Fauquier County contains a wide variety of habitats; some are noted for either being uncommon or especially susceptible to impact.

1. Diabase Soils

Diabase glades are characterized by historically fire-dominated grassland vegetation on relatively nutrient-rich soils underlain by Triassic bedrock. Diabase flatrock, a hard, dark-colored volcanic rock, is found primarily in northern Virginia counties and is located within the physiographic sub-unit known as the Triassic Basin. Where the bedrock is exposed, a distinctive community type of drought-tolerant plants occurs. Diabase flatrocks are extremely rare natural communities

that are threatened by activities such as quarrying, development and land-use conversions.

In northern Virginia, diabase flatrock communities support occurrences of several global and state rate plant species, such as:

- earleaf foxglove (*Agalinis auriculata*)
- American bluehearts (*Buchnera americana*)
- downy phlox (*Phlox pilosa*)
- stiff goldenrod (*Oligoneuron rigidum* var. *rigida*)
- purple milkweed (*Asclepias purpurescens*)
- Torrey's Mountain-mint (*Pycnanthemum torrei*)
- Hairy hedgenettle (Stachys arenicola)

Within Fauquier County, diabase soils are primarily found within the Culpeper Basin. Currently, no federal, state or County protection conservation strategies have been developed for diabase soils.

2. Floods and Floodplains

In addition to dissipating water and energy caused by storms, floodplains also provide special habitat for a variety of organisms. Many floodplains are also regulated wetlands. Since floodplains are components of the adjacent stream system, activities within floodplains may have an equivalent impact to streams and other surface waters. Except where prohibited by law or carefully analyzed and reviewed special exception, new floodplain impacts should not be authorized without suitable mitigation. Chapter 2 of the Comprehensive Plan is the appropriate location to place any guidance for the issuance of any such permit, as well as the process the County should use in reviewing applications. Once in place in the Comprehensive Plan, a determination may be made if any complementary ordinances are appropriate.

Floodplains are a valuable resource, which provide a necessary interface between land and water and require thoughtful management to sustain their functions. Their use or non-use is critical with respect to water quality and aquatic life. Floodplains are susceptible to flooding and by definition store water and accommodate fluctuations in stream volume during heavy rains. The limitations for certain types of development within floodplains can prevent financial loss, personal harm, and even loss of life.

Urbanization is a primary contributing factor to increased flooding. The process of urbanization tends to restrict a stream's natural flow through channelization and infill, resulting in higher water velocities and volume. Furthermore, the increased imperviousness of the surrounding land area results in less infiltration of rainfall into the soil and more stormwater which flows directly into the stream channel. The result is a higher "peak" flow, which means that a higher volume of water enters the stream channel at one time and at a higher velocity. Damage is caused by the increased erosive powers of the floodwaters, the impact of the water itself on structures, the deposition of sediment and debris as floodwaters recede, and the potential contamination of water supplies.

In addition to the potential for damage caused by flooding, soils within floodplains often have limited development potential due to high water table, wetness, and poor load bearing capacity which limits the use of septic systems and may require special engineering to ensure the structural stability of buildings and roadways.

Floodplains provide a number of valuable benefits. In addition to mitigating the damaging effects of floods, they serve as wildlife habitat. They are also sensitive ecological areas vulnerable to impact thereby warranting special management attention. In many cases, because of their ability to hold water and reduce run-off, they serve as an effective flood control device by reducing downstream flooding.

The potential harm of urban development in floodplains has been increasingly recognized over the last century, and floodplain management has now become a common land use tool. Floodplain management is also important because in many cases, alterations in the floodplain may severely impact downstream properties.

Floodplain areas have been generally identified in studies conducted by the Federal Emergency Management Agency (FEMA). These studies, which are largely for flood insurance purposes, result in maps which identify the one hundred year floodplain and flood prone areas. In addition, stream sections in highly developed areas with historic flooding problems have been studied in detail by FEMA. The detailed FEMA maps show floodways, 100 and 500-hundred year floodplains, and flood-prone areas. As watersheds develop, and the percentage of impervious surface increases, the County should require more detailed flood evaluations than those provided by the general FEMA studies.

In order for its residents to qualify for flood insurance under the FEMA program, and to protect the public health, safety, and general welfare of its citizens, Fauquier County adopted a Floodplain District overlay as part of its Zoning Ordinance in 1983 (Fauquier County Zoning Ordinance, Article 4, Part 4). The Floodplain District governs the type and extent of development and redevelopment recommended within designated floodplain district boundaries and should be consulted for more specific details.

Current County ordinances require that anyone contemplating disturbing floodplains acquire permits and reviews that assess the potential flood impact to adjacent properties. No impact to floodplains will be allowed if it is demonstrated that there would be an increase in flood height or flood velocity as a result of the proposed activity. These provisions minimize the chances of increasing flooding impact to neighboring properties. Currently, the County has limited tools for the protection of the ecological value of floodplains. For the protection of these resources and values, the County largely defers to the Virginia Department of Environmental Quality and the U.S. Army Corps of Engineers.

3. Wetlands

Wetlands are the transitional habitat that separates upland and aquatic environments. Wetlands are an important natural resource for a number of reasons. They serve as habitat and nesting grounds for a variety of species, regulate flood control, remove sediment and impurities from the water and moderate water temperatures, and serve as recharge areas for groundwater aquifers.

Currently, the County indirectly regulates local wetlands. Wetlands are protected under the federal Clean Water Act, Section 404. The U.S. Army Corps of Engineers, which is assigned as the primary federal agency with regulatory authority for these laws, must be consulted and requires issuance of a wetlands permit. The primary agency responsible for managing wetlands at the state level is the Virginia Department of Environmental Quality (DEQ). For both organizations, the proper delineation of wetlands is considered the first step in the determination if wetlands are potentially impacted by a proposed project. Two primary tools for the initial identification of wetlands are National Wetlands Inventory (NWI) maps as well as local soils maps. Soil maps show the location of hydric soil which is one of the indications of jurisdictional wetlands. Through the County's development process, protection of wetland areas is considered in all land development.

As in the situation with floodplains, the County has limited tools for the protection of the ecological value of wetlands. For the protection of these resources and values, the County largely defers to the Virginia Department of Environmental Quality and the U.S. Army Corps of Engineers.

Floodplains[1]	Acres	Percent of County
Total Floodplains	30,848	7.4 %
Wetlands[2]		
Freshwater Emergent Wetlands	5,257	1.3 %
Freshwater Forest/Shrub Wetlands	10,562	2.5 %
Freshwater Ponds	2,654	0.6 %
Lakes	475	0.1 %
Riverine	2,402	0.6 %
Other	184	0.0 %
Total Wetlands	21,534	5.2 %

Sources: 1 = The 100-year floodplains as defined by the United States Federal Emergency Management Service (FEMA)

2 = The National Wetland Inventory (NWI) developed by the United Stated Fish and Wildlife Service

Table 8: Floodplains and Wetlands of Fauquier County

4. Terrestrial Natural Communities

Natural communities are those which have experienced only minimal human alteration or have recovered from anthropogenic disturbance under mostly natural regimes of species interaction and disturbance. An ecological community is an assemblage of co-existing, interacting species, considered together with the physical environment and associated ecological processes that usually recur on the landscape. Classifications of natural communities can be based on various

components (*e.g.*, vegetation, fauna, landforms, hydrologic regime), used singly or in combination. As part of its work, the Virginia Natural Heritage Program, managed by the Virginia Department Conservation and Recreation (DCR) maintains database information on the status, distribution, and ecology of rare native species and all natural communities; protects and manages these resources through a system of natural area preserves; and provides information and technical advice to other agencies, organizations, and individuals. Within this context, community inventory and classification represent an important "coarse-filter" approach to biological conservation that ensures the protection of intact ecological systems containing diverse organisms. By identifying and protecting excellent examples of all natural community types in Virginia, the majority of our native plant and animal species, including many cryptic and poorly known ones, can be protected without redundant individual attention.

The Virginia Natural Heritage Program identifies several natural community types within Fauquier County, including the following:

Acidic Oak-Hickory Forest;
Acidic Oak-Hickory Woodland/Savanna;
Appalachian Rich Cove Forest (Tuliptree-Mixed Hardwoods Type);
Central Appalachian Acidic Boulderfield Woodland;
Central Appalachian Basic Ash-Hickory Woodland;
Central Appalachian Basic Seepage Swamp;
Central Appalachian Dry-Mesic Chestnut Oak-Northern Red Oak Forest;
Central Appalachian/Inner Piedmont Chestnut Oak Forest;
Central Appalachian Low-Elevation Acidic Seepage Swamp;
Central Appalachian Pine-Oak/Heath Woodland;
Coastal Plan/Outer Piedmont Seepage Bog;
Inner Piedmont/Lower Blue Ridge Mesic Forest;
Inner Piedmont/Lower Blue Ridge Basic Oak-Hickory Forest;
Little Bluestem-Indian-Grass Piedmont Prairie;
Mountain/Piedmont Acidic Cliff;
Northern Coastal Plain/Piedmont Mesic Mixed Hardwood Forest;
Northern Hardpan Basic Oak-Hickory Forest;
Piedmont Mafic Barren;
Piedmont River-Scour Shrubland;
Piedmont Upland Depression Swamp;
Piedmont/Central Appalachian Floodplain Swamp (Pin Oak-Swamp White Oak Type); and
Piedmont/Central Appalachian Rich Floodplain Forest.

5. Steep Slopes

Although steeply sloping areas can provide breathtaking vistas and are often sought after for residential development, they are also areas of special concern and are very sensitive to development. Generally, steep sloped areas are quite susceptible to erosion. The amount of susceptibility and erosion which may occur varies according to the amount of rain, length of slope, ground, cover, grade, and the erosion characteristics of the soil type. For example, erosion from a 25% slope can be as much as 15 times that from a 4% slope.

Another major slope related problem is the amount of rainfall which does not soak into the ground, known as "storm water run-off". Two items need to be examined in relation to storm water run-off. The first is direct run-off and the second is peak discharge. Direct run-off is the amount and velocity of water which runs off of a given area. Direct run-off is critical from a downstream landowner's viewpoint. Peak discharge is the amount of run-off at the height of the discharge. Decreasing the vegetative cover, increasing the impervious surface, or both will result in an increase in the amount of run-off as well as an increase in the peak discharge. The increase in run-off and in peak discharge can significantly alter flood conditions downstream. These and other similar factors are often incorporated into a comprehensive land use review process.

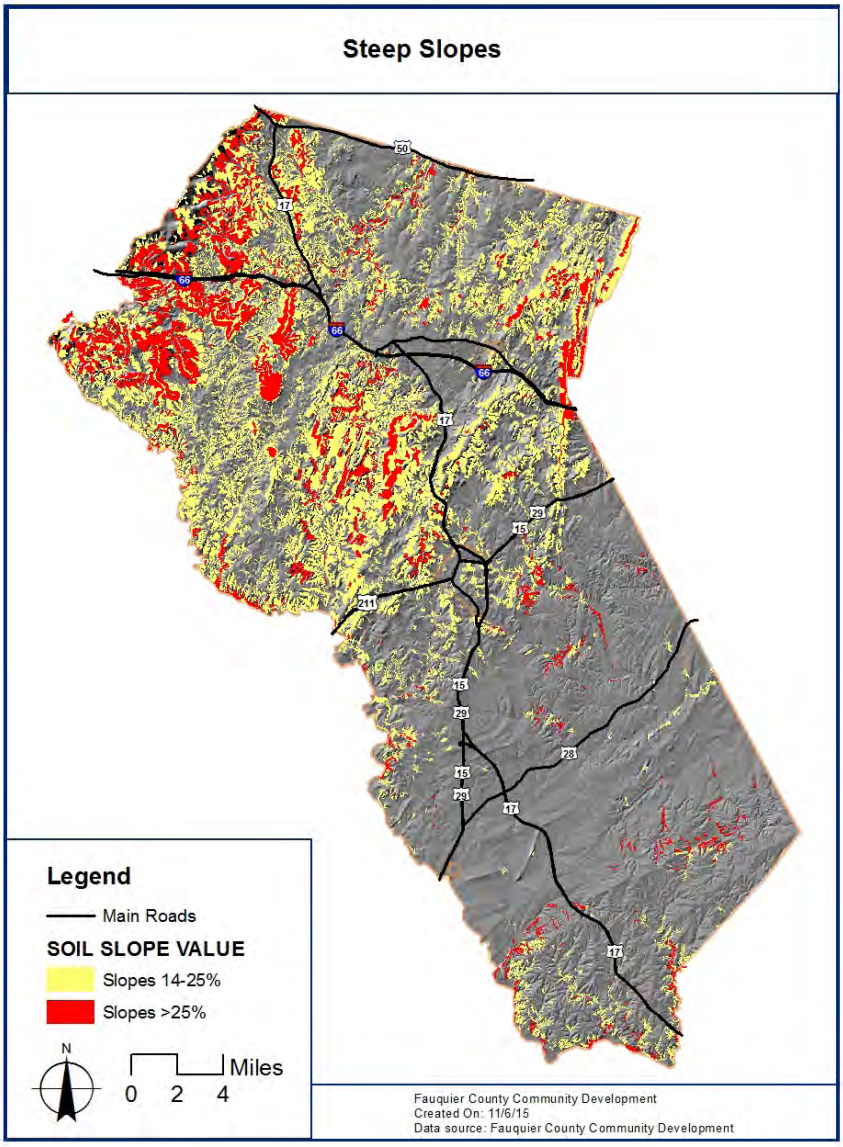

Figure 20 Steep Slopes

6. Other Natural Values and Assets

Other natural values and assets include such concepts as natural night sky and natural quiet. In the past, these attributes may have been taken for granted, but in an increasingly developed and impacted world, there are fewer areas left that provide these amenities. As such these assets have value and they are potential resources that Fauquier County could capitalize upon and potentially promote. Many studies have linked these assets to quality of life.

Examples of the rarity of natural night sky, people, especially astronomy clubs and classes, come from hundreds of miles around to visit the isolated desert wilderness of Death Valley National Park due to its rich night sky resources. However, even in this isolated region, the impact of the lights of Las Vegas and even Los Angeles is intruding more and more on Death Valley's night sky.

Within our area of the World, Fauquier County has better than average night sky and natural quiet resources. Currently, some local groups are taking advantage of these Fauquier County assets and visiting Meadows State Park and C. M. Crockett County Park and taking advantage of this Fauquier County asset. In addition to these outside groups and organizations, many County residents value these attributes as a component of Fauquier County's rural characteristics and quality of life values.

IV. NATURAL RESOURCE MANAGEMENT

The preceding section provided an overview of natural resources of Fauquier County. This section presents the overview from one resource type to the next. While this approach may be easier to organize and understand the issues and challenges of each resource type, there are draw-backs in such an approach. The danger is that people may tend to think of natural resources as single entity things, such as water or trees, each independent upon one another. Nothing can be further from the truth. For instance, a good agricultural soil, like any other soil, is the result of unique site-specific conditions, ranging from climate, water flow, geology, and in some situations, time. Nearly all of the resources discussed previously interact with each other as processes within very complex natural systems. For instance, if you cut a forest down, you alter the land's ability to infiltrate precipitation. As a consequence, less water is recharging groundwater and more is running in surface streams. This increase of surface streams creates excess erosion, which in turn negatively impacts aquatic organisms and removes protective riparian vegetation. This loss of streamside vegetation creates more erosion and more impacts to aquatic organisms. The cycle of "disturbance" continues until the entire natural system adjusts itself, sometimes violently, to its new fundamental environmental conditions. Outside of these natural processes, this "adjustment" to the system's new conditions, is often highly disruptive to resident populations. For instance, the impacts discussed in this deforestation example, would likely also increase flood damage to resident's properties, would result in soil erosion and potential loss of economic value and the land's productivity, and the resource-dependent economies ranging from regional fish and shell-fish industries in the Chesapeake Bay, to recreational and quality of life attributes.

If natural resources are interconnected into complex systems, it is little wonder that natural resource management should also be complex and interconnected to other related activities and actions. Therefore, a more detailed look at natural resource management is in order.

A. Environmental Review

When proposing new projects or changing existing conditions, there are many aspects of land-use planning that require review for consistency with ordinances and the comprehensive plan, such as zoning and permitted usage. Currently, there are few components required for environmental review; stormwater management, floodplain and erosion and sedimentation management during land-disturbing activities are noted exceptions. However, for the natural resource vision outlined in the beginning sections of this plan, as well as support by County residents, to be realized or substantive progress to be made, a more comprehensive review prior to any County approval will be required. The County's more robust review process would need to be based upon the vision and priorities established through public input and adopted by the Board of Supervisors. The review process should not only look at the specifics of individual proposals and actions and the effect that the proposal would have on the County's natural resources, but it should also gage the cumulative impact of activities in general. Cumulative impact assessment places a particular impact in context with other related impacts, both in space and time. For instance, upon first glance, someone may consider that the loss of 100 acres of wetland from one proposed project to be acceptable, but they may permit a project that would only impact one-half acre of wetland. However, in a relatively short-period of time, there may be 300 similar "small-scale" projects approved that each impact one-half acre of wetland. Taken as a whole, these 300 "small-scale" wetland impact projects may have impacted as much as 150 acres of wetlands, far more than the one 100-acre earlier denied. From a cumulative impact perspective, perhaps it would have been better to approve the one project that impacted 100 acres of wetlands over the 300 that impacted 150 acres.

One of the most perplexing aspects of cumulative impact is that while it is usually the most critical attribute needed to be assessed in any environmental review, it is often the most difficult and challenging to assess. Due to the many complications inherent upon cumulative impact assessment, most governmental entities do not even attempt to start. The importance of cumulative assessment is not limited to natural resources, it applies to many other resources and values within the County. Fundamentally, the challenges inherent in cumulative assessment is best addressed by having a strong comprehensive plan, since cumulative impacts is one of the key reasons for having a Comprehensive Plan. Without a well thought-out comprehensive plan that strategically outlines a strategy to tackle challenging issues, effective tools in place to give the plan strength, and the plan and management tools consistently implemented, it is all too easy to incrementally creep along a pathway that not only does not accomplish any long-term goals, residents in a community may reach a point that they look around and do not recognize the place. They may wonder "what happened and how did our community get this way?" So this does not happen to Fauquier County, we may want to articulate the County's vision for natural resources, and spell out the best strategy to realize this vision, and provide the effective tools to implement and achieve it.

A 2013 court opinion emphasized the need and importance of localities creating ordinances and policies that support state and regional natural resource issues. The court opinion derived from this opinion dealt with EPA's authority to manage and

implement TMDL and provisions of the Chesapeake Bay Act. The Summary Judgment prepared by a United States District Court stated:

> *It is logical for states to retain control over implementation of non-point pollution regulation* [versus the EPA] *because non-point pollution control measures often involve local land use and zoning decisions, activities which are generally within the well-protected province of state and local government.*

To effectively realize Fauquier County's long-term goals, this plan supports the adoption of a County project review that affirmatively assesses the proposed activity's affect upon relevant natural resources, processes and systems. This review process should be codified in County ordinances and consistently implemented.

B. Green Infrastructure Concept

While the term "Green Infrastructure" is relatively new, the basic concept is not. However, what is new is having the Green Infrastructure concept consistently applied and implemented. What is Green Infrastructure? Green Infrastructure is both an asset feature and an approach to land-use planning.

A traditional approach to building and site design is to first locate the various infrastructural elements; such as location of electrical, water and sewer lines and utilities, the location of substantive bedrock for foundation construction, and the location of critical transportation corridors. The design of the building and the associated parcel development is designed around these fixed assets. Green Infrastructure planning is simply recognizing the monetary and social benefits of open spaces and natural resources and incorporating these features with the other fixed assets. Therefore, the site's design highlights, facilitates, sustains and even enhances these open spaces and natural resources. This concept was perhaps first to be embraced in building design. Architects have long since abandoned the practice of placing just any building design onto any landscape regardless of the site specifics. The first reason for the change was economics. It was found that with a little creative planning and design work, tremendous heating and cooling expenses could be realized. Therefore, passive solar concepts were incorporated into building designs to provide some of nature's natural heating and cooling elements into the building design rather than depend entirely upon costly utilities when the sun can help heat your building for free.

This same concept is now being applied to larger landscaping projects. It has been consistently found that communities value open space and natural resources, whether it be greenway trails, protected green corridors through urban centers, intact natural blocks that provide natural habitat, preserved cultural landscapes, and vibrant farmsteads. If these valued farmlands, open spaces and green corridors are placed in the design as fixed assets up front, they not only will be retained, but the overall landscape design will be enhanced by having the increased value derived from these assets. This is the core principle in Green Infrastructure planning. In summary, green infrastructure planning is in essence developing your project IN the landscape rather than ON the landscape.

The first phase of Fauquier County's Green Infrastructure mapping project was completed in early 2013. Fauquier County assets mapped during this phase include: water resources, ecological assets, cultural resource and heritage areas, and agricultural and forest lands. The next phase of this project involved further refinement of the data in order to make it more useful as a planning tool for Fauquier County, as well as the addition of forest economics and cultural assets models. The County has not yet made any decision in how these assets will be incorporated into the County's landscape planning process. The County's goal of retaining its rural characteristics and quality of life is consistent and even enhanced with this planning approach, since these elements are treated as outright assets in the first place.

C. Natural Resources as a Land Management Tool

Planning tools for managing natural resources may also be used for other purposes. For instance, mandated water pollution budgets established for environmental concerns are likely to have a real affect upon development patterns. Knowing this, the affect upon development can be treated as an unintended consequence, or it may be used to serve other goals as well. Under some situations, managers may use these tools strategically to accomplish more than one goal at a time. The coordination and complementary management of multiple goals shall be encouraged. For example, if there is a desire to establish a block of undeveloped land in order to form a buffer between a developed area and the remaining rural space, perhaps this undeveloped block can serve multiple complementary purposes, ranging from well-head protection, rare species conservation, water filtration, recreational access, and environmental education. These multiple opportunities and purposes should be explored and encouraged.

D. Natural Resource Economics

The traditional approach to the discussion of natural resource management goals is to state them and the associated benefits in value-based, philosophical, esoteric and measureless terms; however, the majority of other goals are usually measured in more tangible and market-based through hard currencies that can easily be quantified and compared in recognizable cost-benefit analyses.

"*Everybody needs beauty as well as bread, places to play in and pray in, where nature may heal and give strength to body and soul.*" -- John Muir[4]

Societies have long recognized that natural resources are economic assets that should be assessed in more quantifiable terms so that they can be compared more equitably with other assets, but finding a standardized and acceptable metric has proven to be the primary challenge.

Themes that often arise when people discuss Fauquier County's primary assets often include "open space," rural characteristics, farming and hunting traditions, and our land-based quality of life attributes. These are all assets that apparently have value for Fauquier County residents. For instance, is it valued that The Plains

[4] *The Yosemite* (1912), page 256

is not Gainesville, Catlett is not Woodbridge, Warrenton is not Tysons Corner and Fauquier County is not Prince William County? This is due to the common view that the rural character and natural resources attributes have value that contribute to resident's vision of Fauquier County. The need to identify this shared vision and articulate a process to accomplish it in a timely and effective manner is the primary purpose of the comprehensive plan, and the update of this chapter.

It is widely accepted that natural resources have value as a commodity whether it is lumber from trees, minerals from the Earth, or water to sustain life and industry. Lesser understood is the economic value of non-commodity-based sustainable natural resources. This value of natural resources may be grouped in four categories: aesthetic and quality of life appeal; ecotourism-oriented; economic support; and natural capital.

a. Quality of Life

Quality of life is hard to measure, but a significant component is living in an area in which a person can identify with and conforms to their vision of a good community. Do we value a working farm over a strip mall; or hamlets with distinct boundaries with open space compared to borderless and strip-mall developments? How much is clean water worth? The only right answer to these and other related questions is one that more closely is tied to the community's identity and what residents want the County to look like in the future. Data from multiple studies (Adamchak, 1978; Bartik, 1988; Rudzitis and Johansen, 1989; Mattson, 1990; Patton and Duggan, 1990; Power, 1981; etc.) suggest a strong correlation between vibrant economic growth with localities that promote environmental protection and quality of life attributes.

Goldstein (1976) reports that "[a new] emphasis on quality of life as opposed to more strictly economic considerations seems to be assuming increasing importance as a motivation both in the decisions to move and in the choice of residence."

Jerry Johnson and Raymond Rasker's (1995) study of rural communities in Wyoming assessed the values that entrepreneurs used when deciding the location of their businesses. Out of the fifteen values, the study found that cost of doing business and overall local tax structure were the two lowest ranked reasons that factored in their business location decision. The top three reasons business leaders used to locate their business was scenic beauty, quality environment, and good place to raise a family. The general consensus is if a business wants to attract quality employees and present a quality image to the public, they cannot do so by offering their employees mediocre amenities in a community situated among run-down and impaired resources. Some of the most vibrant economies in the United States are at least partly based upon the environmental quality, outdoor recreation opportunities and community attractiveness that the area has over otherwise similar areas.

Figure 21 Pond in Fauquier County

b. Ecotourism

Ecotourism is a term used to define industries that are centered on providing sustainable recreational opportunities focused on an area's natural and cultural resources and associated assets. It is well known that people travel long distances to visit areas that they find enticing. It goes well beyond a particular tourism opportunity, such as commercial guided tours. The notion of sustainable ecotourism includes the all-encompassing infrastructure needed to sustain the tourism attraction in the first place. For instance, if someone travels a distance to take a bicycle tour, other businesses other than the bike rental benefits; such as service stations that fueled the vehicle that they arrived in; the hotel they spent the night in; the restaurants that they ate in; the gift shops that sold them souvenirs; etc. There are entire communities, located throughout the nation, that have significant components of their economy based upon being a gateway community that serves visitors to nearby natural resource attractions.

c. Economic Support

Natural resources provide a substantive economic value due to their ability to perform functions that would either be costly or cost-prohibitive otherwise. The

following six examples are provided to give a snap-shot of the diversity of economic benefits that natural resources may provide communities:

- floodplains dissipate the energy from floods that would cost many millions of dollars if communities needed to construct facilities to perform the same functions;
- wetlands filter contaminants from waters that would be costly to perform artificially;
- trees shade and cool homes at no cost compared with expensive air conditioning units;
- trees buffer and absorb high energy winds that could wreak havoc to buildings and utility lines;
- soils and other natural pervious surfaces absorb water and slowly release water over time; this has multiple economic benefits ranging from reducing impact from floods and erosion, to sustaining municipal water supplies over a longer duration rather than constantly going from flood to drought conditions.

These preceding examples, and other related benefits that natural resources provide at no or little cost, which when combined, saves taxpayers nationally billions of dollars a year. It is for some of these reasons that localities often adopt floodplain and wetland ordinances. This also relates to quality of life issues and community vision. Would a rural community prefer having its stormwater filtered by natural wetlands or by expensive massive concrete structures that are costly to maintain?

Along a similar vein, Viscusi et. al (2007) quantified the economic benefits of improving a locality's water quality. This study demonstrated that every percentage point of water quality improvement resulted in a positive economic benefit to the community greater than the cost required for the water quality improvement effort.

d. Natural Capital

Natural Capital in many ways is similar to the Economic Support section mentioned previously. Natural Capital benefits include both goods and services. Goods can come from extractable living components of the ecosystem (such as timber), as well as extractable non-living attributes (such as gold). Services derived from natural resources can range from quality of life and land values, tourism, and safe water. In a detailed financial study within New Jersey (New Jersey, 2000), the economists estimated that the sustainable service-oriented ecosystem protection values in New Jersey outweighed those resources good-oriented extraction-based value. In this New Jersey study, they estimated that the natural resource values of New Jersey contributed to the state's economy on average between $93 billion to $322 billion annually. They deemed that freshwater wetlands were one of the highest assets, since they contributed to buffering of floods and water filtration. Nearly as high were forests that provided wildlife habitat, contributed to water supply, pollination of agricultural products, aesthetics and recreations opportunities. Wildlife tourism alone contributed an estimated $3 billion dollars a year and provided an estimated 37,000 jobs.

No similar study has attempted to quantify the natural resource values and assets in Fauquier County, but many people do recognize the significance of these

Fauquier County assets, and as such, this comprehensive plan should be structured in a manner that assists in managing these valuable assets wisely and sustaining them into the future.

V. ON-GOING PLANNING EFFORTS

A. The Chesapeake Bay Preservation Act

The Chesapeake Bay Preservation Act ("the Bay Act") was originally adopted by the Virginia General Assembly in 1988. The General Assembly of Virginia passed the Bay Act in an effort to promote "the general welfare of the people of the Commonwealth" by protecting the Chesapeake Bay and its tributaries.

The Bay Act was designed as an extension of the public trust doctrine – the principle that certain resources are preserved for public use, and that the government has a responsibility to maintain these resources. As such, the Bay Act recognizes that the way land is used and developed has an impact upon water quality, and thus the Act focuses on reducing and preventing nonpoint source pollution. The aspirations of the Bay Act are summed up in its opening sentence:

> *Healthy state and local economies and a healthy Chesapeake Bay are integrally related; balanced economic development and water quality protection are not mutually exclusive.*

But beyond providing a few basic guidelines, the Bay Act itself did not explicitly establish what criteria the localities would be required to implement to protect their water resources. Instead, the Act called for the creation of the Chesapeake Bay Local Assistance Board ("the Board"), whose responsibility it would be, among other things, to "develop, promulgate, and keep current" criteria to be used by local governments in deciding how land protected under the Bay Act could be rezoned, subdivided, used, or developed.

Following these requirements, the Board developed the Chesapeake Bay Preservation Area Designation and Management Regulations, officially adopting the regulations in 1990 and later amending them in December 2001. These regulations laid out in detail the protective measures that would be taken to safeguard the region's waterways, focusing on the implementation and protection of riparian buffers along perennial streams. The revised regulations took effect in March 2002 and were adopted by all 84 localities by December 2003.

By granting local governments the authority to manage water quality, the Bay Act enabled each locality to establish protective measures and land-use guidelines specific to its region. Now, with the Board's regulations in hand, it was believed that these local governments had the tools necessary to fully exercise the powers granted to them by the Bay Act.

While various subsequent assessments indicated water quality progress had been made in the Bay, there was a growing realization that more progress was needed. Therefore, a renewed commitment to restoring the Bay would be needed.

President Obama issued Executive Order 13508 on May 12, 2009, which directed the federal government, with the Environmental Protection Agency (EPA) designated as the lead agency, to take a renewed effort to restore and protect the Chesapeake Bay and its watershed. This was a keystone commitment in the strategy developed by federal agencies to meet the Chesapeake Bay Act.

On December 29, 2010, the U.S. Environmental Protection Agency established the Chesapeake Bay Total Maximum Daily Load (TMDL), a historic and comprehensive "pollution diet" with rigorous accountability measures to initiate sweeping actions to restore clean water in the Chesapeake Bay and the region's streams, creeks and rivers.

An outgrowth of the Bay Act was the establishment of a nutrient and sediment diet. Each watershed within the Chesapeake Bay was given nitrogen, phosphorus and suspended sediment caps. Nitrogen may exist in more than one form within any typical natural water sample, such as nitrate and ammonium; therefore, the term "Total Nitrogen" (TN) refers to a sum of all the forms of nitrogen combined. Similarly, the term "Total Phosphorus" (TP) refers to a sum of all the forms of Phosphorus combined. The term "Total Suspended Solids (TSS) refers to the total amount of non-dissolved "solids" (sediment) within the water [or a measure of the dirt and solid residue in water that turns the water cloudy or murky]. TSS is usually expressed in mg per liter of water.

Fauquier County lies within three of these larger watersheds: Middle Potomac River, Lower Potomac River and Upper Rappahannock River. There are separate caps for total nitrogen, total phosphorus and total suspended sediment for each of these three watersheds. The following table lists these caps, along with the current levels in these watersheds, as well as the difference between the two (the reduction needed to meet the cap). Note: TN = Total Nitrogen; TP = Total Phosphorus; and TSS = Total Suspended Solids; and all units are in pounds per year.

	TN TMDL	TN Current	Difference
Middle Potomac River	547,624	569,992	22,368 (4%)
Lower Potomac River	1,086,690	1,280,940	194,250 (4%)
Upper Rappahannock River	4,193,259	4,724,938	531,679 (11%)
	TP TMDL	TP Current	Difference
Middle Potomac River	37,943	38,482	539 (1%)
Lower Potomac River	98,660	135,581	39,921 (5%)
Upper Rappahannock River	729,730	875,321	145,591 (17%)
	TSS TMDL	TSS Current	Difference
Middle Potomac River	14,076,126	17,280,595	3,204,469 (19%)
Lower Potomac River	7,503,432	10,266,702	2,763,270 (27%)
Upper Rappahannock River	646,015,721	709,235,879	63,220,158 (9%)

It should be noted that these values are for the entire watershed (such as the Upper Rappahannock River watershed), Fauquier County is only one of several counties comprising these watersheds. There are no established caps or even targets for the percentage of these caps that Fauquier County is responsible for; however, one would hope that whatever caps that will be eventually assigned to Fauquier County would be related to rational and equitable distribution of responsibility.

A key aspect of the Chesapeake Bay Act is that not all portions of the watershed are treated equally. Many of the provisions of the Act apply to the Coastal zone area of the watershed (roughly defined East of US Interstate 95), while the bulk of the watershed (including all of Fauquier County), those provisions of the Act had been voluntary. Few counties that were not legally required to comply with the specific provisions of the Act chose to do so voluntarily. The requirements and whether they are voluntary or mandated may change upon the release of the refined nitrogen, phosphorus and total suspended solids caps.

In either situation, these caps may be challenging to meet. In Fauquier County, they may not be able to be met unless we find different ways of managing our surface water resources. As of 2015, there is a state-wide effort underway in the development of specific implementation strategies and goals, running the gamut from stormwater management requirements to specific nutrient load reduction strategies and local watershed targets. A goal for Fauquier County should be in finding ways to integrate these statewide efforts in a way that works for Fauquier County, developing additional local means to reduce nutrients and sediment in County streams, and establishing ways of quantifying our efforts and successes so that we may receive credit for the results and demonstrate our commitment to the state, the public and other interested parties.

Figure 22 Eroding Hillside in Fauquier County

As of 2015, the land-use sectors within Virginia not meeting the established state goals for the restoration of the Chesapeake Bay, are all pollutants within urban areas, and sediment from agricultural land.

B. Erosion and Sediment Control Program

Due to the significant impact that improperly managed land disturbing activities can and do have upon Fauquier County's resources, the County has implemented a thorough erosion and sediment control program through the land disturbing permits and the various stormwater permits issued by the Commonwealth and Fauquier County.

C. Stormwater Program

In one form or another, Fauquier County has been indirectly involved in stormwater management for many years, but it became much more direct upon the adoption of the Commonwealth's new stormwater standards on July 1, 2014. From that point forward, the County issues "VSMP Authority Permits" and manages the stormwater program for those areas of Fauquier County outside of Warrenton. One purpose of Virginia's new stormwater regulations is the proposed reduction in nitrogen, phosphorus and suspended solids discharges from the County in a manner in which would bring us closer to the TMDL/WLA targets outlined in the Bay Act. The term TMDL refers to "Total Maximum Daily Load" and WLA refers to "Waste Load Allocation." There are differences between these two terms, but both are established thresholds of the maximum pollutants that a given area may discharge. To further complicate the situation, there are two different TMDLs, one established through the provisions of the Chesapeake Bay Act (typically called "Bay TMDL") and the other established through listed "Impaired Water" restoration plans (typically called "local TMDL").

D. MS4 Program

Municipal Separate Storm Sewer Systems (known more commonly as "MS4") are stormwater drainage and management facilities owned and managed by public entities that direct stormwater into natural waterways without being treated in wastewater treatment facilities. Some stormwater is directed or inadvertently sent to wastewater treatment plants. More typically, stormwater is channeled through culverts, ditches, open and closed pipes and conduits to eventually discharge into a natural stream or lake. As the water flows through these communities it can pick up pollutants from households, from leaking septic systems, from land disturbing activities, from road and parking lot run-off, from rooftops that partly leach tar, metals and other substances from these surfaces and be carried into the natural waterways. The Environmental Protection Agency and the Virginia Department of Environmental Quality established regulations and standards for the more heavily developed communities to follow for the purpose of limiting the pollutants that are carried by these publicly-owned stormwater drainage systems and eventually discharge into natural waterways.

In 2013, the DEQ evaluated Fauquier County to see if we met the definitions of being an MS4 regulated community. It was determined that the Town of Warrenton would be an MS4 community, and a portion of Fauquier County would be a separate MS4 community. The portion of Fauquier County designated by the DEQ as being an MS4 is a portion of the Warrenton area and most of New Baltimore. As a side note, other public entities, such as the Virginia Department

of Transportation (VDOT) are also MS4 regulated entities. Therefore, County MS4 facilities located in the Town of Warrenton discharge into Warrenton's MS4 facilities, and County MS4 facilities in other areas discharge into VDOT's MS4 facilities.

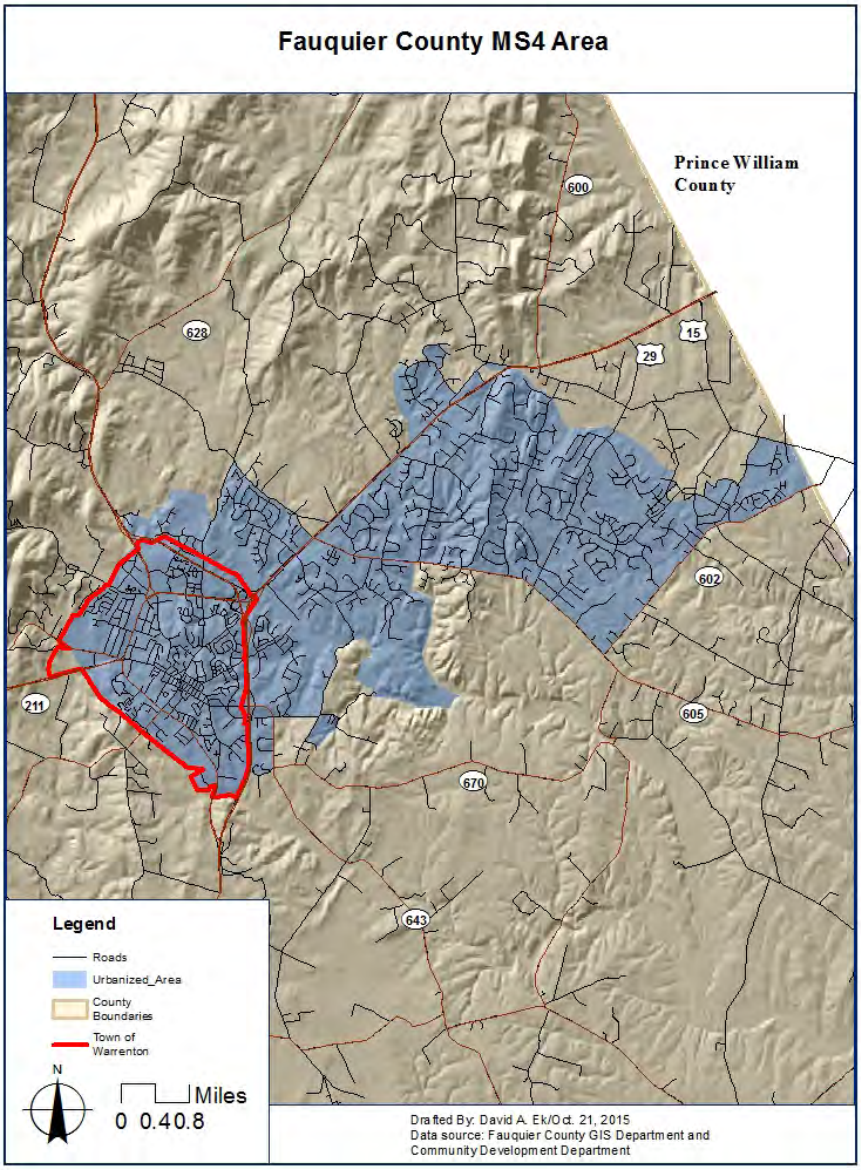

Figure 23 The Urbanized Area of Fauquier County in which Fauquier County's MS4 Permit Applies

What this means is that there is recognition that Fauquier County contributes stormwater runoff into natural streams, and there is a potential that this run-off may contain pollutants; as a consequence, certain processes and reporting

procedures are required to lessen this potential. In addition, the County becomes responsible for some aspects of those public and private areas within this urbanized area that drains into one of these County-owned stormwater systems. If the County cannot obtain certain stormwater pollutant reduction targets on strictly County-owned lands, then the County would be required to implement a strategy designed to reach these pollutant reduction mandates through education, incentives and other measures on private lands.

E. Water Supply Plan

The State mandates that all counties, cities, and towns in the Commonwealth of Virginia submit a local water supply plan to the State Water Control Board. The Water Supply Plan summarizes the status of potable water sources, demands and water-related challenges facing the respective governmental entity. Fauquier County combined with the Towns of Remington and The Plains to produce a Water Supply Plan that was conditionally approved September 29, 2011. Initially, the Virginia Department of Environmental Quality (DEQ) felt that the chapter dealing with drought management was insufficient, especially the management actions and enforcement section. In addition, ordinances were needed that officially implement these actions and enforcement strategies. The County did not want to hold up the main portion of the Water Supply Plan, so it asked DEQ to approve the Water Supply Plan on the condition that the needed improvement in the Drought Plan section was to be dealt with separately. The DEQ agreed, and provisionally approved the Water Supply Plan on the condition that the County provide the needed details in a separate Drought Management Plan effort. Approved Water Supply Plans are required to be updated every five years.

F. Drought Management

Warrenton receives most of its potable water from surface water sources; however, the majority of other county residents obtain potable water from groundwater sources.

The County estimated that a droughts in the ten year period from 1999 to 2008 cost Fauquier County farmers over 22 million dollars. This equates to over $2.22 million per year. This is a conservative figure, since there are often many losses that are not officially reported, and there were several official reported losses recorded in Fauquier County Board of Supervisors' meeting notes that were recorded by acres of crops lost, not as actual dollar figures.

Year	Reported Loss to Farmers	Source: Fauquier County Board of Supervisors Meeting Date
1999	$8,000,000	08/02/1999
2000		
2001		
2002	$2,500,000	08/19/2002
2003		
2004		
2005	$2,350,000	07/14/2005
2006	$1,800,000	09/14/2006
2007		
2008	$7,500,000	11/13/2008
Total	$22,150,000	

During these droughts, surface waters used for livestock ran dry and alternative water sources were needed to get them through the drought. Clearly, surface water conditions are important to be evaluated and monitored within the context of this drought management and response plan.

The County's Drought and Emergency Preparedness Plan is contained in the 2011 Water Supply Plan; however, the Commonwealth has not yet formally approved this drought plan, due mostly to the need to provide more details on what actions are permitted and/or restricted during the various drought levels. In addition, the County is required to develop follow-up ordinances to support the implementation and enforcement components of the Drought Plan.

Besides these changes, there are a few other changes that are currently underway. Drought, like most other natural resource phenomena, does not recognize political or administrative boundaries. Therefore, a more comprehensive and coordinated approach is being pursued, working cooperatively with the Town of Warrenton, the Town of Remington, the Fauquier Water and Sanitation Authority; the John Marshall Soil and Water Conservation District, the Fauquier County Extension Office and the Fauquier County Farm Bureau, among others, in the preparation of a unified Drought Management and Emergency Response Preparedness Plan. It should be finalized in 2016.

G. Agricultural Programs

There are numerable agricultural-related programs implemented and managed by entities such as the Fauquier County Agricultural Extension Office, the John Marshall Soil and Water Conservation District, Natural Resource Conservation Service, Fauquier County Agricultural Development Office, and the Fauquier County Farm Bureau, as well as others. Several of these have a connection to natural resource management, especially those related to surface water, streams and riparian resources.

A stream or riparian buffer is fundamentally the zone of vegetation that lies on either side of a stream. Stream buffers have many functional uses, ranging from

water quality, recreational, aesthetics, to wildlife habitat. However, for the purpose of the comprehensive plan, the focus will be on water quality.

The primary means that stream buffers may help manage water quality includes the following: as a filter for pollutants; as shade structures that cool water and aquatic organisms; as a buffer that absorbs the stream's energy (especially during floods); and as a buffer to slowly release surface water run-off, thereby moderating flood highs and drought lows. Stream buffers are so effective in filtering pollutants from water that they are widely accepted as being one of the most effective ways to filter pollutants from surface water run-off.

There have been many studies that looked at the effectiveness of stream buffers. Some of the attributes of a buffer that influences its effectiveness include the following: stream width; stream orientation; soils; quantity of water flow; overland/surface flow versus groundwater flow; type of vegetation and vegetation size class; type of pollutant; soil type; and time and duration between flood events.

Stream width and orientation has a significant bearing upon the effectiveness of streamside shading and cooling as a result of riparian vegetation.

Higher treatment efficiencies are gained when low volumes of water move slowly through the buffer to allow the biotic elements in the buffer to filter the pollutants from the water. This is where soil type, nature of flow and time and duration come into play. Water travels through sand faster than it does through loam soils, so therefore is not filtered as effectively. Water travels through a grass field quicker than it does through a heavily forested and structurally diverse community. Clay soils transmit water slowly, but if there is more water flowing to a clay soil in a given time than what can pass through the clay soil, then much of the water may rapidly run over the surface into the adjacent stream and thereby bypass any filtering derived from the soil. Therefore, the best buffer is one which is sufficiently wide; contains healthy and structurally diverse vegetation; water flowing into the buffer are sufficiently moderated so there are not large pulses of high volume water; contains soils that allow enough infiltration to absorb the water being transported into the buffer, but does not transmit the water through the soil so quickly that pollutants just pass through; contains stabilized stream banks that are not eroding; and the buffers are protected from grazing, trampling and soil compaction.

> *"The single most important action a landowner can take to protect the watershed is to promote and enhance vegetation …along their streams and ponds." 'RappFlow'(http://rappflow.org/stream-buffers-2007/)*

How wide a stream buffer is wide enough? The many factors mentioned in the preceding paragraph influence how wide a buffer needs to be. Oftentimes, to be 100-percent effective, a stream buffer may need to be 100 feet or more on either side of a stream. Many farmers may feel uncomfortable with giving up so much

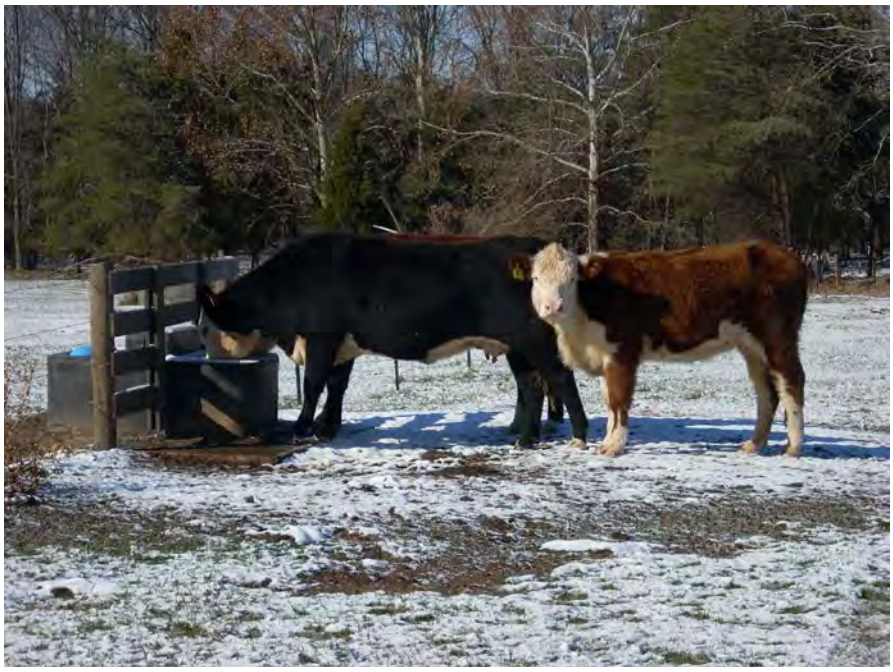

Figure 24 **Dedicated Water Source Provided in Fauquier County so Livestock Do Not Need to Wade into Stream**

Figure 25 **Student Volunteers Replanting Trees Along a Fauquier County Stream; the Landowner is Participating in the Volunteer Cost-share Program Administered by John Marshall Soil and Water Conservation District**

land from livestock grazing, so compromises are often deployed. In many situations, a 35-foot buffer on either side of the stream is the accepted compromise, since it may be 70 to 80 percent effective in filtering pollutants. Stream buffers less than 35 feet wide significantly drop off in effectiveness.

Besides the filtering capabilities of a stream buffer, most cattle ranchers find economic benefits to establishing stream buffers and fencing their cattle from the stream and buffer and providing a clean water alternative to their livestock where they do not have to wade into the water. Livestock defecating in the same water that they drink from or even just drinking the same water in which they are lying causes significant animal health issues that directly affect the livestock producer's profits. Cattle drinking waters containing fecal contaminants create wide ranging health problems that require frequent vet assistance and diverse livestock medications. Often the savings from vet bills alone will more than off-set the cost for the fencing and other supplies needed to establish the buffer in the first place. Cattle drinking clean water usually put on more weight and therefore can garner higher income to the rancher. Lastly, the installation of a pressurized watering system enables the rancher to better manage grazing and therefore may be able to increase stocking rates. In addition, the John Marshall Soil and Water Conservation District and other private and public organizations provide many cost sharing opportunities that enable ranchers to acquire needed fencing material and also access to volunteer labor forces to replant riparian buffers.

While there may be many livestock health and economic reasons to establish stream buffers, currently within Fauquier County, and Virginia as a whole, there are no requirements that would dictate for a rancher or landowner to fence off their streams or establish buffers. Since the benefits of stream buffers are widely recognized, localities usually deploy one of three policies with regard to stream buffers: 1) establish legal requirements to keep livestock out of streams; 2) provide various tax or monetary incentives to encourage ranchers to keep livestock out of streams; or 3) provide educational programs that promote the advantages and benefits of stream buffers. To date, Fauquier County policies have not strongly emphasized stream buffers. Fauquier County's main involvement in stream buffers has been through the John Marshall Soil and Water Conservation District and access to state funds for education and cost-sharing opportunities.

Every use of natural resources has some impact on that resource and the community at large, and agriculture is no exception. By and large, people that engage in agriculture as a livelihood have become very adept at stewardship and conserving those resources integral to their operation. An example of this is sustainable soil practices. If a farmer on private land does not provide good stewardship of his soil, he will not be engaged in economically viable farming for very long. As a consequence the more significant natural resource impacts resulting from agricultural practices include the following:

- impacts that are incidental or not directly affecting their operation, such as loss of wildlife species diversity due to habitat loss;
- impacts associated with competition of resources (for instance, if water is scarce on a property, that limited water that is distributed to livestock needs

may be to the detriment of ecological needs);

- impacts that are conflicting with economically viable agriculture (such as loss of wetlands, since most agricultural products do not grow as well in wetlands, and no matter how attractive they are, how much water filtration they provide, or how much wildlife habitat wetlands provide, these wetland attributes do not sustain farming income); and
- impacts associated with knowledge and tradition (some agricultural practices have been in use for generations, and newer more sustainable, and even less expensive methods have been developed, but it takes a long time to overcome habits and traditions in a way that gives landowners the confidence to try newer methods unfamiliar with their experiences or family traditions). An example of this is providing livestock open access to streams. In early years it made sense, cattle need access to water, and rather than pay a lot of money to bring water facilities to the cattle, you simply let them wander down to the creek for free. However, studies and common practice now find such practices to be much more costly on a long-term basis. Livestock wading in streams, defecating in streams and drinking water from the same streams often incur expensive-to-treat illnesses and loss of livestock production as a result of parasite and viral-infected waters. In addition, soil and land loss as a result of livestock-induced streambank erosion is costly in pasture degradation and fence damage. A small investment that provides alternative water supplies to cattle is more expensive up-front, but will likely be a large savings over time. If the livestock goes to these alternative sources for their water (such as a livestock-dedicated well), then it would enable fragile and sensitive riparian resources to be fenced off and excluded from further impact.

Fortunately for the farmer and the natural resources, there is assistance available to landowners through educational material, the John Marshall Soil and Water Conservation District, National Resource Conservation Service, and the Fauquier County Agricultural Extension Office. These organizations provide technical assistance, recommendations, training, and access to grants and funding assistance programs.

In addition, in an effort to sustain agricultural operations, and as a recognition that some natural resource impacts will result from agriculture, agricultural operations are exempt from many state environmental laws and restrictions, and Virginia laws afford some latitude to counties to also exempt agriculture from many environmental and land-use County requirements.

One thing that influences agricultural-related impacts is agriculture's susceptibility to forces beyond their control. There are countless variables in the weather, environmental effects such as wind storms, floods, droughts, wildlife impacts and a host of other influences which could produce a boom one year and total economic loss the next. Society has generally afforded agriculture a certain leeway and latitude in light of the need to stay viable in this highly dynamic system.

Market forces also are on top of these environmental stressors. For instance, increased health and quality control standards on dairy products have considerably increased the cost of milk production. These costs are often too high for small farmers to absorb, and market forces prohibit them from passing the increased costs to the consumer, so therefore, many small diary operations have gone out of

business. Those that are barely hanging on may not have enough economic reserves or flexibility to participate in conservation efforts, such as removing land from their farming production to establish a wider stream buffer, since even the loss of a half-acre may be enough of a loss to force them out of business. Any cooperative projects with farmers will require an awareness and appreciation of these realities. Fortunately, the staff at the John Marshall Soil and Water Conservation District has developed a sufficient rapport with the agricultural community to enable effective communication built on trust. However, many of the more recent successes were partly the result of state and federal financial assistance, and with budgets growing tighter, the access to these agricultural grant assistance programs may be more limited in the future.

VI. REGIONAL CONTEXT AND PARTNERSHIPS

As stated under the Environmental Review section, one of the most critical components in a comprehensive plan is the development of strategies and a process to manage long-term trends and incremental change. Incremental change may occur slowly enough that it goes unnoticed until such a time that it may be too late to make an effective difference. Therefore, it is critical that land use planning decisions are guided by a strategically-oriented comprehensive plan. This is even more apparent in the complicated world of managing natural resource processes. Therefore, there is greater likelihood that the future will look more like our vision, rather than relying upon fate or happenstance. The comprehensive plan should outline what we want our natural resources to look like in the future, so that we may use this forward vision to guide us through day-to-day and year-to-year decisions, so that these short-term decisions contribute towards having us reach our long-term goals. Therefore, this long-term vision and goal must be specific enough in order to be useful to frame short-term decision-making, but broad enough to allow flexibility in the manner in how to get us there. Being too prescriptive limits the ability to seize upon situational opportunities as they arise, and such plans become woefully out-of-date. On the opposite extreme, being too broad and vague provides no guidance or framework for decision-making, and therefore ensures most long-term goals to be unattainable.

Also complicating effective long-term planning is the broad scope that many of these issues operate within. For instance, long-term water quality issues within Fauquier County are determined just as much by upstream communities and downstream Chesapeake Bay issues and conditions as upon any specific actions taken in Fauquier County. This is one of the reasons that Fauquier County must be interested and engaged in regional natural resource issues. This interest and engagement should run the whole spectrum from concerned citizens, County staff, appointed officials, to elected Supervisors. This is also the reason that the County participates in a variety of regional groups and entities.

In many ways natural resource management in Fauquier County is more complex than the typical Virginia county. Some of this complexity arises from the diversity of issues and how the vision of the county intersects new trends and realities. For instance many long-time residents view Fauquier as being a rural county; however, the County also contains large suburban developments and MS4 stormwater issues more aligned with Northern Virginia neighbors to the east (such as Prince William County) than with rural neighbors to the west (such as Rappahannock County). Conversely, diverse rural landscapes make the implementation of many of the solutions that urban neighbors utilize impractical or unworkable in our context. We truly cross the spectrum in a way that few of our neighbors have to operate in. This diversity provides challenges for County-wide policies, but it also should highlight the importance of this particular and related plans, since we could be at a critical turning point. Without a strong vision of our future and a strong policy

framework that guides future decisions, we could easily find that unrecognized forces shifted us into something that does not conform to our vision or long-term goals.

Most natural resources do not recognize political or jurisdictional boundaries. Therefore, responsible resource management often entails working cooperatively across administrative boundaries. As much as possible a coordinated regional or watershed scale approach is desirable.

Previous sections of this plan outline and summarize some of the natural resource management issues and challenges facing Fauquier County. The Comprehensive Plan's Vision Statement and its Guiding Principles provide several policies that direct the County to promote the management of natural resources. The following goals, objectives and actions for implementation are proposed to further realize this vision for Fauquier's future.

VII. GOALS,OBJECTIVES AND ACTIONS FOR IMPLEMENTATION

The previous sections outline and summarize natural resource management issues and challenges facing Fauquier County. The Comprehensive Plan's Vision Statement and its Guiding Principle A promotes management of natural resources. The following goals, objectives and actions for implementation are proposed to accomplish this.

GOAL 1: Seek to realize benefits beyond responsible natural resource stewardship.

Objective 1.1: Seek to ensure natural resource management and economic development goals and actions are complementary.

Action 1.1.1: Inventory the County's Natural Capital resources and develop a green infrastructure management plan.

Action 1.1.2: Quantify the economic benefit of the County's natural resources and associated values through a comprehensive economic impact analysis study.

Action 1.1.3: Identify, and where appropriate, promote proposed industries compatible with the County's open spaces and rural values.

Action 1.1.4: Explore opportunities to leverage natural resources, such as the Blue Ridge Mountains and Rappahannock River, with compatible economic development.

Objective 1.2: Explore means to ensure natural resource management and open space goals and actions are complementary.

Action 1.2.1: Explore opportunities in the establishment of open spaces in a way that maximizes beneficial uses beyond simply open space; for example, the establishment of natural area preserves, or the combining of complementary needs for open space such as wellhead protection, wildlife corridors, recreational amenities, and historic preservation.

Action 1.2.2: Inventory and track Fauquier County's open spaces and large blocks of undeveloped lands.

Objective 1.3: Explore means to ensure natural resource management and agricultural goals and actions are complementary.

Objective 1.4: Promote the retention of the County's rural quiet and natural dark sky attributes.

Action 1.4.1: Encourage the marketing and promotion of Fauquier County's dark night skies.

Objective 1.5: Promote and encourage the retention and enhancement of the County's diverse scenic resources.

Action 1.5.1: Consider the adoption of an ordinance directed at preserving identified key viewsheds from officially designated Scenic Rivers and Byways.

Action 1.5.2: Create a scenic resources/viewshed plan.

Objective 1.6: Seek means to integrate natural resources aims with complementary recreation and public accessibility.

Action 1.6.1: Seek through public purchase, proffer, density transfer, donation or open-space easement, the preservation of greenways and the development of trails.

Objective 1.7: Encourage the development and implementation of environmental education programs targeted to specific needs and programs within Fauquier County.

Action 1.7.1: Facilitate and support programs and activities that encourage youth to experience Fauquier County's outdoors.

GOAL 2: Manage and protect surface and groundwater resources to provide sufficient potable water and support aquatic ecosystems.

Objective 2.1: Work cooperatively with the Fauquier County Water and Sanitation Authority and the Towns of Remington and Warrenton in the development of a comprehensive water supply program strategy.

Action 2.1.1: Work cooperatively with the Fauquier County Water and Sanitation Authority and Towns of Remington and Warrenton to fulfill the water supply needs of current and future County businesses and residents within areas designated for service.

Action 2.1.2: Seek to establish back-up water supplies and critical water supply infrastructure in order to provide greater flexibility in public water supplies.

Action 2.1.3: Explore creative water conservation, distribution, management, and re-use opportunities.

Action 2.1.4: Develop a strategic plan regarding the placement and siting of public water supply wells to support the County's Service Districts.

Action 2.1.5: Formalize roles and responsibilities regarding the partnership arrangement between Fauquier County and Fauquier County Water and Sanitation Authority (WSA) regarding water management.

Action 2.1.6: Develop a groundwater and wellhead protection plan.

Action 2.1.7: Investigate creative water-storage options to meet our current and projected water supply needs.

Objective 2.2: Develop and implement a comprehensive and robust water management program.

Action 2.2.1: Identify critical areas for groundwater investigation and management based upon projected growth and water use.

Action 2.2.2: Develop management strategies for protecting existing groundwater supplies. Such measures can include acquisition of property or easements within critical wellhead protection areas, developing redundancy in the water supply systems and the development of contingency plans.

Action 2.2.3: Work with the state and regional partners to preserve and protect the health of streams and reservoirs.

Action 2.2.4: Coordinate a surface water management program with state and regional initiatives, including water supply planning, TMDL studies and implementation plans, and Chesapeake Bay programs.

Action 2.2.5: Investigate the nature, characteristics, and long-term sustainability of Fauquier County's groundwater aquifers.

Action 2.2.6: Encourage businesses to be creative with water re-use options, including that of stormwater.

Action 2.2.7: Consider developing programs to support private well owners to maintain a healthy water supply.

Action 2.2.8: Consider revising and clarifying the various sections and chapters of the Comprehensive Plan and the Zoning Ordinance that pertain to centralized water systems versus individual wells.

Action 2.2.9: Encourage studies that source bacteria contamination of County water.

Objective 2.3: Encourage the establishment of stream buffers for water quality protection.

Action 2.3.1: Facilitate, augment and support existing programs and efforts to establish streamside vegetative buffers. This may include, but not be limited to exploring means in which buffers may serve multiple purposes, for example, community amenities such as greenway trails working as buffers.

Action 2.3.2: Develop a riparian buffer protection program that leverages resources from state and regional partners.

Objective 2.4: Seek to reduce pollution to our natural waters and stormwater systems.

Action 2.4.1: Encourage and support community programs that keep water bodies free from debris and litter.

Action 2.4.2: Support the development of additional appropriate standards by which to manage bacteria, soil erosion, and deposits of sediment in receiving streams and water bodies.

Action 2.4.3: Support the development of turf/nutrient management plans for areas maintaining large areas of fertilized turf.

Action 2.4.4: Encourage creative stormwater retrofits in any redevelopment, repair or replacement projects affecting buildings, roads, parking lots and other impervious surfaces within the County.

Action 2.4.5: Develop and implement incentives that encourage homeowners and business owners to utilize optional local stormwater retention practices and infrastructure (such as rain gardens and down-spout disconnects).

Action 2.4.6: Continue to work cooperatively with the Town of Warrenton in the management of the County's MS4 program.

Action 2.4.7: Inventory all stormwater BMPs in the County, both old and new.

Objective 2.5: Identify fully functioning and healthy surface waters and explore means to sustain and maintain these baseline conditions.

GOAL 3: Encourage the retention and restoration of the County's terrestrial resources so that these resources and habitats are not degraded, and are sustained.

Objective 3.1: Take a firm position against mineral extraction and oil and gas exploration and development within Fauquier County.

Action 3.1.1: Investigate and establish a firm position regarding uranium mining within Fauquier County.

Action 3.1.2: Investigate and establish a firm position regarding 'fracking' and natural gas collection within Fauquier County.

Objective 3.2: Cooperate with landowners and agencies that are engaged in promoting and sustaining the County's rich forest resources.

Action 3.2.1: Partner with the Virginia Department of Forestry on developing strategies for the preservation and conservation of the County's forest resources.

Objective 3.3: Promote the preservation of agricultural and forested areas through the use of Agricultural and Forest Districts, easements and other voluntary means.

Objective 3.4: Encourage the retention and sustainability of the County's natural biological diversity.

Action 3.4.1: Encourage the surveying and identification of small-whorled pogonia populations that may be naturally occurring in Fauquier County.

Action 3.4.2: Encourage surveying and tracking the long-term trends of the County's native aquatic mussel populations.

Action 3.4.3: Encourage inventories for rare species occurrences within Fauquier County.

Action 3.4.4: Encourage the development of a strategy to conserve diabase soils and their special habitats.

Action 3.4.5: Consider revising the County's wetland policies to ensure they reflect Fauquier County's ecological values and goals.

Action 3.4.6: Encourage the retention and health of Fauquier County's terrestrial diverse natural communities.

GOAL 4: Implement a robust natural resource monitoring program.

Objective 4.1: Develop and maintain accurate and up-to-date inventories, including, but not be limited to, prime agricultural soils, wetlands, healthy and impaired water resources, sensitive and protected species, water quality, and groundwater wells.

Objective 4.2: Adopt metrics to gauge the status of natural resources, and update them as appropriate.

Action 4.2.1: Work in partnership with the Department of Environmental Quality in developing a surface water monitoring project tailored to meet the unique needs, goals and programs of Fauquier County.

Action 4.2.2: Monitor groundwater contaminants prior to their arrival to public water supply wells.

Action 4.2.3: Monitor the quality of high priority groundwater aquifers.

Action 4.2.4: Track the long-term trends of the County's open spaces and large blocks of undeveloped lands.

Action 4.2.5: Track the long-term trends and losses of prime agricultural soils.

Action 4.2.6: Encourage or support the development of fish biologic integrity index studies of the County's surface waters every ten years in order to gage the long-term trends of the health of the County's aquatic resources.

Action 4.2.7: Develop and maintain a County-wide GIS layer of septic systems.

Action 4.2.8: Stay current with state-wide air pollution trends and assess the potential affect upon Fauquier County.

Action 4.2.9: Work with partners and citizen volunteers to establish and maintain a surface water monitoring program.

Action 4.2.10: Continue monitoring and tracking Johnsongrass infestations within the County.

GOAL 5: Encourage natural resource planning and management within a regional context.

Objective 5.1: Take a regional or watershed-based approach to environmental issues.

Action 5.1.1: Explore means to integrate regional concerns and issues into local plans, review processes and management plans, so they may be complementary.

Action 5.1.2: In cooperation with other relevant jurisdictions, explore a unified Rappahannock River watershed management plan.

Objective 5.2: Implement optional practices and policies that facilitate the restoration goals of the Chesapeake Bay Act.

Objective 5.3: Evaluate situations in which the over-design of stormwater systems may be appropriate in order to meet MS4, Chesapeake Bay Act, and other nutrient and sediment reduction mandates.

Objective 5.4: Encourage the creation of land-owner based watershed alliances.

Objective 5.5: Lead and maintain an interagency and coordinated drought management partnership program that includes partners such as the Fauquier County Water and Sanitation Authority, the agricultural community, and the towns of Warrenton, Remington, and The Plains.

GOAL 6: Incorporate natural resource management elements into County permit and plan review processes.

Objective 6.1: Explore ways to incorporate natural resource protection measures into County permit and plan review processes.

Action 6.1.1: Update the County's permit and plan review processes to include consideration of such items as prime agricultural soils, groundwater resources, wetlands, impaired waters and open spaces.

Action 6.1.2: Incentivize property owners to voluntarily accomplish actions that further natural resource goals.

VIII. REFERENCES AND BIBLIOGRAPHY

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