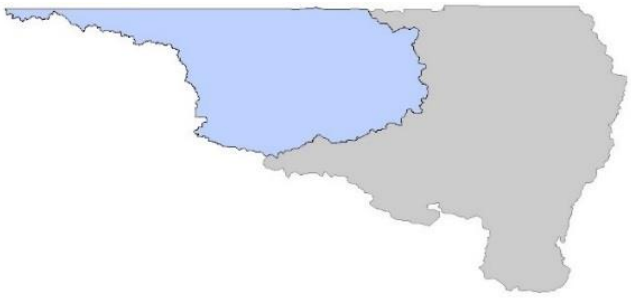
Chapter 3
Meherrin River



Hydrologic Unit Code (HUC): 03010204

3.1. General Description

The Meherrin River subbasin is located in the Mid-Atlantic Coastal Plain and Southeastern Plains ecoregions. This subbasin drain 1,612 square miles of mostly forest (49.4%) and agricultural (21.4%) land cover from VA and NC. The NC portion of the subbasin is only 497 square miles (30.8%). Major tributaries include the Meherrin River, Potecasi Creek, and Kirbys Creek. Significant natural heritage areas include the Meherrin River Slopes and Swamp.

3.2. Population and Land Use

Population for this subbasin is estimated to be around 24,449 or 49 people per square mile based on the 2010 census. The largest municipalities in this subbasin include Murfreesboro and Rich Square. Each of these municipalities experienced a small net increase in population over the 2000 to 2010 time-period (Table 1-3). In 2016, the North Carolina portion of the Meherrin River subbasin was predominantly forest land at around 37%. Agricultural land cover types were also prevalent at 33% while only 4% was classified as developed (Figure 3-1 and Table 3-1). The land cover for the entire subbasin is provided in Table 3-2.

Figure 3-1: Land Cover for the Meherrin River Subbasin of the Chowan River Basin (Source: NLCD 2016)

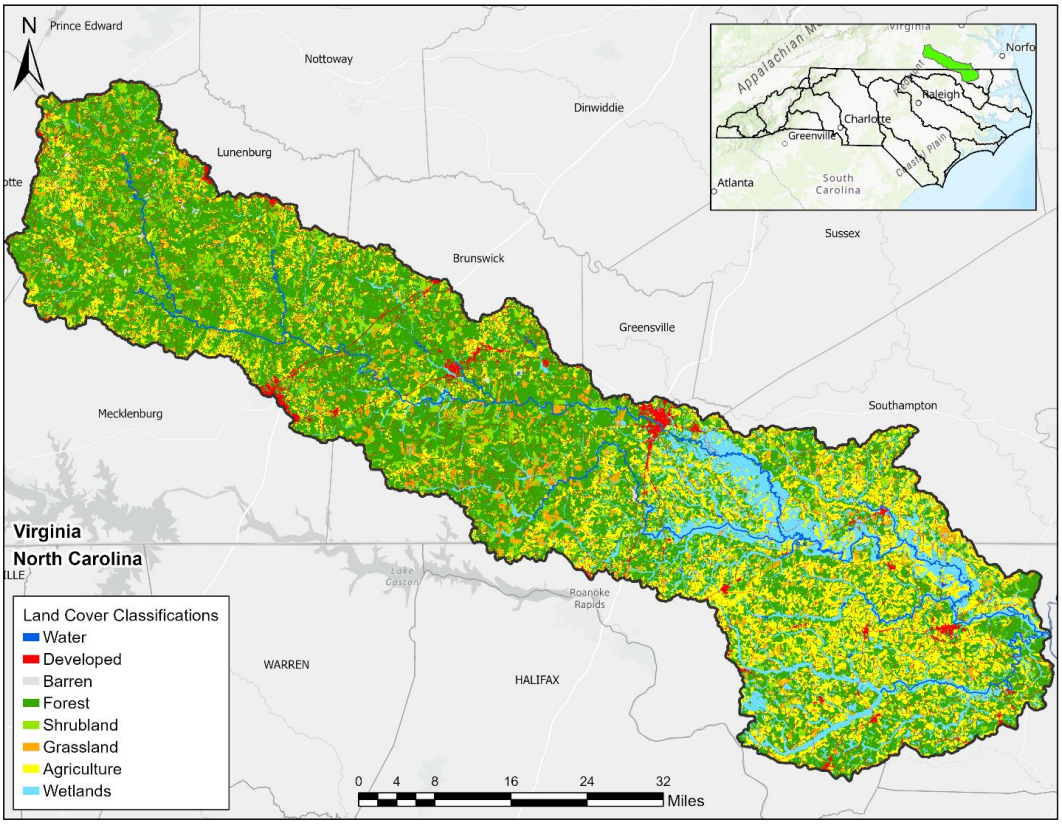


Table 3-1: Land Cover of NC Portion of Meherrin River Subbasin

Land Cover Type	2001	2004	2006	2008	2011	2013	2016
Agriculture	38.82%	33.79%	33.63%	33.45%	33.31%	33.31%	33.25%
Barren	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%
Developed	4.36%	4.36%	4.38%	4.38%	4.39%	4.39%	4.46%
Forest	36.73%	35.47%	35.57%	36.16%	38.07%	38.78%	37.20%
Water	0.52%	0.74%	0.54%	0.57%	0.58%	0.57%	0.60%
Shrubland	4.01%	4.57%	4.20%	5.65%	3.97%	3.76%	3.72%
Grassland	2.55%	3.29%	3.70%	1.83%	1.72%	1.20%	2.80%
Wetland	17.98%	17.75%	17.95%	17.93%	17.94%	17.96%	17.93%

Table 3-2: Land Cover of Entire Meherrin River Subbasin - NC and VA

Land Cover Type	2001	2004	2006	2008	2011	2013	2016
Agriculture	22.16%	21.88%	21.77%	21.63%	21.47%	21.46%	21.43%
Barren	0.25%	0.28%	0.24%	0.25%	0.20%	0.19%	0.22%
Developed	1.01%	1.01%	1.04%	1.04%	1.05%	1.05%	1.09%
Forest	52.29%	51.33%	51.23%	50.65%	51.72%	51.60%	49.30%
Water	0.41%	0.52%	0.45%	0.45%	0.45%	0.45%	0.46%
Shrubland	3.34%	4.58%	3.58%	6.13%	4.79%	6.37%	7.17%
Grassland	4.83%	4.79%	6.01%	4.17%	4.62%	3.18%	4.63%
Wetland	11.90%	11.80%	11.87%	11.87%	11.88%	11.89%	11.88%

3.3. Permits

There are no NPDES wastewater dischargers in this subbasin. There are eight permitted stormwater (Table 3-3), eight non-discharge (Table 3-4), one land application of residual solids permit (Table 3-4), and 22 animal operation permits (Table 3-5) issued in the Meherrin subbasin.

Table 3-3: NPDES Stormwater General Permits in the Meherrin River Subbasin (2020).

Permit Number	Facility Name	Owner Type	County	Permit Type
NCG020417	Union Sand and Gravel Inc	Non-Government	Hertford	Mining Activities Stormwater Discharge COC
NCG020476	Newsome #2 Pit	Non-Government	Northampton	Mining Activities Stormwater Discharge COC
NCG060343	Severn Peanut Company, Inc	Non-Government	Northampton	Food/Tobacco/Soaps/Cosmetics/Public Warehousing Stormwater Discharge COC

Permit Number	Facility Name	Owner Type	County	Permit Type
NCG080134	Pilot Travel Centers LLC #68	Non-Government	Northampton	Transportation w/Vehicle Maintenance/Petroleum Bulk/Oil Water Separator Stormwater Discharge COC
NCG100130	Liverman's Automotive Inc	Individual	Hertford	Used Motor Vehicle Parts Stormwater Discharge COC
NCG160206	Winton Asphalt Plant	Non-Government	Hertford	Asphalt Paving Mixture Stormwater Discharge COC
NCG210078	Seaboard Lumber Mill	Non-Government	Northampton	Timber Products Stormwater Discharge COC
NCG210360	Carolina Bark Products	Non-Government	Northampton	Timber Products Stormwater Discharge COC

Table 3-4: NPDES Non-Discharge Permits in the Meherrin River Subbasin (2020).

Permit Number	Facility Name	Owner	County	Permit Type	Permit Flow GPD
WQ0001284	Town of Conway-WWTP	Town of Conway	Northampton	Wastewater Irrigation	150,000
WQ0001602	Town of Winton WWTP	Town of Winton	Hertford	Wastewater Irrigation	585,000
WQ0001868	Severn Town - WWTP/Spray System	Town of Severn	Northampton	Wastewater Irrigation	62,000
WQ0002012	Georgia-Pacific Chemicals LLC	Georgia-Pacific Chemicals LLC	Northampton	Wastewater Irrigation	8,450
WQ0003299	Seaboard Town WWTF/Spray	Town of Seaboard	Northampton	Wastewater Irrigation	134,000
WQ0004910	Town of Woodland WWTF	Town of Woodland	Northampton	Wastewater Irrigation	185,000
WQ0005192	Murfreesboro Hatchery #5	Perdue Foods LLC	Northampton	Wastewater Irrigation	10,909
WQ0006785	Murfreesboro WWTF	Town of Murfreesboro	Hertford	Wastewater Irrigation	649,610
WQ0001989	Roanoke Rapids Sanitary District	Roanoke Rapids Sanitary District	Northampton	Land Application of Residual Solids (503)	-

Table 3-5 Animal Feeding Operation (AFO) Permits – Meherrin River Subbasin (2020)

Permit Number*	Facility Name	Combined Owner	County	Watershed Name	Number of Lagoons
AWI660009	Williams Farms	Williams Farms of NC Inc	Northampton	Fontaine Cr	2
AWS660030	Farms 27-30	Murphy-Brown LLC	Northampton	Fontaine Cr	8
AWS660011	Farm 39	Murphy-Brown LLC	Northampton	Fontaine Cr	2
AWS660005	Farm 40 A & 40B	Murphy-Brown LLC	Northampton	Tarrara Cr-Meherrin R	3
AWS660022	Farm 8532	Murphy-Brown LLC	Northampton	Tarrara Cr-Meherrin R	1
AWS660034	Farm 11 / 8511	Murphy-Brown LLC	Northampton	Tarrara Cr-Meherrin R	2
AWS660014	Blue Rose 3	Blue Rose Inc	Northampton	Potecasi Cr	1
AWS660023	Farm 8537	Farm 37 LLC	Northampton	Potecasi Cr	2
AWS660027	Wheeler Farm	William Wheeler	Northampton	Potecasi Cr	3
AWS460006	Farm 8134	Murphy-Brown LLC	Hertford	Potecasi Cr	1
AWS460009	Farm 31	Murphy-Brown LLC	Hertford	Potecasi Cr	2
AWS460011	Farm 8525 & 8526	Murphy-Brown LLC	Hertford	Potecasi Cr	4
AWS660039	Long's Hog Farm	James Long	Northampton	Potecasi Cr	1
AWS660040	Barrow East	Jimmy Barrow	Northampton	Potecasi Cr	1
AWS660041	Blue Rose 4	Blue Rose Inc	Northampton	Potecasi Cr	1
AWS660049	Jenkins Farm	Autrey Jenkins	Northampton	Potecasi Cr	1
AWS660051	DMJ Farm	Dmj Group LLC	Northampton	Potecasi Cr	2
AWS660055	DMJ Farms 2	Dmj Group LLC	Northampton	Potecasi Cr	2
AWS660058	Mike Lassiter Farm	Michael Lassiter	Northampton	Potecasi Cr	2
AWI660059	Greg Taylor Farm	Gregory Taylor	Northampton	Potecasi Cr	2
AWS660077	Farms # 91 / 8091	Murphy-Brown LLC	Northampton	Potecasi Cr	2
AWS660078	Winnaway Farm	Wee Winn LLC	Northampton	Potecasi Cr	3
*Permit Type: AWS – Swine State COC, AWI – Animal Individual State Permit					

3.4. Biological Health

The Biological Assessment Branch (BAB) of DWR monitors macroinvertebrates using two biological indices. The Ephemeroptera, Plecoptera, Trichoptera (EPT) index is a measure of pollution-sensitive aquatic insects inhabiting a waterbody. A stream showing high EPT richness is less likely to be polluted than one with low richness in the same geographic region. In addition, they evaluate the streams biotic integrity (BI), which measures the presence of pollution-tolerant species. High BI values characterize streams that have poor water quality and are dominated by pollution-tolerant species.

The Chowan River basin has two types of stream collection methods: Swamp and Coastal B (boat). Coastal B rivers are defined as waters in the coastal plain that are deep (nonwadeable), freshwater systems with little or no visible current under normal or low flow conditions. Other characteristics may include an open canopy, low pH and low DO. There currently are not approved biological criteria for these Coastal B streams, and therefore a bioclassification of Not Rated is assigned to these sites. The BAB defines swamp

streams as streams that are within the coastal plain ecoregion and have little to no visible flow during certain parts of the year. Little or no flow usually occurs during summer months, but flowing water should be present in swamp streams during winter months. Samples are collected during winter months (February to early March) because sampling during the high-flow months provides the best opportunity for detecting differences in naturally occurring communities. Swamp stream bioclassification fall into three categories: Natural, Moderate and Severe. For specific methodology defining how these ratings are given, refer to the Benthic Standard Operating Procedures (SOP).

Most of the swamp samples collected in the Chowan River basin showed a higher Biotic Index when compared to samples collected in previous years. Based on field observations, land use has moved from mature forested land cover to shrubs, open fields, and new, immature tree plantings. The loss of mature forested areas may be impacting the benthic communities in these swamp streams. The loss of forested areas may also be contributing to higher stream flows during months that would normally be low to no flow which can impact characteristics typically associated with swamp stream. It could also contribute to the higher Biotic Index. More research and data need to be collected to understand the correlation between the changes in the swamp benthic communities and changes in land use as it relates to the loss of mature forested areas. A study was done on a fourth order blackwater creek in southeastern North Carolina where a clear-cut was monitored downstream two and half years before the clear-cut happened, during the clear-cut and for two years following the clear-cut (Ensign and Mallin, 2001). These findings were measured against a similar control site without clearcutting. Their findings showed an increase in total suspended solids, total nitrogen, total phosphorous, total Kjeldahl nitrogen and fecal coliform bacteria, and significantly lower dissolved oxygen over a 15-month period. Algal blooms were also present after the clearcutting, which had not been there during the two- and half-year monitoring period before the clearcutting. A 10-meter uncut buffer was left along the stream but appeared to be insufficient in preventing impacts to water quality.

Biological samples were collected during the winter and summer months of 2015 as part of the basinwide sampling five-year cycle. Four benthic macroinvertebrate sites were collected in 2015 compared to five in 2010. The 2015 basin sampling efforts were reduced primarily because of the lack of personnel resources. The limited data shows no change in the four sites since the 2010 sampling period. The fish community was last sampled in 2000 because currently there are no coastal plain metrics and criteria. Table 3-6 lists the biological sites and their rating. Their location can be found in Figure 3-2.

Table 3-6: Benthos Biological Sample Results in Meherrin River Subbasin

Station ID	Waterbody Name	Assessment Unit #	Drainage Area (mi^2)	Assessment Method	Sampling Date	Bioclassification
DB11	Meherrin River	25-4-(5)	1610	Boat	7/31/2000	Good
					9/27/2005	Good-Fair
					7/21/2010	Not Impaired
					7/11/2015	Not Rated
DB10	Kirbys Creek	25-4-4	61.5	Swamp	2/17/2000	Natural
					2/7/2005	Moderate
					2/25/2010	Natural
					2/3/2015	Natural

Station ID	Waterbody Name	Assessment Unit #	Drainage Area (mi^2)	Assessment Method	Sampling Date	Bioclassification
DB12	Potecasi Creek	25-4-8a	31.8	Swamp	2/9/2000	Moderate
					2/7/2005	Moderate
					2/23/2010	Moderate
					2/4/2015	Moderate
DB13	Urahaw Swamp	25-4-8-4	54.9	Swamp	2/9/2000	Moderate
					2/7/2005	Moderate
					2/23/2010	Moderate
					2/4/2015	Moderate
DB9	Cutawhiskie Creek	25-4-8-8	36.4	Swamp	2/2/2000	Not Rated
				Swamp	2/8/2005	Not Rated
				Full Scale	8/26/2005	Not Rated
				Swamp	2/24/2010	Moderate
DB26*	Ivy Creek	25-4-3-1	1	Swamp	3/14/2011	Not Rated
DB25*	Unnamed Tributary Corduroy Swamp	25-4-4-1ut8	1.1	Swamp	3/14/2011	Moderate

*Special Study monitoring not part of 5-year Basin Cycle Monitoring

3.5. Ambient Water Quality

Monthly chemical and physical samples are taken by DWR through the Ambient Monitoring System (AMS) stations. Many of the ambient stations are associated with waterbody locations where potential pollution could occur from known land use activities in the subbasin. There are also portions of the subbasin where no water quality data are collected; therefore, we cannot evaluate the condition of the water quality in those areas. Parameters collected depend on the waterbody classification, but typically include conductivity, dissolved oxygen, pH, temperature, turbidity, nutrients and fecal coliform. Each classification has an associated set of standards the parameters must meet in order to be considered supporting the waterbody's designated uses. Ten sample results are required within the five-year data collection window in order to evaluate the water quality parameter and compare it to the water quality standards. Stressors are either chemical parameters or physical conditions that at certain levels prevent waterbodies from meeting the standards for their designated use. Ambient stations are listed in Table 3-7, and their locations are found in Figure 3-2 below.

Table 3-7: Ambient Stations in the Meherrin River Subbasin

Station ID	Station Location	County	Stream AU#	Stream Classification
D4150000	POTECASI CREEK AT NC 11 NEAR UNION	HERTFORD	25-4-8b	C, NSW
D5000000	MEHERRIN RIVER AT SR 1175 PARKERS FERRY NEAR COMO	HERTFORD	25-4-(5)	B, NSW

There were also two additional short-term (2-year) Random Ambient Monitoring System (RAMS) stations (Table 3-8). These two stations were not monitored for nutrients or chlorophyll *a* as part of the RAMS program. These stations were used to monitor for pesticides, semi-volatiles and volatile organic compounds, dissolved metals and low-level mercury as well as physical parameters. It is recommended that as funding, personnel, laboratory capacity resources become available the RAMS program incorporate collection of nutrients and where appropriate, chlorophyll *a* samples. Since most of the RAMS stations are located in smaller headwater streams, this would help the division understand "background" nutrient concentrations in smaller watersheds, especially in nutrient sensitive waters (NSW) watershed. This information could give some perspective to nutrient concentrations and chlorophyll *a* throughout the basin.

Table 3-8: Random Ambient Stations (RAMS) in Meherrin River Subbasin

Station ID	Station Location	County	RAMS Year	Stream AU#	Stream Classification
D4008000	WICCACANEE SWAMP AT SECONDARY ROAD 1500 NEAR JACKSON	NORTHAMPTON	2009-2010	25-4-8-1.5	C, NSW
D4206000	POTECASI CREEK OFF NC 158 NEAR MAPLETON	HERTFORD	2013-2014	25-4-8b	C, NSW

3.6. Local Water Quality

There is one entire and two partial watersheds (HUC-10) in the North Carolina portion of the Meherrin River subbasin made up of 19 subwatersheds (HUC-12). To determine the source of a pollutant in a watershed it is useful to break down a large drainage area into smaller areas. This approach also helps identify where monitoring and restoration is being conducted and where it is in need. The Basin Planning Branch in the Chowan River basin should work with the Nonpoint Source Planning Branch, Soil and Water Conservation Districts, Natural Resources Conservation Service and whoever else they can to improve our understanding of point and nonpoint sources and encourage continued efforts to implement restoration and best management practices to reduce nutrients, sediment loads and flow volume to the receiving streams of these watersheds. Table 3-9 list's the number of benthic and ambient monitoring sites that were sampled for the 2005-2018 assessment period by watersheds. Figure 3-3 shows the location of these watersheds.

Figure 3-2: Monitoring Locations in the Meherrin River Subbasin

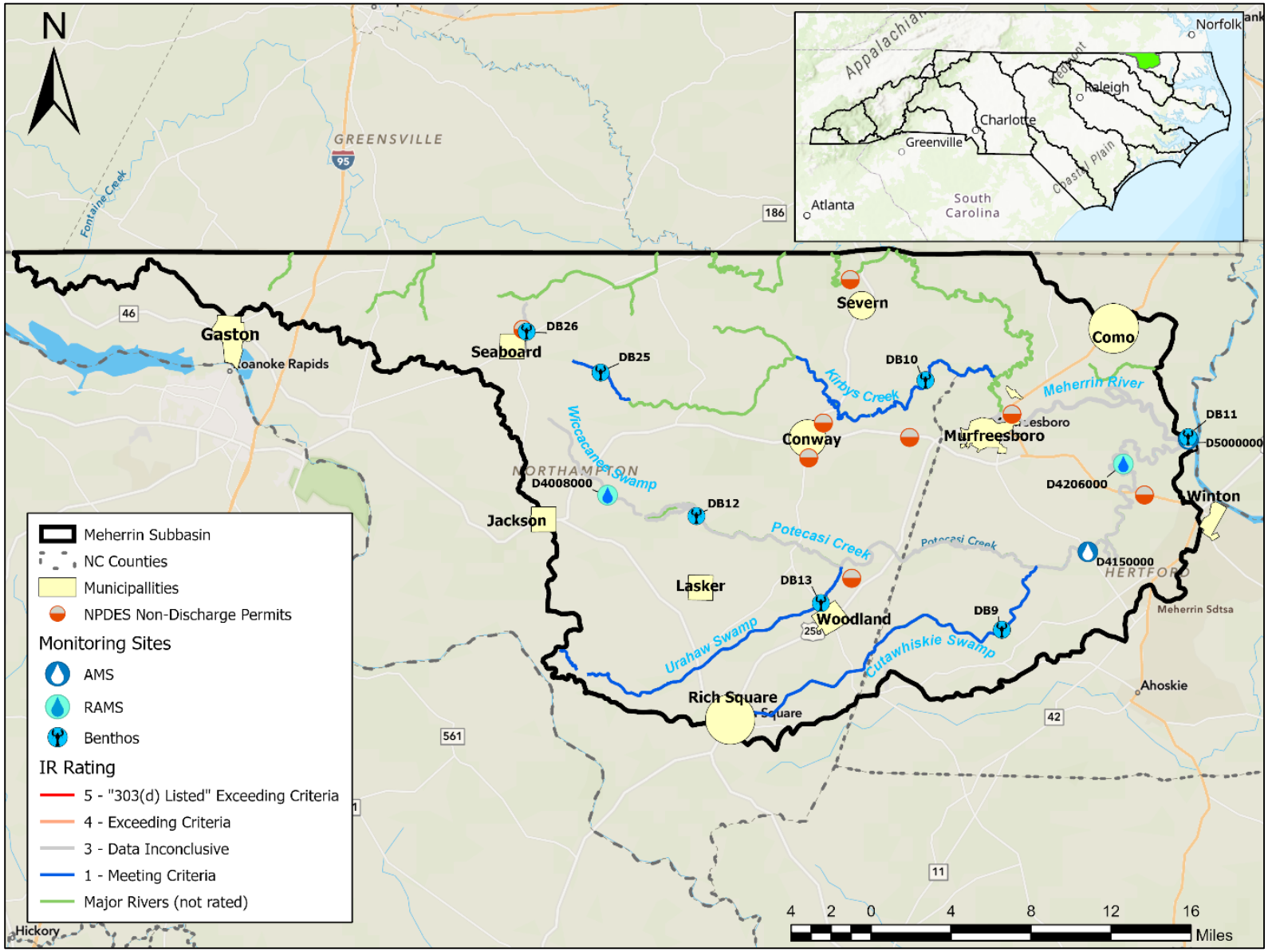


Figure 3-3: HUC-10 watersheds in the Meherrin River Subbasin

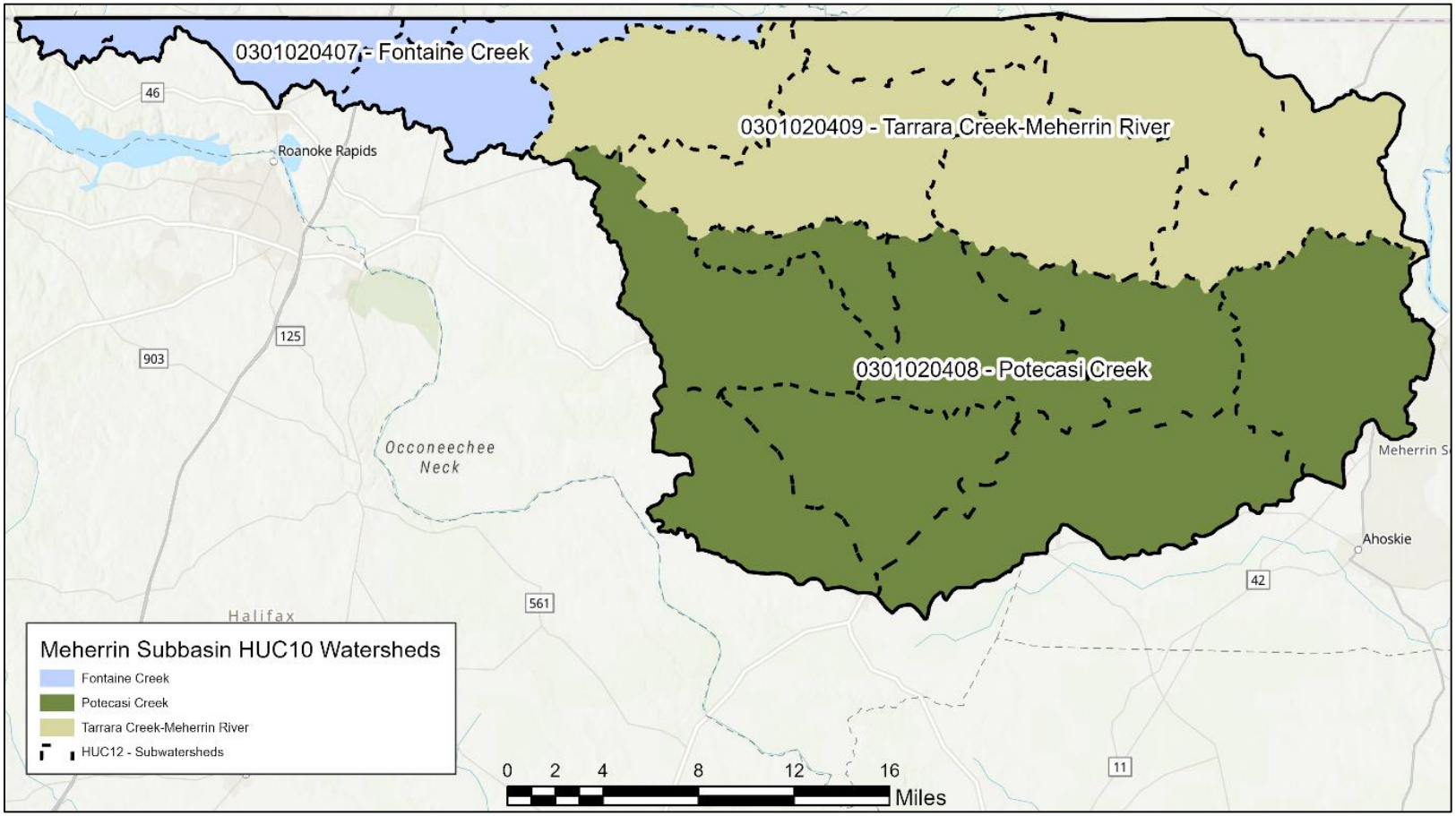


Table 3-9: Number of Benthic and Ambient Sites in the Meherrin River Subbasin by HUC-10 Watershed

Watershed	HUC-10	Area (mi^2)	Benthic Sites	Ambient Stations	RAMS Stations
Fontaine Creek*	0301020407	48	0	0	0
Potecasi Creek	0301020408	258	3	1	2
Tarrara Creek-Meherrin River*	0301020409	192	4	1	0

*Denotes a partial watershed in North Carolina and the area was only calculated for that portion in NC.

3.7. Fontaine Creek Watershed (HUC: 0301020407)

This watershed drains approximately 48 square miles of the northwestern portion of Northampton County. The watershed drains north into Virginia which eventually flows back into the Meherrin River on the Virginia side. Beaverpond Creek and Jacks Swamp are the main waterbodies on the North Carolina side of the border. The land cover in this watershed is primary forest (46.2%) and agriculture (27.9%). Currently, there are no NPDES permitted wastewater dischargers, non-discharge permitted facilities, ambient monitoring stations or benthic monitoring sites in this watershed. There are three permitted animal operations and five land application of residuals fields in the watershed.

3.8. Potecasi Creek Watershed (HUC: 0301020408)

The Potecasi Creek watershed is located in southeastern Northampton County and central Hertford County. Potecasi Creek in the primary stream flowing through this watershed. This watershed drains approximately 258 square miles of primarily forest (39.3%) and agriculture (32.3%) land cover. There are no wastewater dischargers and the area is less than five percent (4.4%) developed. This watershed includes the municipality of Rich Square, Lasker, Woodland and the southern portion of Conway. There are no NPDES permitted wastewater dischargers in the watershed. Currently, there is one ambient monitoring station and three benthic macroinvertebrate monitoring sites. There is one fish community station, but the index of biological integrity (IBI) is undergoing revisions in the Chowan. There are three permitted non-discharge facilities and 16 permitted animal operations in the watershed. Two RAMS stations were established in this watershed between 2009 – 2010 and 2013 – 2014 in Wiccacanee Swamp and Potecasi Creek, respectively. No water quality standards were violated in either of these streams.

Potecasi Creek [AU# 25-4-8a and AU# 25-4-8b; Primary Surface Water Classification: C, Supplemental Classification: NSW; Length is 42.5 river miles]

Potecasi Creek drains the southeastern region of Northampton County and central Herford County. The ambient monitoring station (D4150000) in the Potecasi Creek is about 17 miles upstream from the confluence with the Meherrin River (Figure 3-2). The United States Geological Survey (USGS) gage number 02053200 is co-located with ambient monitoring station in Potecasi Creek. The drainage area for this station is 224 square miles and the land use is primarily forest (38.2%), agriculture (33.2%) and wetlands (17.6%). This stream exhibits low velocity, with swamps and heavy tree canopy throughout the watershed. The primary surface water classification for this stream means there are water quality standards for parameters such as pH, dissolved oxygen, turbidity and fecal coliform. The entire length of Potecasi Creek from source to the Meherrin River has been on the impaired waters list since 1998, due to violations of the States' water quality standard for dissolved oxygen and pH. Potecasi Creek remained on the impaired waters list until 2008 when it was removed. The reason for removal noted as follows: "the previous listing in Category 5 was inconsistent with the assessment methodology. Available data was insufficient to determine attainment status" (US EPA, 2010). In the 2007 Chowan River Basin Plan, the Division of Water Resources recommended that Potecasi Creek be included in a Swamp Waters Study Plan to determine if the low dissolved oxygen and pH were associated with naturally occurring swamp conditions. A natural conditions assessment for dissolved oxygen and pH was completed by the Division of Water Resources in 2009. This assessment concluded that the water quality in Potecasi Creek and its tributaries have not been violated but were the result of natural conditions and therefore a Total Maximum Daily Load was not required for this creek (NCDWQ, 2009). The Potecasi Creek - Assessment Report on Natural Conditions for DO and pH can be found on the Modeling and Assessment Branch's website. Turbidity and fecal coliform

readings were higher in Potecasi Creek relative to the other monitored streams in the Chowan River basin. The elevated turbidity and fecal coliform readings did not result in an impairment, but the occasional exceedance of the water quality standard does occur. Between 2000 and 2018, seven high turbidity events occurred which violated the surface water standard in Potecasi Creek with a peak value of 634 NTUs on June 20, 2000. The elevated turbidity and fecal coliform measurements observed could be due to nonpoint source runoff as some events occur during days with recorded precipitation. Currently, there are no water quality standards for nutrients including nitrogen and phosphorus. The nitrate and total kjeldahl nitrogen concentrations have been increasing at the Potecasi ambient monitoring station D4150000 since 2000 (Figures 3-4 and 3-5). Total phosphorus has remained relatively stable since 2012 after relatively historical high annual mean concentrations (Figure 3-6). For additional discussion regarding nutrients and loading see the Nutrient Sensitive Water History and Current Nutrient Conditions chapter (Chapter 5). The 2018 IR reports that no water quality standards were exceeded at the ambient monitoring station (D4150000) or biological community station (DB12) on Potecasi Creek aside from mercury in fish tissue. Iron was determined to be Data Inconclusive on the 2018 IR.

Figure 3-4: Annual Mean Nitrate (NO_x) Concentration at AMS D4150000 with the Number of Samples in the Bar and Discharge from USGS Gage 02053200.

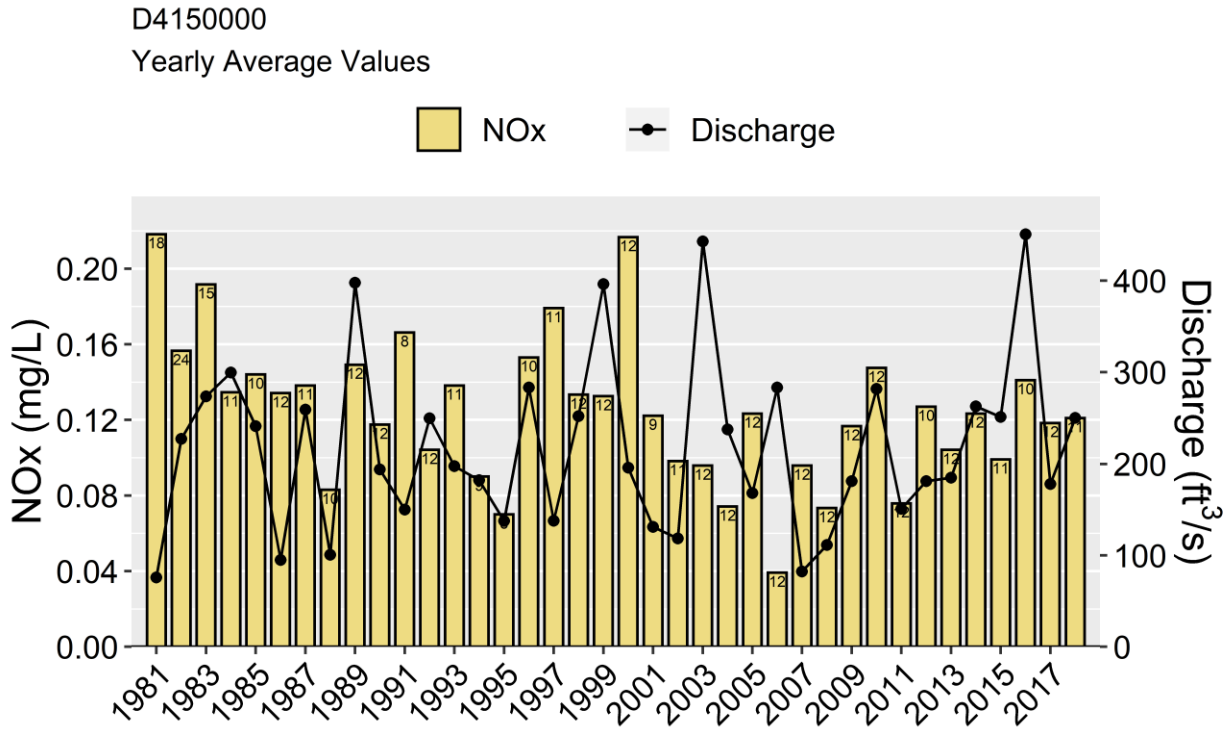


Figure 3-5: Annual Mean Total Kjeldahl Nitrogen Concentration (TKN) at AMS D4150000 with the Number of Samples in the Bar and Discharge from USGS Gage 02053200.

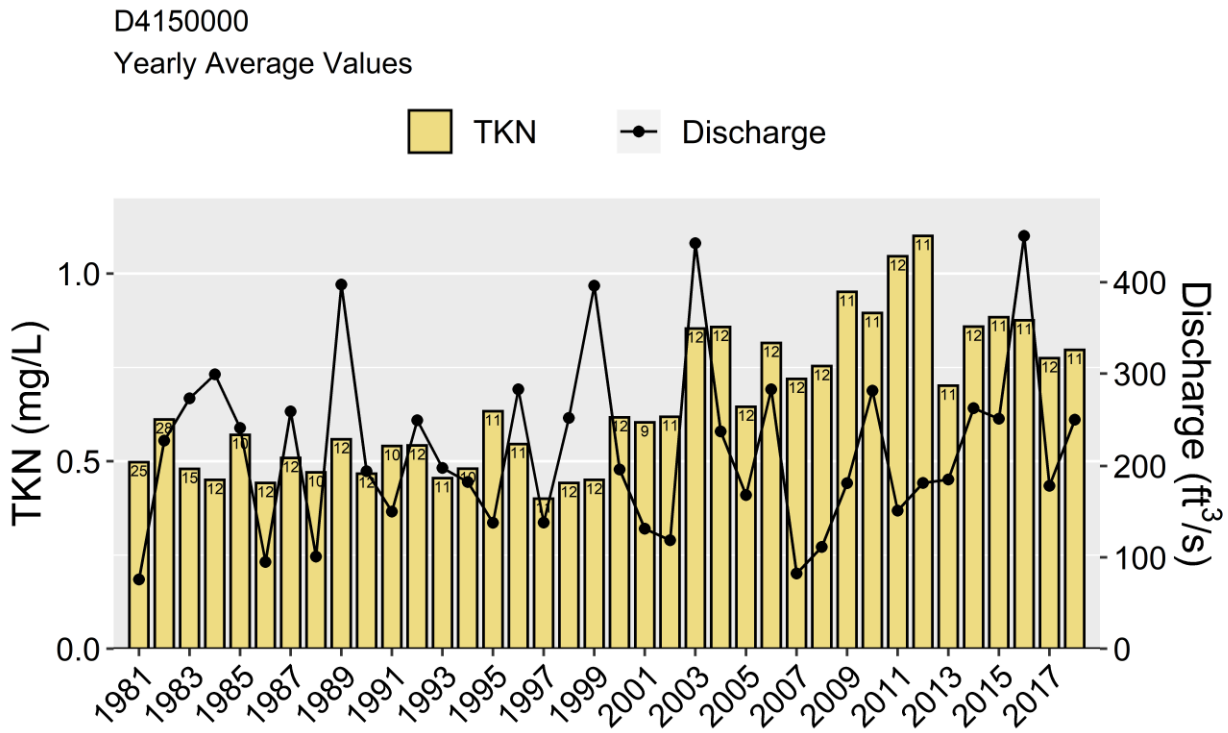
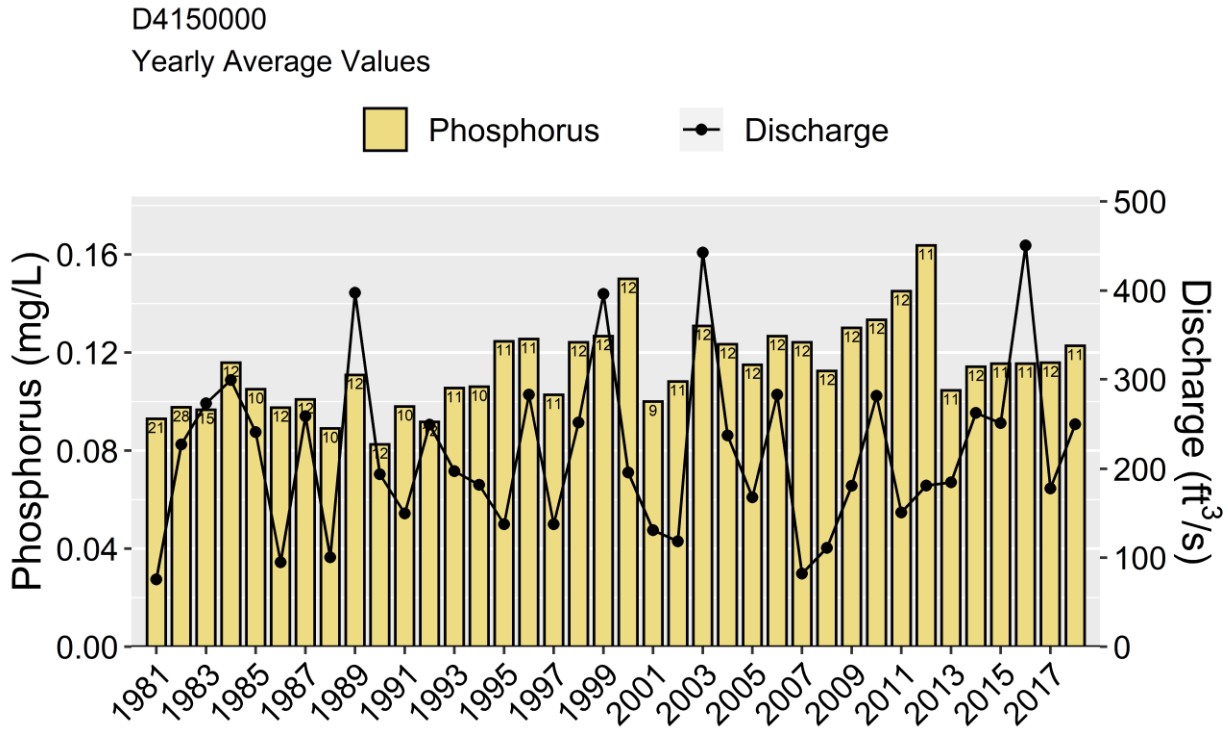


Figure 3-6: Annual Mean Total Phosphorus Concentration at AMS D4150000 with the Number of Samples in the Bar and Discharge from USGS Gage 02053200.



The benthic macroinvertebrate sampling site DB12 maintained its Moderate biological rating in 2015. Potecasi Creek maintained its Moderate rating in 2015 despite a general loss of forest in the watershed (54% forest in 1992 down to 29% forest in 2006) and a recent clear cut on the left bank. This clear cut reduces canopy shading which may have resulted in the elevated Biotic Index and Biotic Index EPT in 2015 as well as the overabundance of the filter feeding black flies (Simulium).

Sampling Year	Bioclassification (DB12)
2000	Moderate
2005	Moderate
2010	Moderate
2015	Moderate

Town of Woodland Wastewater Treatment Facility (WWTF) (WQ0004910) is located upstream of the confluence of Potecasi Creek and Urahaw Swamp. This facility has had some compliance issues with their permit. Their storage lagoon has an excessive amount of solids which reduces capacity. Spray fields are in good condition and unlikely to have issues relating to runoff into surface waters. During the last compliance inspection, monitoring well nine showed exceedances of chloride and total dissolved solids. The Town of Woodland has received funding from the Division of Water Infrastructure (DWI) to support improvements in the sewer system and their wastewater system. Additional information related to funding from DWI can be found in the Water Quality Initiatives and Funding chapter (Chapter 6).

Town of Winton Wastewater Treatment Plant (WWTP) (WQ0001602) is located near where highway 158 cross Potecasi Creek. The Pretreatment Program identified some troublesome metal concentrations in groundwater, but these were not believed to be caused by wastewater treatment/disposal activities.

Painter Swamp and Bells Branch [AU# 25-4-8-5; Primary Surface Water Classification: C, Supplemental Classification NSW; Length is 3.7 river miles] and [AU# 25-4-8-10; Primary Surface Water Classification: C, Supplemental Classification: NSW; Length is 4.8 river miles]

Painter Swamp drains a portion of west-central Hertford County. Bells Branch drains a portion of west-central Hertford County. These tributary flow to meet Potecasi Creek before the confluence with the Meherrin River. These tributaries of Potecasi Creek were placed on the impaired waters list in 1998 and remained on the list due to historic listing. Both were removed from the 2008 impaired water list because "flaws in the original analysis of data and information led to the segment being incorrectly listed" (US EPA, 2010). Bells Branch and Painter Swamp were not sampled during the last assessment period and a review of the DWR biological data reflects no previous sampling of these waterbodies has occurred.

Georgia-Pacific Chemicals LLC (WQ0002012) is located near the headwater of Painter Swamp. The location of the spray irrigation fields for this facilities, indicates the potential for surface water impacts is always present. The facility is in a part of the state that has a lot of wet areas for much of the year. During the recent visit the Raleigh Regional Office (RRO) of NCDEQ made to this facility they noted standing water in the spray fields. There were no indications this was a result of irrigation water, however, a previous inspection in 2018 mentioned formaldehyde detected in groundwater monitoring wells.

Urahaw Swamp [AU# 25-4-8-4; Primary Surface Water Classification: C, Supplemental Classification NSW; Length is 14.4 river miles]

Sampling Year	Bioclassification (DB13)
2000	Moderate
2005	Moderate
2010	Moderate
2015	Moderate

Urahaw Swamp is a tributary of Potecasi Creek and drains a portion of southeastern Northampton County. This tributary maintained a Moderate bioclassification at site DB13 despite an increase in the Biotic Index in 2015. This may indicate that there are more pollution tolerant species residing in the swamp. Usual sources of pollution do not appear to be a problem since the specific conductance (42 µS/cm) was low compared to other swamps in the basin. It may be that higher than average water levels may have precluded access to the optimal high flow areas such as the main channel, which was not fully wadeable at the time of sampling. During 2010 sampling, the entire right bank (looking upstream), including some trees within some of the side channels, had been recently logged. Other areas around the swamp were regenerating from earlier logging events. In 2010, Urahaw Swamp had little to no extensive riparian vegetation, the water was very turbid from the recent activities and some large silty pools were present in the backwater areas.

Cutawhiskie Creek [AU# 25-4-8-8; Primary Surface Water Classification: C, Supplemental Classification NSW; Length is 17.0 river miles]

Sampling Year	Bioclassification (DB9)
2000	Not Rated
2005	Not Rated
2010	Moderate

Cutawhiskie Creek's (previously referred to as Cutawhiskie Swamp) catchment drains an east-central portion of Hertford County which is primarily composed of agricultural fields interspersed with small animal operations. This stream has been extensively channelized and has had much of its natural habitat modified or removed. Cutawhiskie Creek may also flow during the summer months but may cease during dry years. Because of this, Cutawhiskie Creek has been sampled both in the winter and summer to best assess the type of stream (Coastal A or Coastal B) it most resembles, and the subsequent sampling effort needed to rate the stream. Cutawhiskie Creek has therefore not been rated for the past 15 years. In 2010, it has been determined that the stream is best sampled during the peak flowing season (winter) to mitigate taxa losses that may occur with minimal flows. Taxonomic data suggests little to no improvements occur to water quality in the summer months as evidenced by both similar EPT richness and the Biotic Index over the past few samples. Cutawhiskie Creek received a Moderate rating for 2010. Cutawhiskie creek was not sampled in 2015, due to staff limitations.

3.9. Tarrara Creek-Meherrin River Watershed (HUC: 0301020409)

The Tarrara Creek-Meherrin River watershed drains approximately 192 square miles of land in the northern portions of Northampton and Hertford Counties. The land cover is primarily forest (32.1%) and agriculture (35.9%). The major municipalities included in this drainage area are Seaboard, Severn, Murfreesboro and the southern portions of Conway and Como. There are no NPDES permitted wastewater dischargers in the watershed. There is one ambient monitoring station. Two benthic macroinvertebrate monitoring sites for basinwide assessment and two special study sites in the watershed. There are five non-discharge permitted facilities, three permitted animal operations and 14 land application of residuals fields in the watershed.

Meherrin River [AU# 25-4-(5); Primary Surface Water Classification: B, Supplemental Classification: NSW; Length is 11.7 river miles.]

This section of the Meherrin River drains the northern portions of Northampton and Hertford Counties. The benthic macroinvertebrate sampling site is located on the Meherrin River, upstream of the North Carolina Department of Transportation ferry operation. The catchment is primarily forested but contains a large percentage of agriculture and is downstream from the municipality of Murfreesboro.

Sampling Year	Bioclassification (DB11)
2000	Good
2005	Good-Fair
2010	Not Impaired
2015	Not Rated

The overall benthic community trend since monitoring initiated in 1983 suggests that the macroinvertebrate community appeared to be mildly declining in quality through 2010. Although in 2015, the benthic community collection had the second highest EPT richness value ever attained at this sampling location, recovering from the lowest EPT richness value in 2010 back to the levels seen in the 1980s. Over the past 30 years, the benthic fauna has remained consistent composed of mainly species common to lakes and slow-flow systems. Benthic sampling in 2015 also resulted in the first North Carolina DWR record of the polycentropodid caddisfly, *Cernotina*. This caddisfly is restricted to lentic (standing water) conditions.

This site has historical been assigned a bioclassification rating, however, these were based on a provisional criterion. As this site is still under a provisional the 2010 sample was assigned a Not Impaired bioclassification. However, for purposes of inter-year comparison, the 2010 collection would have received a Good-Fair bioclassification based on the provisional criteria. The 2015 collection received a Not Rated bioclassification. While it was recorded as Not Rated the site does seem to have improved.

The Meherrin River, from a point 1.0 mile upstream from U.S. Highway 258 to the Chowan River, is impacted by low dissolved oxygen which is displays an inverse relationship with temperature and correlates with decreased discharge (Figure 3-7). The percentage of dissolved oxygen measurements exceeding the 4.0 mg/l water quality standard has varied over time resulting in changes in the impairment status of this river (Table 3-10). In 2010 IR, the Meherrin River was listed as Meeting Criteria for dissolved oxygen as the percentage of measurements which exceeded the evaluation level was less than 10% (Table 3-10). The percent confidence was not calculated because of the meeting criteria status. In the 2012 IR the impairment status changed to Exceeding Criteria for dissolve oxygen. For the 2014 IR period, the assessment methodology changed to requiring greater than 10% exceedance of the standard, with greater than 90% confidence. As a result of this change, Meherrin River was moved from an Exceeding Criteria status to Data Inconclusive. In 2018, the station was listed as Meeting Criteria since there were less than 10% of dissolved oxygen measurements below the 4 mg/L evaluation level. During the draft 2020 IR period, the low dissolved oxygen measurements combined with the less than 90% confidence could result in a Data Inconclusive impairment status.

The low dissolved oxygen in the Meherrin River could be the combined result of drainage from swamp-like areas including Potecasi Creek, slow-flow water as indicted by the benthic community, shallower water conditions as indicated by the decreased discharge through the river channel and/or increased water temperature during the summer months (Figure 3-7). The relatively low dissolved oxygen sourced from the Meherrin River could contribute to ecological impacts to the Chowan River. The 2018 IR reports that no water quality standards were exceeded at the ambient monitoring station on Meherrin River

(D5000000) aside from mercury in fish tissue. Benthos and Iron were determined to be Data Inconclusive on the 2018 IR.

Recommendations:

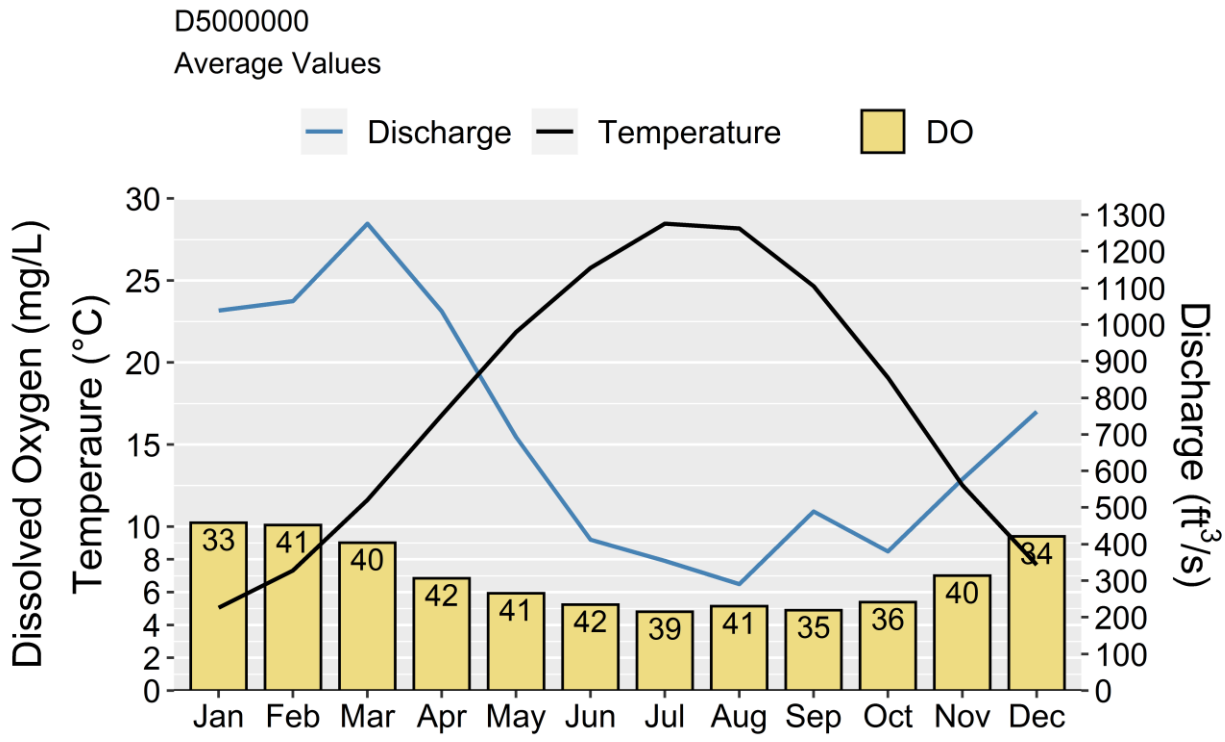
If future data establishes this section of the Meherrin River as Exceeding Criteria, then the Division of Water Resources is recommending that a natural conditions assessment be conducted on the Meherrin River to determine if the low dissolved oxygen is associated with naturally occurring swamp-like waters.

Table 3-10: Dissolved Oxygen Impairment Status by Integrated Report Year

IR List	Sample Years	Number of Observations	% Exceedance	% Confidence	Impairment Status
2010	2004-2008	-	7.1	NA	Meeting Criteria
2012	2006-2010	59	10.2	62.3	Exceeding Criteria
2014	2008-2012	56	14.3	80.6	Data Inconclusive
2016	2010-2014	55	10.9	52.3	Data Inconclusive
2018	2012-2016	50	8	NA	Meeting Criteria
2020*	2014-2018	58	13.8	77.9	Data Inconclusive

*Integrate Report in Draft Condition

Figure 3-7: Monthly Average Dissolved Oxygen Levels, Number of Dissolved Oxygen Records, Water Temperature, and Discharge Measurements from 1973 to 2018. The Discharge Measurements Were Collected at USGS Gage 02052000.



Severn Town WWTP/Spray System (WQ0001868) is located near the VA/NC boundary and the Meherrin River. This facility has no disinfection in their treatment process. During a site visit in 2019 to review the facility for permit renewal, RRO made a note of this to the permit writers. Future reviews of this facility will determine the status of the installation of disinfection components to the treatment plant. There was no evidence to note of ponding or runoff on the spray irrigation areas. This facility frequently has had exceedances for total dissolved solids in monitoring wells.

Murfreesboro WWTF (WQ0006785) is located near where highway 258 crosses over the Meherrin River. This facility has enhanced some ditches, but they are properly setback according to the 15A NCAC 02T rules. This facility expanded their fields around 2006 as they had issues keeping up the effluent and ponding issues. Murfreesboro recently received funding to support sewer system rehabilitation and wastewater asset inventory and assessment. Additional information related to funding from DWI can be found in the Water Quality Initiatives and Funding chapter (Chapter 6).

Kirbys Creek [AU# 25-4-4; Primary Surface Water Classification: C, Supplemental Classification: NSW; Length is 13.7 river miles]

Kirbys Creek, a tributary to the Meherrin River, is a fast-flowing swamp stream that lies in the northeastern portion of Northampton County. It has exposed portions of the Yorktown Formation along some portions of its banks due to high energy flow. This stream retains a Natural bioclassification in 2015. This is the fourth Natural bioclassification in the five most recent times this site has been rated. Kirbys Creek continues to represent some of the best water quality in the Chowan River basin.

Sampling Year	Bioclassification (DB10)
2000	Natural
2005	Moderate
2010	Natural
2015	Natural

Town of Conway WWTP (WQ0001284). This spray irrigation facility does not have a history of impacts to surface waters and during the last inspection, no evidence of wastewater ponding or running off the site was observed. The facility has issues with meeting monitoring requirements and has failed to sample effluent and monitoring wells for certain parameters. Similar to all facilities in this part of the state, there is potential for surface water impacts from spray irrigation due to the area being naturally wet much of the year.

Murfreesboro Hatchery #5 (WQ0005192) This facility does not appear to have any issues impacting surface waters. The facility apparently does not use their spray system.

UT Corduroy Swamp and Ivy Creek [AU# 25-4-4-1ut8; Length is 3.2 river miles] and [AU# 25-4-3-1; Primary Surface Water Classification: C, Supplemental Classification: NSW; Length is 1.0 river miles]

Ivy Creek is a tributary of Cypress Creek which flows into the Meherrin River. On March 14, 2011 two benthic macroinvertebrate community samples were taken from northwestern Northampton County in support of a request from the Raleigh Regional Office (RRO). The RRO was investigating the possible effects on surface water from runoff associated with a mulching operation. Results of the benthic macroinvertebrate assessment indicate that the receiving stream (Ivy Creek off Williams Street near the town of Seaboard) was being adversely affected by this operation and received a bioclassification of Not

Sampling Year	Bioclassification (DB26)	Bioclassification (DB25)
2011	Not Rated	Moderate

Rated. Conversely, the reference site (UT Corduroy Swamp at SR 1333) received a Moderate bioclassification.

Seaboard Town WWTF/Spray System (WQ0003299) has a long history of non-compliance and other issues. The town recently entered into a SOC (S18-007) because they had been under a flow moratorium for many years. A nearby facility, West Fraser, wants to connect to the Town's sewer system but the flow moratorium has prevented that. The town is aggressively pursuing funds and grants to help with their long-term inflow and infiltration issues. Additionally, the treatment plant storage lagoon has reduced capacity due to many large bubbles in the liner. Irrigation fields are adjacent to or in wet areas. Irrigation water runoff and ponding is a frequent issue for this facility. In addition to looking for funding to repair issues related to inflow and infiltration and lagoon liner repairs, the town is looking for an alternative site for spray irrigation due to the problems with the current fields. Seaboard has recently been able to acquire funds to repair their sewer infrastructure and in time should help alleviate some of the problems. Additional information related to funding from DWI can be found in the Water Quality Initiatives and Funding chapter (Chapter 6).

References:

Ensign S. H., Mallin M. A., 2001. Stream Water Quality Changes Following Timber Harvest in a Coastal Plain Swamp Forest. Water Resources. Vol. 35, No. 14. pp. 3381-3390.

North Carolina Department of Environmental Quality Biological Assessment Branch (NCDEQ BAB), (2010), Benthos Site DB11 Details. Accessed: https://www.ncwater.org/?page=672&SiteID=DB011

North Carolina Department of Environmental Quality Biological Assessment Branch (NCDEQ BAB), (2015), Benthos Site DB10 Details. Accessed: https://www.ncwater.org/?page=672&SiteID=DB010

North Carolina Department of Environmental Quality Biological Assessment Branch (NCDEQ BAB), (2011), Benthos Site DB26 Details. Accessed: https://www.ncwater.org/?page=672&SiteID=DB026

North Carolina Department of Environmental Quality Biological Assessment Branch (NCDEQ BAB), (2011), Benthos Site DB25 Details. Accessed: https://www.ncwater.org/?page=672&SiteID=DB025

North Carolina Department of Environmental Quality Biological Assessment Branch (NCDEQ BAB), (2010), Benthos Site DB12 Details. Accessed: https://www.ncwater.org/?page=672&SiteID=DB012

North Carolina Department of Environmental Quality Biological Assessment Branch (NCDEQ BAB), (2015), Benthos Site DB13 Details. Accessed: https://www.ncwater.org/?page=672&SiteID=DB013

North Carolina Department of Environmental Quality Biological Assessment Branch (NCDEQ BAB), (2015), Benthos Site DB09 Details. Accessed: https://www.ncwater.org/?page=672&SiteID=DB009

North Carolina Division of Water Resources (NC DWR). 2009. Assessment of Natural Condition for DO and pH in Potecasi Creek, Chowan River Basin, NC. Accessed: https://files.nc.gov/ncdeq/Water%20Quality/Planning/TMDL/Special%20Studies/Potecasi%20Creek%20Assessment%20report_final.pdf

US EPA. 2010. Decision Document for The Approval of the North Carolina Department of Environment and Natural Resources' 2008 Section 303(d) List Submitted on February 5, 2010. Accessed: https://files.nc.gov/ncdeq/Water%20Quality/Planning/TMDL/303d/EPA%202008%20303d%20Approval.pdf