TMDL SUMMARY APPENDIX B-13

Stetson Brook

WATERSHED DESCRIPTION

This **TMDL** applies to a 6.82 mile section of Stetson Brook, located in the City of Lewiston. The impaired segment of Stetson Brook begins in the northern portion of the watershed in a predominantly forested area at the outlet of a wetland, and flows south crossing College Road, Lane Road, College Road again, and rail road tracks before entering into another wetland. The stream re-crosses the railroad tracks and enters into mixed agriculture and development, crossing College Street and Hamel Road before entering woods. After crossing Stetson Road and College Street, Stetson Brook flows through a developed area crossing the railroad tracks and Main Street (Route 11), finally flowing into the Androscoggin River just downstream of the dam. The Stetson Brook watershed covers an area of 14.87 square miles. The watershed is located within the City of Lewiston and the town of Greene.

- Stetson Brook is on Maine's 303(d) list of Impaired Streams as referenced in the 2016 Integrated Report (Maine DEP, 2018).
- The Stetson Brook watershed is predominately non-developed (75.7%). Forested areas (64%) within the watershed absorb and filter pollutants helping protect both water quality in the stream and stream channel stability. Wetlands (10%) may also help filter nutrients.
- Non-forested areas within the watershed are predominantly developed (14.6%) and agricultural (9.3%) and are located throughout the watershed.
- Runoff from developed areas and agricultural land are likely the largest sources of **nonpoint source (NPS) pollution** to Stetson Brook. Runoff from cultivated lands, active hay lands, pasture, and impervious surfaces can transport sediment, nitrogen, and phosphorus to the stream.

Definitions

- ***Total Maximum Daily Load (TMDL)*** *represents the total amount of pollutants that a waterbody can receive and still meet water quality standards.*
- **Nonpoint Source Pollution** *refers to pollution that comes from many diffuse sources across the landscape, and are typically transported by rain or snowmelt runoff.*

Waterbody Facts

Segment ID: ME0104000208_413R03

City: Lewiston, ME

County: Androscoggin

Impaired Segment Length: 6.82 miles

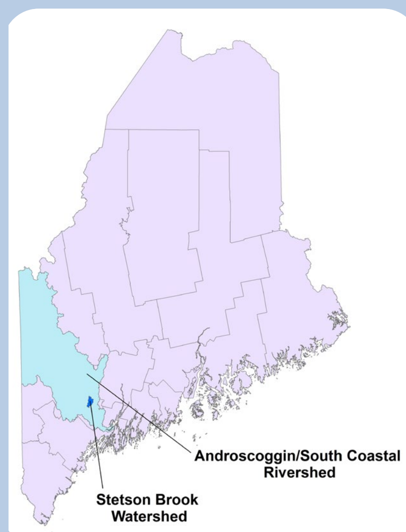
Classification: Class B

Direct Watershed: 14.87 mi^2 (9,517 acres)

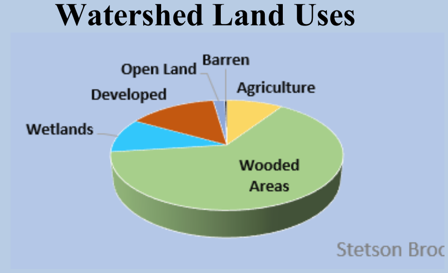
Impairment Listing Cause: Dissolved Oxygen

Watershed Agricultural Land Use: 9.3%

Major Drainage Basin: Androscoggin



Watershed Land Uses



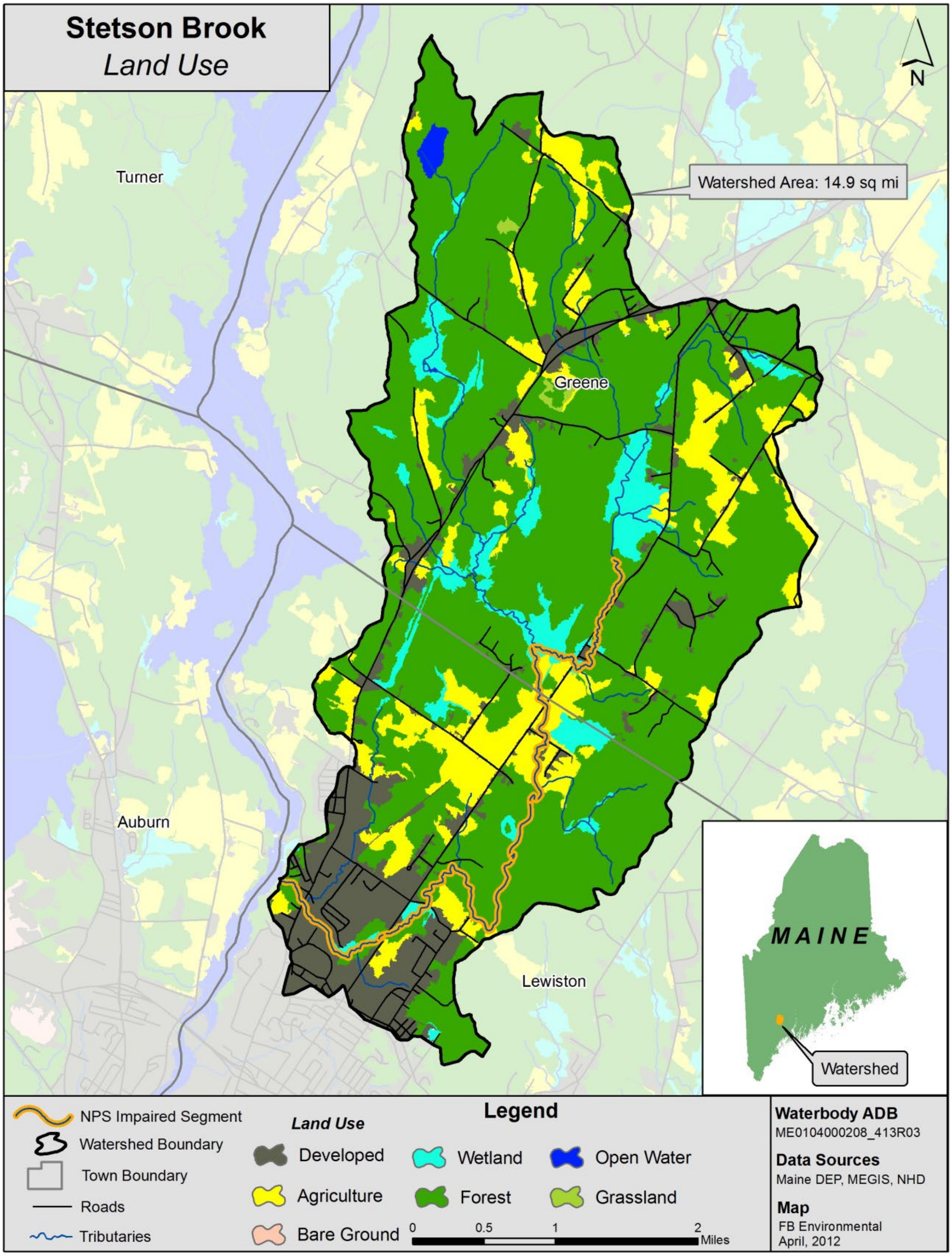


Figure 1: Land Use and Land Cover (from 2011) in the Stetson Brook Watershed

WHY IS A TMDL ASSESSMENT NEEDED?

***Stetson Brook** downstream of the Stetson Road crossing – Station 356*
Photo: FB Environmental

Stetson Brook, a Class B freshwater stream, has been assessed by Maine DEP as not meeting water quality standards for the designated use of aquatic life, and placed on the 303(d) list of impaired waters under the Clean Water Act. The Clean Water Act requires that all 303(d)-listed waters undergo a TMDL assessment that describes the impairments and establishes a target to guide the measures needed to restore water quality. The goal is for all waterbodies to comply with state water quality standards.

Developed land makes up 14.6% of the Stetson Brook watershed. This is 1.6 times the area of agricultural land which makes up 9.3% of the total watershed area. The watershed is heavily forested (64%); however, 39% of the impaired stream segment length passes through agricultural land (Figure 1). Agriculture and development, therefore, are likely to be the largest contributors of sediment and nutrient enrichment to the stream. The close proximity of many agricultural lands to the stream further increases the likelihood that nutrients from disturbed soils, manure, and fertilizers will reach the stream. Eroded stream crossings with washouts and collapsed pavement were fairly common throughout the watershed and may be nonpoint source pollution hotspots.

WATER QUALITY DATA ANALYSIS

Maine DEP uses a variety of data types to measure the ability of a stream to adequately support aquatic life, including; dissolved oxygen, benthic macroinvertebrates, and periphyton (algae). For benthic macroinvertebrates, DEP makes aquatic life use determinations using a statistical model that incorporates 30 variables of data collected from rivers and streams, including the richness and abundance of streambed organisms, to determine the probability of a sample meeting Class A, B, or C conditions. Biologists use the model results and supporting information to determine if samples comply with the numeric aquatic life criteria of the class assigned to the stream or river (Davies and Tsomides, 2002). Maine DEP uses an analogous model to aid in the assessment of algal communities but makes aquatic life use determinations based on narrative standards.

The aquatic life impairment in Stetson Brook is based on historic dissolved oxygen. Macroinvertebrate results from site S-356 in 2013 show attainment of Class B. Periphyton results from this same site show attainment of Class B in 2013 and 2015, but does show impairment in 2018 where it only attains Class C. A wetland station (W-183) was attaining Class B in 2013.

TMDL ASSESSMENT APPROACH: NUTRIENT AND SEDIMENT MODELING OF IMPAIRED AND ATTAINMENT STREAMS

NPS pollution is difficult to measure directly, because it comes from many diffuse sources spread across the landscape. For this reason, an online nutrient loading model, *Model My Watershed* (v. 1.32.0), was used to estimate the sources of pollution based on well-established hydrological equations (Stroud Water Research Center 2017). *Model My Watershed* makes use of the GWLF-enhanced model engine. The model incorporates detailed maps of soil, land use, and slope, daily weather and localized weather data (from the period 2009-2020), and direct observations of agriculture and other land uses within the watershed. *Model My Watershed* is derived from its parent MapShed developed by Evans and Corradini (2012). *Model My Watershed* replaced MapShed in 2017-2018.

The nutrient loading estimates for the impaired stream were compared to similar estimates for five non-impaired (attainment) streams of similar watershed land uses across the state. The TMDL for the impaired stream was set as the mean nutrient loading estimate of these attainment stream watersheds, and units of mass per unit watershed area per year (kg/ha/year) were used. The difference in loading estimates between the impaired and attainment watersheds represents the percent reduction in nutrient loading required under this TMDL. The attainment streams and their nutrient and sediment loading estimates and TMDL are presented below in Table 1.

Table 1: Numeric Targets for Pollutant Loading Based on Model My Watershed Outputs (2021) for Attainment Streams

Attainment Streams	Town	Total P Load (kg/ha/yr)	Total N Load (kg/ha/yr)	Sediment Load (kg/ha/yr)
Footman Brook	Exeter	0.17	1.73	35.2
Martin Stream	Fairfield	0.13	2.98	57.9
Moose Brook	Houlton	0.18	1.59	48.5
Upper Kenduskeag Stream	Corinth	0.16	1.72	100.5
Upper Pleasant River	Gray	0.16	4.26	86.5
Total Maximum Daily Load		**0.16**	**2.46**	**65.7**

RAPID WATERSHED ASSESSMENT

Habitat Assessment

A habitat assessment survey was conducted on both the impaired and attainment streams. The assessment approach is based on the *Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers* (Barbour et al. 1999), which integrates various parameters relating to the structure of physical habitat. The habitat assessments include a general description of the site, physical characterization and visual assessment of in-stream and riparian habitat quality.

Based on rapid bioassessment protocols for high gradient streams, Stetson Brook received a score of 179 out of a total 200 for quality of habitat. Higher scores indicate better habitat. The range in habitat assessment scores for attainment stream was 155 to 179.

The habitat assessment for Stetson Brook was conducted on a relatively short sample reach (about 100-200 meters for a typical small stream), and was located near the most downstream Maine DEP sample station. For both impaired and attainment streams, the assessment location was usually near a road crossing for ease of access. In the Stetson Brook watershed, the downstream sample station was located in a forested portion of the stream downstream of the Stetson Road crossing. This area was forested with a thick buffer, while many other sections of the stream and associated tributaries flow near agricultural lands and developed areas with minimal buffers.

Figure 2 (right) shows the range of habitat assessment scores for all attainment and impaired streams, as well as for Stetson Brook. The overlapping attainment and impaired stream scores indicate that factors other than habitat should be considered when addressing the impairments in Stetson Brook. Consideration should be given to major "hot spots" in the Stetson Brook watershed as potential sources of NPS pollution contributing to the water quality impairment.

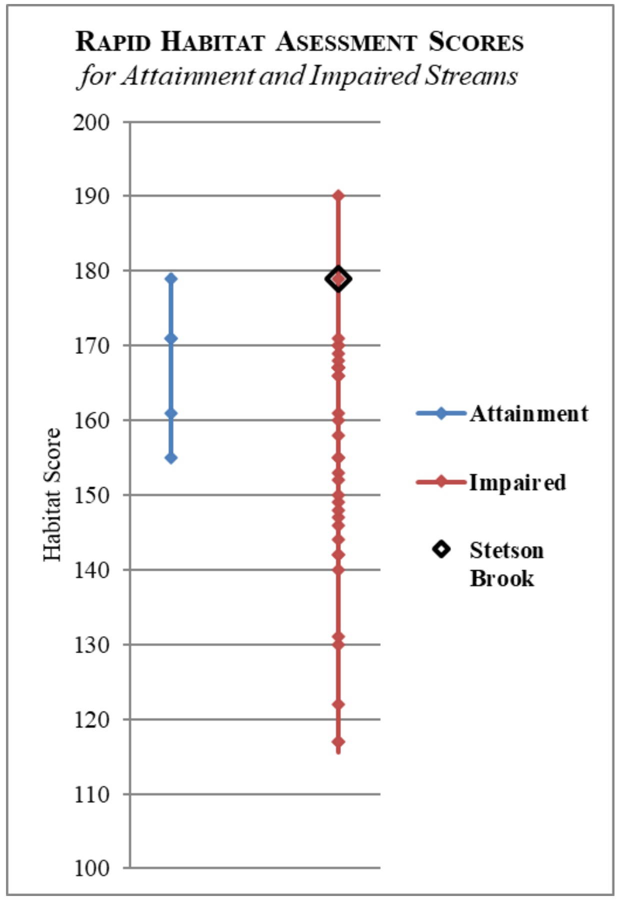


Figure 2: Habitat Assessment Scores for Stetson Brook (2012) Compared to Region

Pollution Source Identification

Pollution source identification assessments were conducted for both Stetson Brook (impaired) and the attainment streams. The source identification work study is based on an abbreviated version of the Center for Watershed Protection's Unified Subwatershed and Site Reconnaissance method (Wright, et al. 2005). The abbreviated method includes both a desktop and field component. The desktop assessment consists of generating and reviewing maps of the watershed boundary, roads, land use and satellite imagery, and then identifying potential NPS pollution locations, such as road crossings, agricultural fields, and large areas of bare soil. When available, multiple sources of satellite imagery were reviewed. Occasionally, the high resolution of the imagery allowed for observations of livestock, row crops, eroding stream banks, sediment laden water, junkyards, and other potential NPS concerns that could affect stream quality. As many potential pollution sources as possible were visited, assessed and documented in the field. Field visits were limited to NPS sites that were visible from roads or a short walk from a roadway. Neighborhoods were assessed for NPS pollution at the whole neighborhood level including streets and storm drains (where applicable). The assessment does not include a scoring component, but does include a detailed summary of findings and a map indicating documented NPS sites throughout the watershed.

The watershed source assessment for Stetson Brook was completed in June 2012. In-field observations of erosion, lack of vegetated stream buffer, extensive impervious surfaces, high-density neighborhoods and agricultural activities were documented throughout the watershed (Table 2, Figure 3).

Table 2: Potential Pollution Source ID Assessment (2012) for the Stetson Brook Watershed

Potential Source			Notes
ID#	**Location**	**Type**	
10	Tekakwitha Drive	Residential	• A large lawn mowed within approximately two feet of stream. • Fertilizer use on the lawn is suspected as it is lush and very green. • A small bridge crossing over stream. • Possible thermal and nutrient impacts.
11	Sawyer Road	Road Crossing	• Slumping road shoulder is eroding directly into stream.
19	College Road	Road crossing	• A small wash out and pavement collapse was observed at an unstable road crossing on College Road.
24	Near College Road crossing	Residential	• Maintained lawn with minimal buffer to stream was identified as a potential source near the College Road crossing in Greene.
34	Daggett Hill Road & Route 11	Road Crossing	• Crumbling pavement and sand and gravel deposits into stream. Excess sediment on road and in ditches.

Nutrient and Sediment Loading – *Model My Watershed* Analysis

The *Model My Watershed* model was used to estimate stream loading of total phosphorus, total nitrogen, and sediment in Stetson Brook watershed. The model estimated nutrient and sediment loads over a 12-year period (2009-2020), which was determined by local (Poland ME USC00176856) weather data inserted into *Model My Watershed*. This extended period captures a recent but wide range of hydrologic conditions to account for variations in nutrient and sediment loading over time. Loads for the attainment watersheds ((five total; Table 1) were computed using the same model with the same recent inputs (i.e., regional weather, 2016 land use and land cover, 2016 wetland extent, and BMPs similar to the impaired watersheds).

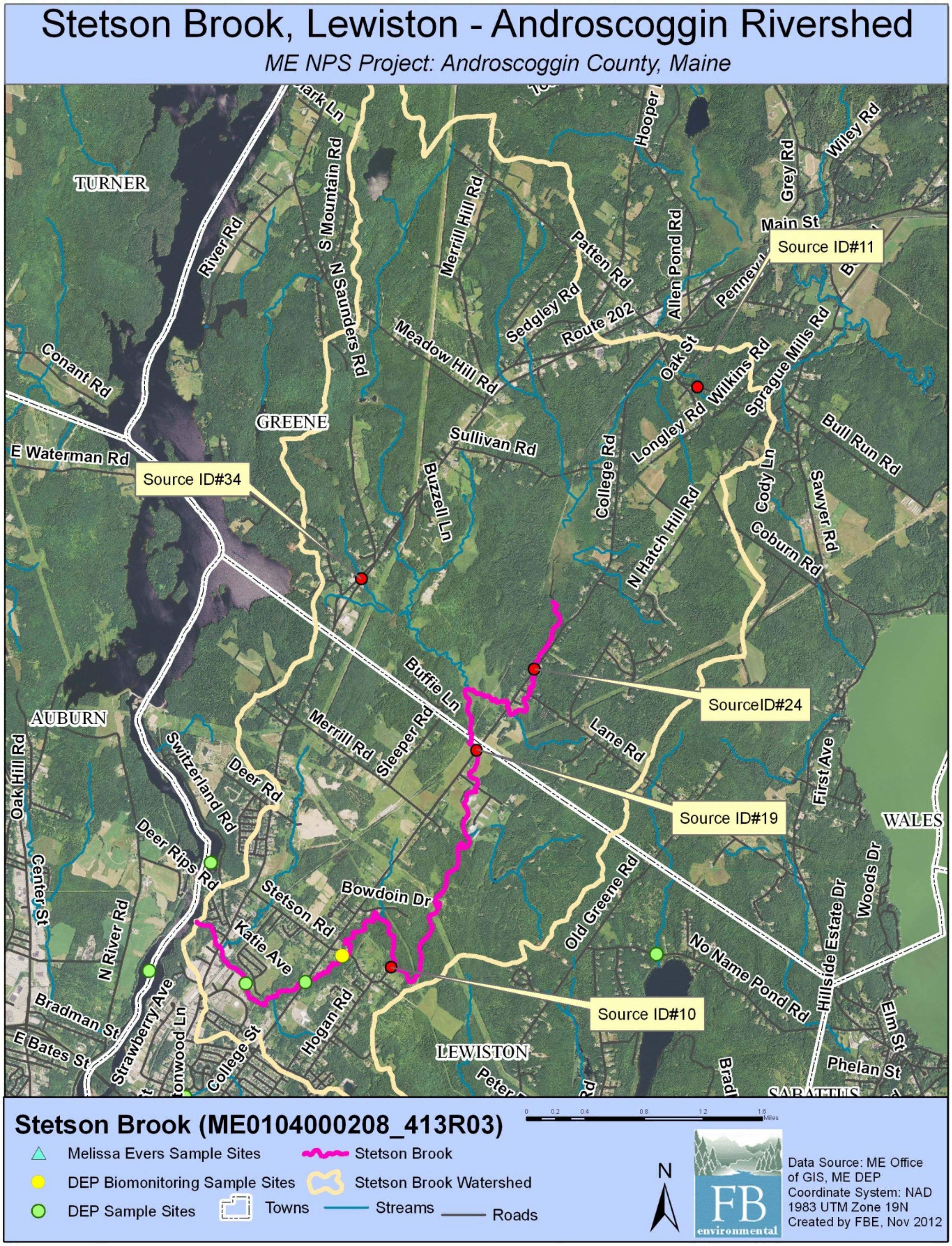


Figure 3: Aerial Photo of Potential Source Locations (identified in 2012) in Stetson Brook Watershed

Many quality assured and regionally calibrated input parameters are provided with *Model My Watershed*. However, several updates to some of the default parameters were made in this TMDL effort, and namely more recent land use/cover using **MRLC-NLCD 2016** [1], more recent and local weather (precipitation and temperature) data (as described above), and more regional estimates of Best Management Practices (BMPs; see ensuing discussion). Because land use/cover is more recent, the estimated filtration fraction of wetland and open water and the amount of stream buffer in agricultural land should be more accurate. It is also worth noting that improved classification algorithms were employed by MLRC in the NCLD 2016 and these new algorithm were used in the revisions of all previous NLCD versions (including the first version in 2001).

Livestock Estimates

Livestock waste contains nutrients which can cause water quality impairment. The nutrient loading model considers numbers and types of animals. Table 3 (right) provides livestock (numbers of animals) in the watershed based on the USDA National Agricultural Statistics Service (NASS) estimation for 2012. Some of these totals were modified by direct observations made in the watershed in the 2012 survey. To generate watershed-based livestock counts, NASS county-based livestock totals are converted to a per unit area (based on the total area of the county). The unit area amount is then multiplied by the total watershed area to derive a watershed total count (as seen in Table 3).

Table 3: Livestock Count in Stetson Brook Watershed

Type	Stetson Brook
Dairy Cows	60
Beef Cows	17
Broilers	49
Layers	--
Hogs/Swine	35
Sheep	13
Horses	23
Turkeys	11
Other	--
Total	**208**

The Stetson Brook watershed is predominantly forested with a substantial amount of development and agriculture. Agricultural areas are concentrated most in the central and upper portion of the watershed away from the Androscoggin River.

Vegetated Stream Buffer in Agricultural Areas

Vegetated stream buffers are areas of trees, shrubs, and/or grasses adjacent to streams, lakes, ponds or wetlands which provide nutrient loading attenuation (Evans & Corradini, 2012). MapShed considers natural vegetated stream buffers within agricultural areas as providing nutrient load attenuation. The width of buffer strips is not defined within the MapShed manual, and was considered to be 75 feet for this analysis. Geographic Information System (GIS) analysis of recent aerial photos along with field reconnaissance observations were used to estimate the number of agricultural stream miles with and without vegetative buffers, and these estimates were directly entered into the model.

[1] MRLC-NLCD 2016 : Multi-Resolution Land Characteristics – National Land Cover Dataset (version 2016) provided by the MRLC Consortium (Jin et al. 2019).

Stetson Brook is a 6.8 mile-long impaired segment as listed by Maine DEP. As modeled, the total stream miles (including tributaries) within the watershed was calculated as 13.7 miles. Of this total, 2.7 stream miles are located within agricultural areas and 1.1 miles of that area appear to have a 98 foot or greater vegetated buffer (Table 4, Figure 4). From a watershed perspective, this equates to 1.6 miles or 11.7% of the total stream length running through agricultural land with less than a 98 foot buffer. By contrast, for attainment stream watersheds, the percentage of total stream miles running through agricultural land without a 75 foot vegetated buffer ranged from 0% to 3.9% with an average of 1.3%. Note, a minimum vegetated buffer width of 75 feet was used in an earlier (2012) effort to produce Figure 4 shown here. Differences in stream length estimates using a 98-foot or 75-foot buffer were practically insignificant.

Table 4: Summary of Vegetated Buffers in Agricultural Areas (2012)

Stetson Brook
• Agricultural Land Stream Length = 2.7 mi • Agricultural Land Stream Length with Buffer = 1.1 mi (or 41% of total agricultural land stream length) • Percentage of total stream length flowing through non-buffered agricultural land = 11.7%

Home Septic System Loads

Loads for "normally functioning" septic systems are calculated in *Model My Watershed* using an estimate of the average number of persons per acre in "Low-Density Mixed" areas. In these areas, it is assumed that the populations therein are served by septic systems rather than centralized sewage systems. All homes in such areas are assumed to be connected to "normally functioning" systems rather than those that experience "surface breakouts" (surface failures), "short-circuiting" to underlying groundwater (subsurface failures), or have direct conduits to nearby water bodies. Non-functioning systems would be modeled with a higher load contribution to the waterbody.

Best Management Practices (BMPs)

Best management practices (BMPs) are typically instituted to reduce the loading of sediment and nutrients from upland (i.e., non-point) sources. Ideally, information on BMPs for a specific watershed from local and regional sources would improve this component of the water quality model. Maine DEP sought information on BMP use in early 2021 from local, regional, and state agricultural agencies for rural BMPs and from nearby municipalities for urban BMPs. Very little to no information was returned in the solicitation. Hence, estimates for typical New England watersheds were derived from information available from Vermont. An upper limit of BMP use was garnered from watersheds entering the Chesapeake Bay where BMP use is intensive.

Four agricultural BMPs were used in this modeling effort and in the following manner:

- *Cover Crops:* Cover crops are the use annual or perennial crops to protect soil from erosion during time periods between harvesting and planting of the primary crop. The percent of cropland area in a cover crop BMP deployed was estimated at 25% and selected as the low end of the range (25 to 30 percent) expected for cropland in New England. This value was assigned to the five attainment watersheds.

- *Conservation Tillage:* Conservation tillage is any kind of system that leaves at least 30% of the soil surface covered with crop residue after planting. This reduces soil erosion and runoff. This BMP was estimated to occur in 25% of cropland. This value was assigned to the five attainment watersheds.
- *Strip Cropping / Contour Farming:* This BMP involves tilling, planting and harvesting perpendicular to the gradient of a hill or slope using high levels of plant residue to reduce soil erosion from runoff. Both interview sources suggest this practice is minimal to non-existent for New England watersheds. Hence, no BMP of this type was used in this modeling effort. This value was assigned to the five attainment watersheds.
- *Grazing Land Management:* This BMP consists of ensuring adequate vegetation cover on grazed lands to prevent soil erosion from overgrazing or other forms of over-use. This usually employs a rotational grazing system where hays or legumes are planted for feed and livestock is rotated through several fenced pastures. Both interview sources were not aware of this practice being active and is likely minimal for New England watersheds. Hence, no BMP of this type was used in this modeling effort for both impaired and attaining watersheds.

Pollutant Load Attenuation by Lakes, Ponds and Wetlands

Depositional environments such as lakes, ponds, and wetlands can attenuate watershed sediment and nutrient loading. This information is entered into the nutrient loading model by a simple percentage of watershed area draining to a lake, pond, or wetland. The Stetson Brook watershed is 10.4% wetland and open water, per the 2016 NLCD land use/cover. A fairly large wetland complex exists at the origin of the impaired segment of Stetson Brook. The major eastern tributaries first drain into this wetland before continuing into Stetson Brook. Smaller wetlands are also found along tributaries in the northwestern portion of the watershed. It is estimated that 20.7% of land area within the watershed drains to wetlands and open water. The percent of watershed draining to a wetland in the attainment watersheds, based on the 2021 analysis, ranged from 26 to 58 percent, with an average of 40%.

NUTRIENT AND SEDIMENT MODELING RESULTS

Selected results from the watershed loading model are presented here. The TMDL itself is expressed in units of kilograms per hectare per year. The additional results shown below assist in better understanding the likely sources of pollution. The model results for Stetson Brook indicate significant reductions of phosphorus and sediment and a small reduction of nitrogen are needed to improve water quality. Below, loading for nitrogen, phosphorus and sediment are discussed individually.

There are two categories of loads – sources and pathways. Sources are determined by land use/cover and the overland flow they generate, livestock counts by animal type, and home sewage treatment systems in developed areas. Pathways represent additional loads derived from subsurface flow and streambank erosion. Subsurface loads are calculated using dissolved N and P coefficients for shallow groundwater and are mainly derived from atmospheric inputs. Sediment and nutrient loads produced by eroding streambanks are estimated using an approach developed by Evans et al. (2003). This pathway is comprised of loads originating from five sources, and listed in order of decreasing importance: amount of developed land area, soil erodibility (K-factor), density of livestock, runoff curve number, and topographic slope. For any given model run, the amount of developed land in the watershed is responsible for just over 72% of the total streambank load, whereas soil erodibility and animal density are responsible for 21% and 7% of the total streambank load, respectively.

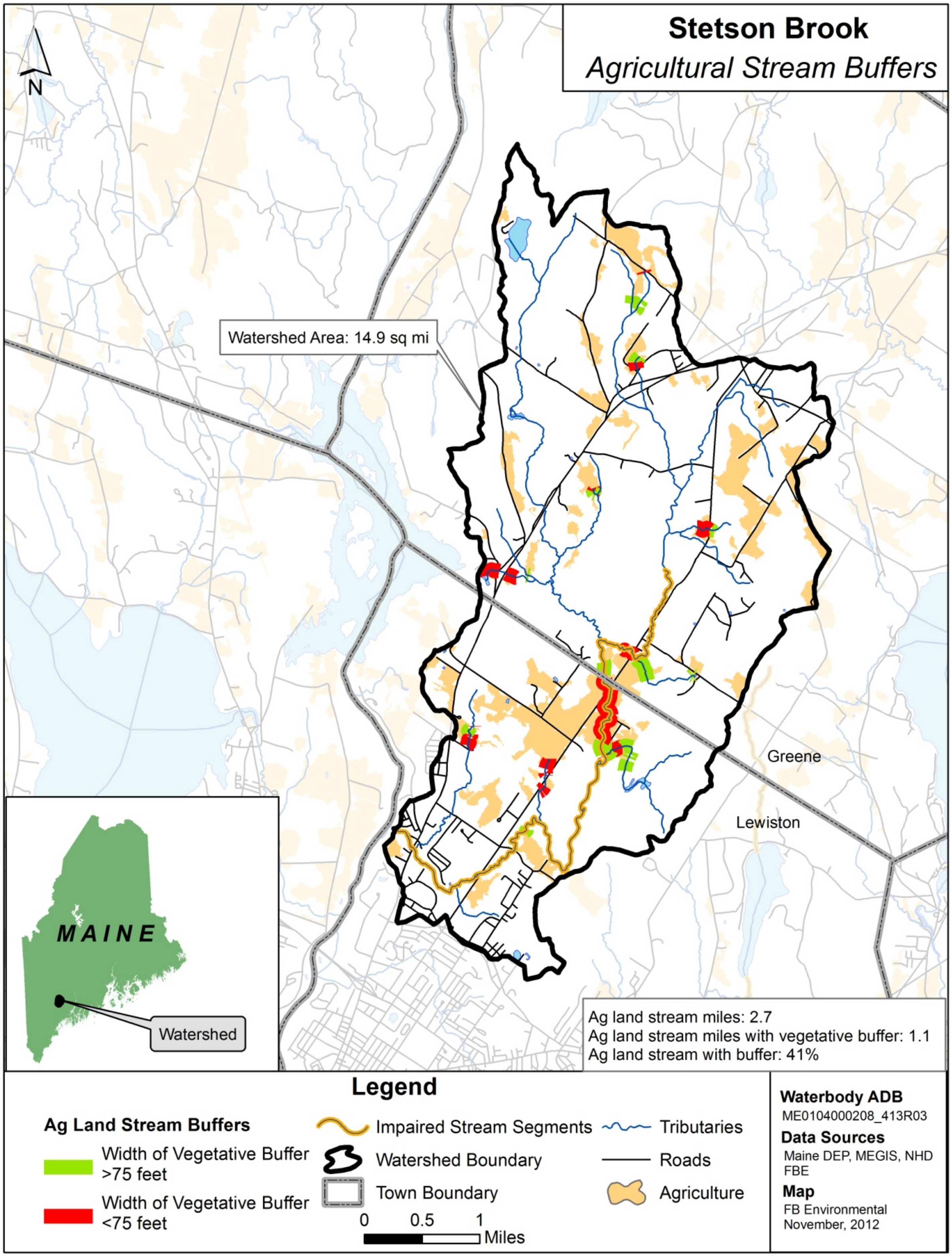


Figure 4: Agricultural Stream Buffers (from 2012) in the Stetson Brook Watershed

Sediment

Aside from stream bank erosion which contributes 76.7% of the total watershed sediment load, the major source load in Stetson Brook watershed originates from hay/pasture land (almost 59% of total sources). Residential sources also contribute a significant source load (32.3%).

Note that total loads by mass cannot be directly compared between watershed TMDLs due to differences in watershed area. See section *TMDL: Target Nutrient and Sediment Levels for Stetson Brook* below for loading estimates that have been normalized by watershed area.

Table 5: Total Sediment Load by Source

Stetson Brook	Sediment (1000 kg/year)	Sediment (%)
Source Load		
Hay/Pasture	80.5	58.8%
Cropland	0.3	0.2%
Wooded Areas	6.3	4.6%
Wetlands	0.4	0.3%
Open Land	5.1	3.7%
Barren Areas	0.010	0.008%
Low-Density Mixed	10.3	7.5%
Medium-Density Mixed	15.4	11.2%
High-Density Mixed	5.8	4.2%
Low-Density Open Space	12.8	9.4%
Farm Animals	0	0
Septic Systems	0	0
Source Load Total:	**136.9**	**100%**
Pathway Load		
Stream Bank Erosion	452.7	-
Subsurface Flow	0	-
Total Watershed Mass Load:	**590**	

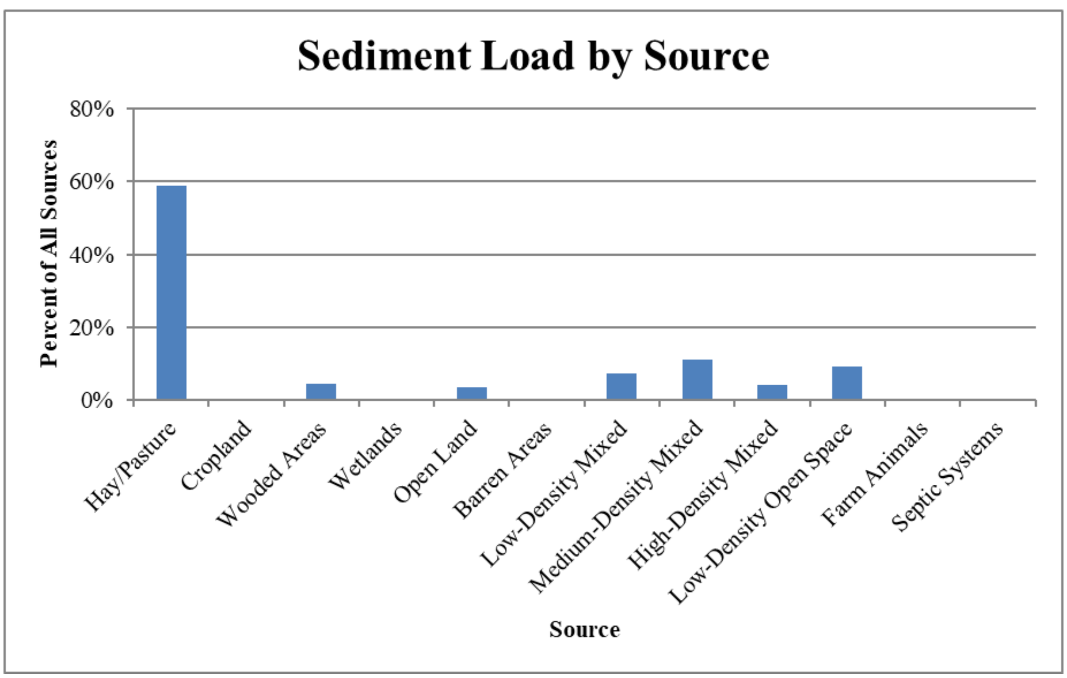


Figure 5: Total Sediment Load by Source in the Stetson Brook Watershed

Total Nitrogen

Table 6 and Figure 6 (below) show the estimated total nitrogen load, in terms of mass and percent of total by source, in the Stetson Brook watershed. Sources of nitrogen originate from several sources where all have an equivalent contribution. The largest combined sources are residential areas (29.8%) and hay/pasture land and farm animals (38.4%).

Note that total loads by mass cannot be directly compared between watershed TMDLs due to differences in watershed area. See section *TMDL: Target Nutrient and Sediment Levels for Stetson Brook* below for loading estimates that have been normalized by watershed area.

Table 6: Total Nitrogen Load by Source

Stetson Brook	Total N (kg/year)	Total N (%)
Source Load		
Hay/Pasture	862	21.3%
Cropland	2	0.1%
Wooded Areas	629	15.5%
Wetlands	275	6.8%
Open Land	117	2.9%
Barren Areas	15	0.4%
Low-Density Mixed	302	7.4%
Medium-Density Mixed	383	9.4%
High-Density Mixed	144	3.6%
Low-Density Open Space	378	9.3%
Farm Animals	696	17.2%
Septic Systems	251	6.2%
Source Load Total:	**4,054**	**100%**
Pathway Load		
Stream Bank Erosion	369	-
Subsurface Flow	5,364	-
Total Watershed Mass Load:	**9,787**	

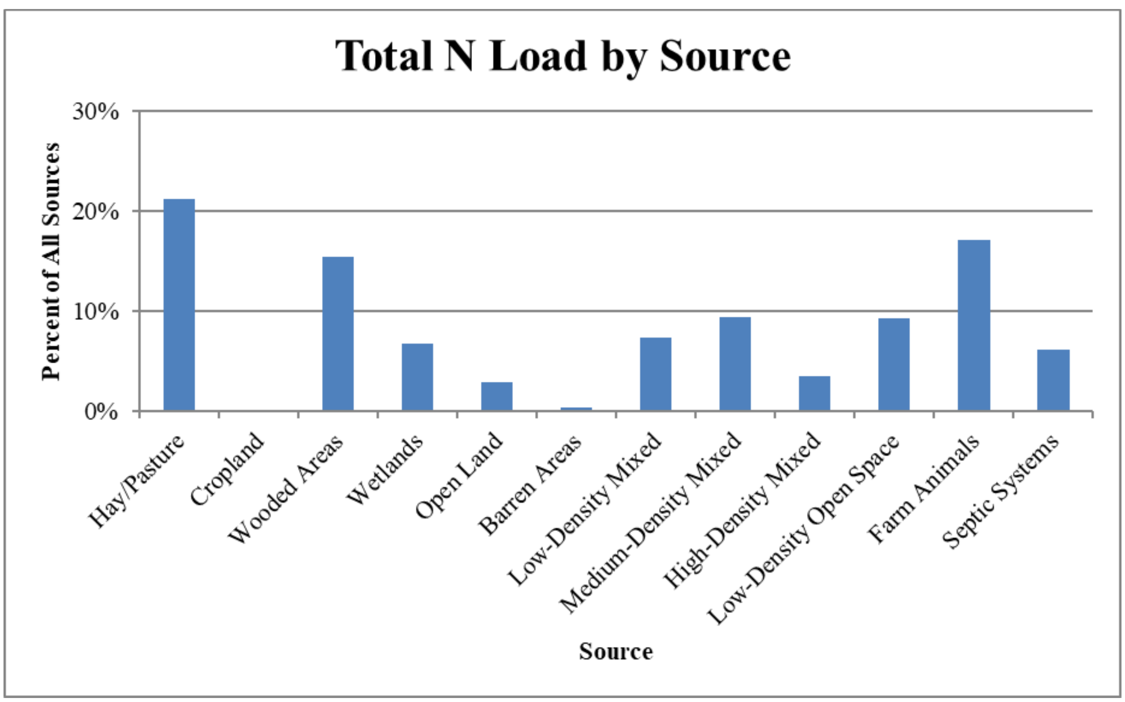


Figure 6: Total Nitrogen Load by Source in the Stetson Brook Watershed

Total Phosphorus

Table 7 and Figure 7 (below) show the estimated total phosphorus load in terms of mass and percent of total by source, in the Stetson Brook watershed. Hay/pasture land contributes almost 56% of the source load. Farm animals contribute 19.1% whereas residential areas contribute 16.1%.

Note that total loads by mass cannot be directly compared between watershed TMDLs due to differences in watershed area. See section *TMDL: Target Nutrient and Sediment Levels for Stetson Brook* below for loading estimates that have been normalized by watershed area.

Table 7: Total Phosphorus Load by Source

Stetson Brook	**Total P** (kg/year)	**Total P** (%)
Source Load		
Hay/Pasture	426.9	55.9%
Cropland	0.7	0.1%
Wooded Areas	41.4	5.4%
Wetlands	14.6	1.9%
Open Land	10.4	1.4%
Barren Areas	0.5	0.07%
Low-Density Mixed	31.4	4.1%
Medium-Density Mixed	37.9	5.0%
High-Density Mixed	14.3	1.9%
Low-Density Open Space	39.3	5.1%
Farm Animals	145.8	19.1%
Septic Systems	0	0
Source Load Total:	**763.2**	**100%**
Pathway Load		
Stream Bank Erosion	189.0	-
Subsurface Flow	224.6	-
Total Watershed Mass Load:	**1,177**	

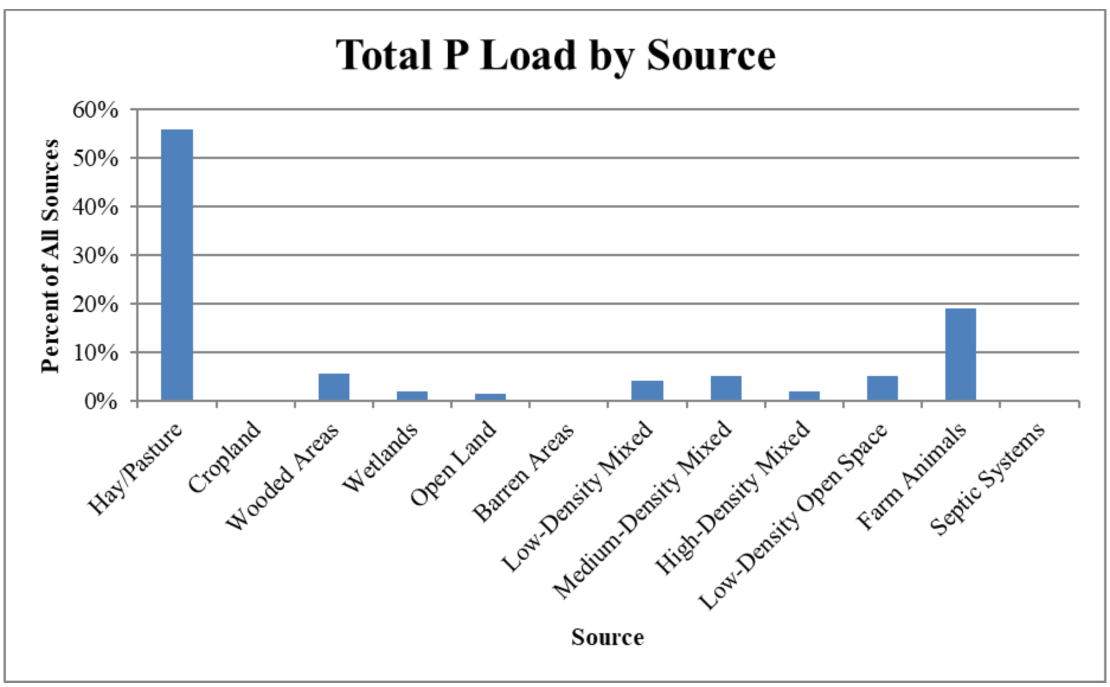


Figure 7: Total Phosphorus Load by Source in the Stetson Brook Watershed

TMDL: TARGET NUTRIENT AND SEDIMENT LEVELS FOR STETSON BROOK

The existing loads for nutrients and sediments in the impaired segment of Stetson Brook are listed in Table 8, along with the TMDL which was calculated from the average loading estimates of five attainment watersheds throughout the state. Table 9 presents a more detailed view of the modeling results and calculations used in Table 8 to define TMDL reductions, and compares the existing nutrient and sediment loads in Stetson Brook to TMDL endpoints derived from the attainment waterbodies. An annual time frame provides a mechanism to address the daily and seasonal variability associated with nonpoint source loads.

Table 8: Stetson Brook Pollutant Loading Compared to TMDL Targets

Stetson Brook			
Pollutant Load	**Existing Load**	**TMDL**	**Reduction Required**
Total Annual Load per Unit Area		Attainment Streams	
Sediment (kg/ha/yr)	154.1	65.72	57.4%
Total N (kg/ha/yr)	2.56	2.46	4.0%
Total P (kg/ha/yr)	0.31	0.16	48.0%

Future Loading

The prescribed reduction in pollutants discussed in this TMDL reflects reduction from estimated existing conditions. Expansion of agricultural and development activities in the watershed have the potential to increase runoff and associated pollutant loads to Stetson Brook. To ensure that the TMDL targets are attained, future agricultural and development activities will need to meet the TMDL targets. Between 2012 to 2017 in Androscoggin County, the growth in agricultural lands is generally decreasing as both total land area in farms (6.4%) and average farm size (12.5%) have declined. However, the total number of farms has increased 7.1%. These values are extracted from the most recent (2017) Census of Agriculture (USDA 2017). Human population in Androscoggin County increased only slightly by 0.53% from 2000 to 2019 (US Census 2020). Future activities and BMPs that achieve TMDL reductions are addressed below.

Next Steps

The use of agricultural and developed area Best Management Practices (BMP's) can reduce sources of polluted runoff in Stetson Brook. It is recommended that municipal officials, landowners, and conservation stakeholders in Lewiston and Greene work together to develop a watershed management plan to:

- Encourage greater citizen involvement through the development of a watershed coalition to ensure the long term protection of Stetson Brook;
- Run a "Hot-Spot Analysis" in *Model My Watershed* to determine sub-watershed locations of higher existing contributions of sediment and nutrients to the outlet of Stetson Brook watershed; then focus BMP mitigation in these hot-spot sub-areas of the watershed;
- Address existing nonpoint source problems in the Stetson Brook watershed by instituting BMPs where necessary; and

- Prevent <u>future</u> degradation of Stetson Brook through the development and/or strengthening of local Nutrient Management Ordinance.

Table 9: Annual Loads by Land Use, Other Sources, and Pathways for Stetson Brook Based on Modeling

Stetson Brook				
	Area (ha)	**Sediment** (1000 kg/yr)	**Total N** (kg/yr)	**Total P** (kg/yr)
Land Uses				
Hay/Pasture	356	80.5	862	426.9
Cropland	0	0.3	2	0.7
Wooded Areas	2,435	6.3	629	41.4
Wetlands	389	0.4	275	14.6
Open Land	74	5.1	117	10.4
Barren Areas	13	0.010	15	0.5
Low-Density Mixed	204	10.3	302	31.4
Medium-Density Mixed	71	15.4	383	37.9
High-Density Mixed	27	5.8	144	14.3
Low-Density Open Space	256	12.8	378	39.3
Total Area	3,826			
Other Sources				
Farm Animals		0.0	696	145.8
Septic Systems		0.0	251	0.0
Pathway Load				
Stream Bank Erosion		452.7	369	189.0
Subsurface Flow		0.0	5,364	224.6
Total Annual Load		590	9,787	1,177
Total Annual Load per Unit Area		0.154	2.56	0.31
		1000 kg/ha/yr	kg/ha/yr	kg/ha/yr

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