Goose Creek: A Decade (or More) Later

Preliminary Land Use Land Cover Change Analysis

Prepared by
The Center for Watershed Protection

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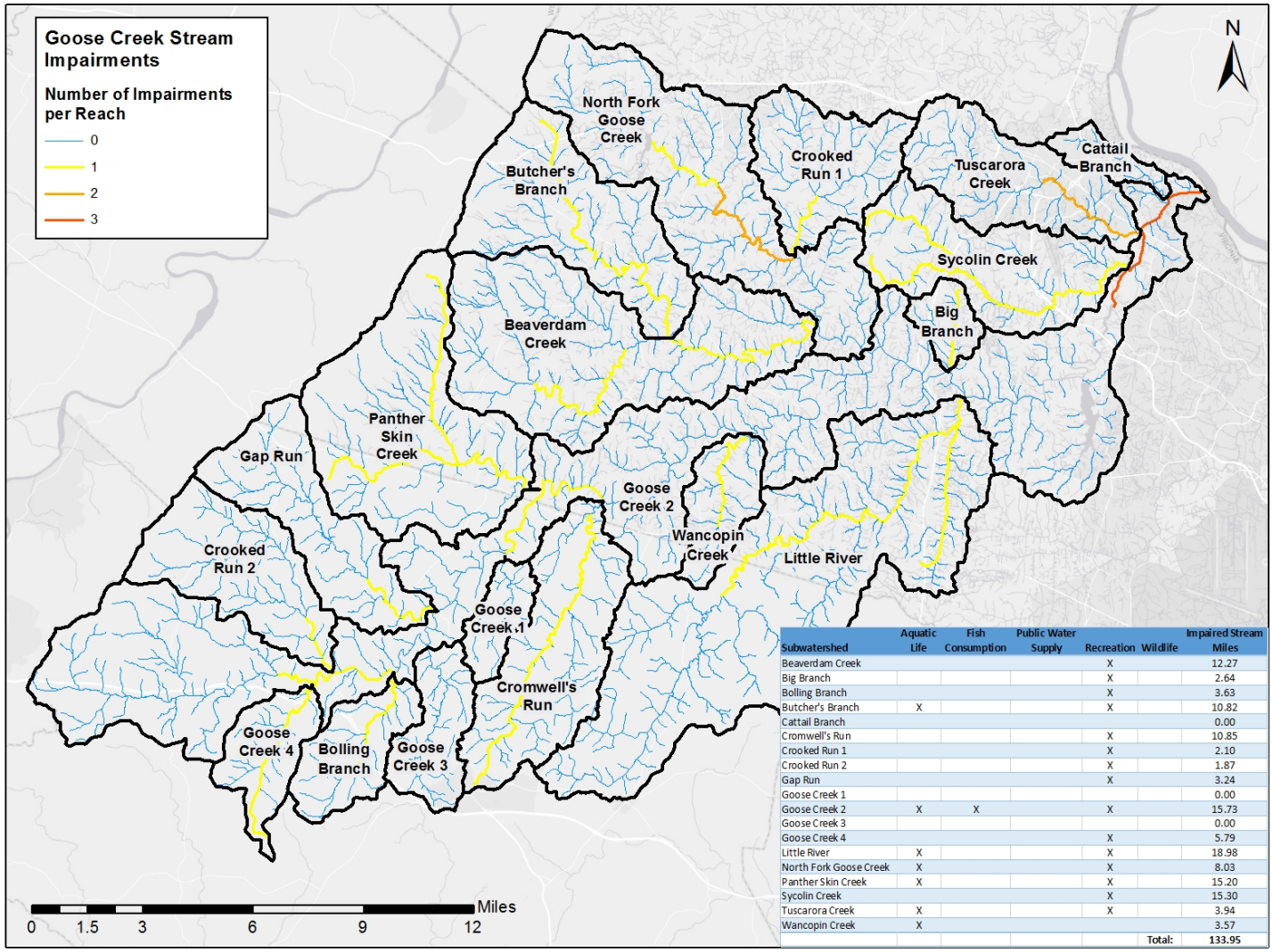
In 2003, the Center for Watershed Protection, Inc. (the Center), Goose Creek Association and the Piedmont Environmental Council completed a project to study the Goose Creek Watershed that evaluated the vulnerability of the watershed to future development and identify opportunities to protect and restore stream health. The study found the majority of the subwatersheds to be classified as high quality. While the Goose Creek watershed maintains its state-designation as a Scenic River, there is a growing list of impaired streams within the watershed based on Virginia Department of Environmental Quality (VA DEQ) data. That is, the VA DEQ list of impaired waters in 2014 has 133.96 miles of streams designated as impaired. This equates to 26.47% of the total stream miles within the watershed. All but three subwatersheds have a listed impairment (Figure 1). Further, the2003 study found that 15 of the 40 subwatersheds were showing signs of impacts from development with eroded stream channels, degraded water quality, and pollution tolerant fish or macroinvertebrates.

In 2015, the Prince Charitable Trusts provided the Center with funding to initiate a 'look back" to determine how the Goose Creek watershed has fared with a decade or more of growth. As a national leader in watershed assessments, management and protection strategies, the Center finds the Goose Creek watershed as a notable opportunity to evaluate the effectiveness of watershed planning in a climate of rapid growth and development, changing regulatory environment, and in a watershed considered significant by State resource agencies. A re-evaluation of watershed health and the factors driving protection and conservation actions, or lack thereof, provides a lens to provide lessons learned and actions moving forward for the Chesapeake Bay and nationally. The initial effort was dedicated to compiling the data that would allow comparison of land use land cover characteristics over a decadal period.

GOOSE CREEK KEY FINDINGS

- Health of the watershed on 'alert' with number of stream miles impaired by bacteria (total coliforms and *E.coli*) more than doubled over the decade. VA DEQ is developing Implementation Plans for the lower Goose Creek Watershed to identify actions to reduce bacteria in the streams in order to meet the total maximum daily load (TMDL). Continued efforts throughout the watershed to identify the most effective policies, program and actions to reduce impacts on stream health are needed.
- Goose Creek watershed is located in the fastest-growing county in Virginia, Loudoun County. While the land use/ land cover change within the watershed was less than expected over the decade, the fastest growing areas of the county are just east of the watershed in the Dulles and Ashburn planning areas. The predominant land use remains agriculture and forest with pockets of growth in a few areas.



Subwatershed	Aquatic Life	Fish Consumption	Public Water Supply	Recreation	Wildlife	Impaired Stream Miles
Beaverdam Creek				X		12.27
Big Branch				X		2.64
Bolling Branch				X		3.63
Butcher's Branch	X			X		10.82
Cattail Branch						0.00
Cromwell's Run				X		10.85
Crooked Run 1				X		2.10
Crooked Run 2				X		1.87
Gap Run				X		3.24
Goose Creek 1						0.00
Goose Creek 2	X	X		X		15.73
Goose Creek 3						0.00
Goose Creek 4				X		5.79
Little River	X			X		18.98
North Fork Goose Creek	X			X		8.03
Panther Skin Creek	X			X		15.20
Sycolin Creek				X		15.30
Tuscarora Creek	X			X		3.94
Wancopin Creek	X					3.57
					Total:	133.95

Figure 1. VA DEQ impaired streams in the Goose Creek Watershed.

- Impervious cover in the watershed is estimated at 2% with no significant or appreciable increase over the decade. It is expected that imperviousness is under-estimated based on the data used for this analysis. Improved, high resolution data may improve the accuracy of the change in land use.
- Much of the development in Loudoun County is occurring in adjacent areas ***directly*** east of the watershed. There may be concern for future encroachment into the watershed in future years.
- A significant proportion of land in the watershed (34%) is protected by conservation easements and this acreage increased by 63% during the 10-year study period
- Despite the high percentage of land in conservation easement, and the relatively low increase in urbanization and impervious cover, stream health has actually declined as indicated by the number of impaired streams in the watershed. The location, type and restrictions of the easements appears to play a role in how well they protect water quality and this relationship should be further explored..

DESCRIPTION OF DATA AND METHODS USED FOR LAND USE LAND COVER CHANGE ANALYSIS

The Goose Creek watershed is a 385 square mile watershed with its headwaters in Fauquier County, traversing Loudoun County before emptying into the Potomac River. The subwatersheds and land use/ land cover for this analysis was re-created to compare the state of the watershed in 2001 to 2011 due to data compatibility issues. As such, this preliminary assessment includes 19 subwatersheds within the Goose Creek, rather than the 40 subwatersheds that were previously used.

The data used for the analysis is the National Land Cover Database (NLDC) for 2001 and 2011. This data provides a national land use land cover classification at a 30 m resolution. A comparison of land use land cover for developed, agriculture, forested and impervious cover was used for this analysis. The NLCD has a relatively coarse resolution where the dominant land cover within 900 m^2 (30m x 30m) is reported (equivalent to an area of 0.2 acres or 9,687 square feet). Based on the Center's experience working with higher resolution dataset for similar types of analyses, we expect the NLCD results in an underestimation of impervious cover, specifically, within the watershed, as roadways, buildings and parking lots within suburban or rural areas are typically patches of smaller areas within a 'pixel' and therefore may not be the predominant land cover. However, this was the best available data to initiate this land use change analysis. Future analysis would recommend acquisition for higher-resolution data from local jurisdictions, or through the Chesapeake Bay Program (available 2017).

RESULTS OF THE LAND USE LAND COVER CHANGE ANALYSIS

The Goose Creek watershed remains relatively undeveloped with 49% of the land in agriculture and 38% forested. Twelve percent of the watershed is classified as developed. The agricultural land in the watershed is predominantly pasture land. There were marginal decreases watershed-wide in both forested and agricultural lands. The NLCD data indicates that pockets of development occurred in

the watershed the past 10 years, largely in the Leesburg area subwatersheds: Tuscarora Creek and Cattail Branch.

Summary	Percent Land Cover in Watershed as of 2011	Percent Change since 2001 (10yrs)
Impervious Cover	2.1	3324.5%
Developed Land	11.3	12.%
Forested land	37.7	-1.9%
Agriculture	49.4	-1.3%

IMPERVIOUS COVER: AN INDICATOR OF DEVELOPMENT AND STREAM HEALTH

Impervious cover is a common indicator of urbanization where increasing levels of impervious cover are shown to have a negative effect on stream quality (Figure 2). The majority of subwatersheds within Goose Creek have less than 5% impervious cover and would be classified by Schueler et al (2009) as "sensitive." Sensitive watersheds typically have high quality streams with stable channels, good habitat conditions, and good to high water quality. However, they are also watersheds that are susceptible to environmental degradation with urbanization and increases in impervious cover.

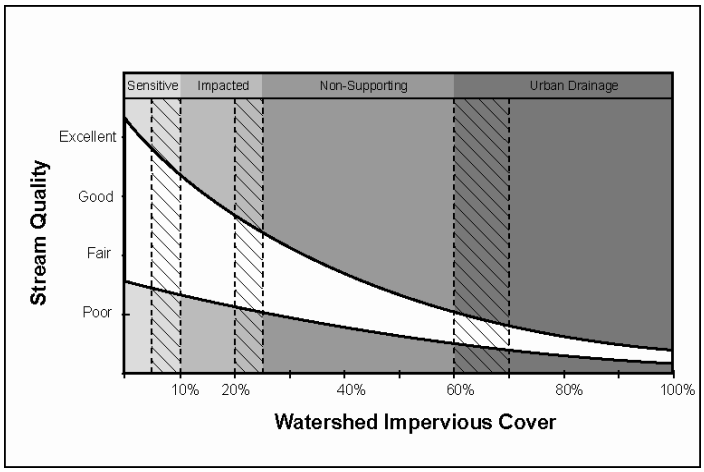


Figure 2. Impact of impervious cover on stream quality (Schueler et al. 2009).

Watershed-wide there was an increase in impervious cover of 33%, which is equivalent to an additional 1,251 acres since 2001. The total watershed impervious area is estimated to be 5,094 acres based on the NLCD, or 2.1% of the total watershed area. The Leesburg area continues to have high levels of impervious cover (Cattail Branch and Tuscarora Creek, 30% and 17%, respectively). Seven subwatersheds had more than a 10% increase in impervious cover, however five of these subwatersheds remain below five percent.

IMPRESSIVE AMOUNT OF LAND IN CONSERVATION EASEMENTS

There is an impressive amount of land in conservation easements within the Goose Creek watershed with over 83,000 acres protected. The area dedicated to conservation easements more than doubled from 2001 to 2011 with a total of 34% of the watershed area in 2011. Each of the subwatersheds has

some area in conservation easements. Figure 3 illustrates the percentage of land that is in conservation easements for each of the 19 subwatersheds.

With a relatively large amount of land in easements, it would be expected that stream health would be good, rather than impaired, but this does not seem to be the case for Goose Creek.

To begin to understand why conservation easements may not have the full benefit on stream health, the Center took a closer look at where the conservation easements are located and the land cover associated with them. On average, only 10.4% of the conservation easements are within the 100-ft buffer. Of the conservation easements within the 100-ft buffer 44.9% is agriculture and 48.6% is forested. Research consistently documents the beneficial effects of forested buffers on water quality. The remaining land use includes small percentage of develop, wetland open water land uses. Surprisingly, the subwatershed with the greater amount of buffer in conservation easement is Cromwell's Run, followed by Goose Creek 1 and Litter River. These subwatersheds have listed use impairments for recreational use.

This analysis suggests that the full benefit of conservation easements may be limited by the type of land cover and easements that are located next to streams. The type of easements and their restrictions may also have a role.

RECOMMENDED NEXT STEPS

- Acquire high resolution land use/ land cover imagery to improve assessment of land use change
- Review the restrictions on the conservation easements as it is likely that older easements have terms that do not limit livestock access to streams
- Identify targeted list of areas to implement conservation practices such as livestock exclusion and reforestation of riparian buffers. An assessment in the number of septic systems and maintenance should also be completed.
- Evaluate the type and level of urban best management practices
- Complete a review of state and local programs to evaluate ability to protect Goose Creek from future growth
- Detailed analyses of selected subwatersheds to target for restoration and protection strategies

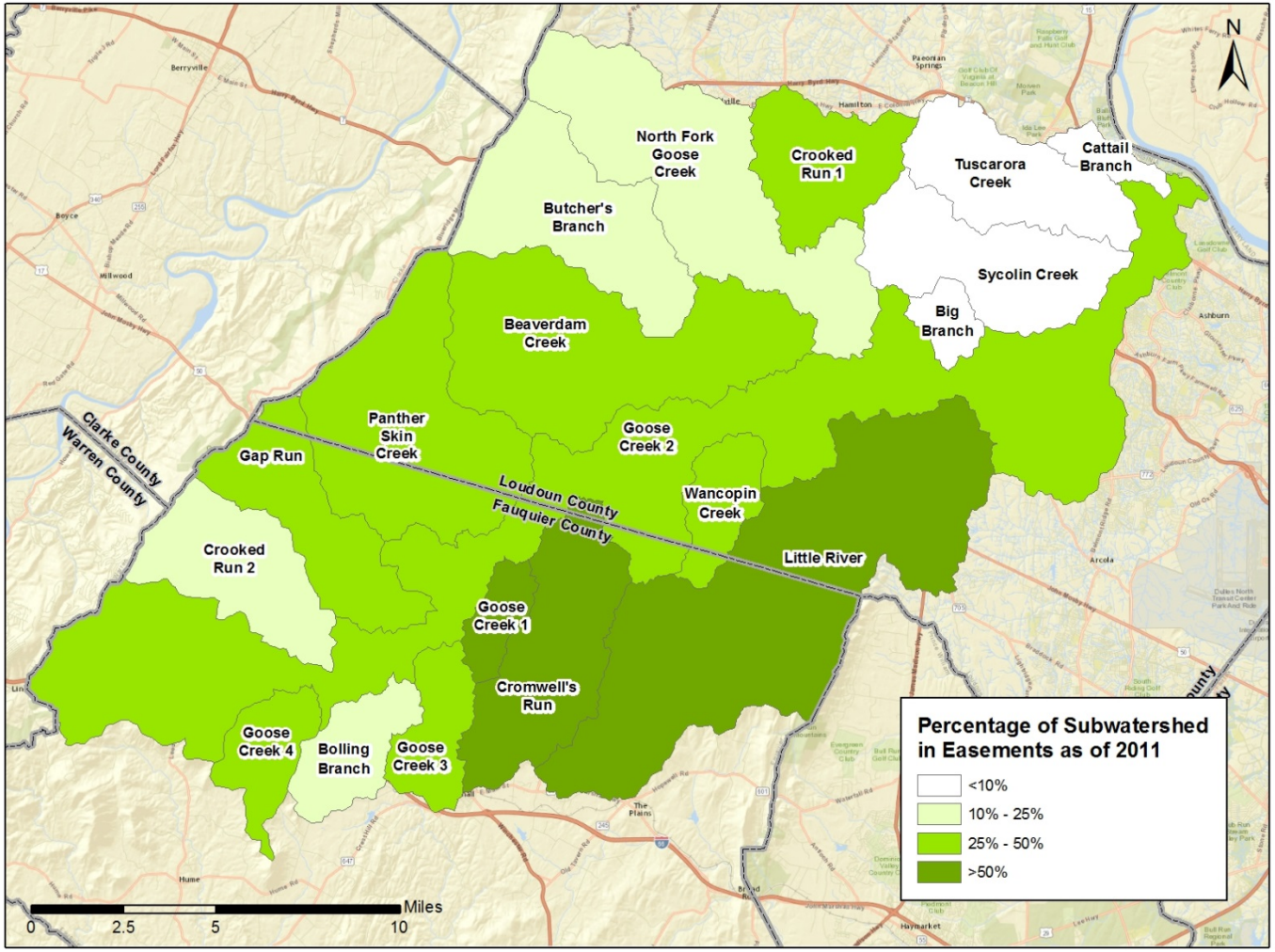


Figure 3. Percentage of land in conservation easement within the Goose Creek subwatersheds.