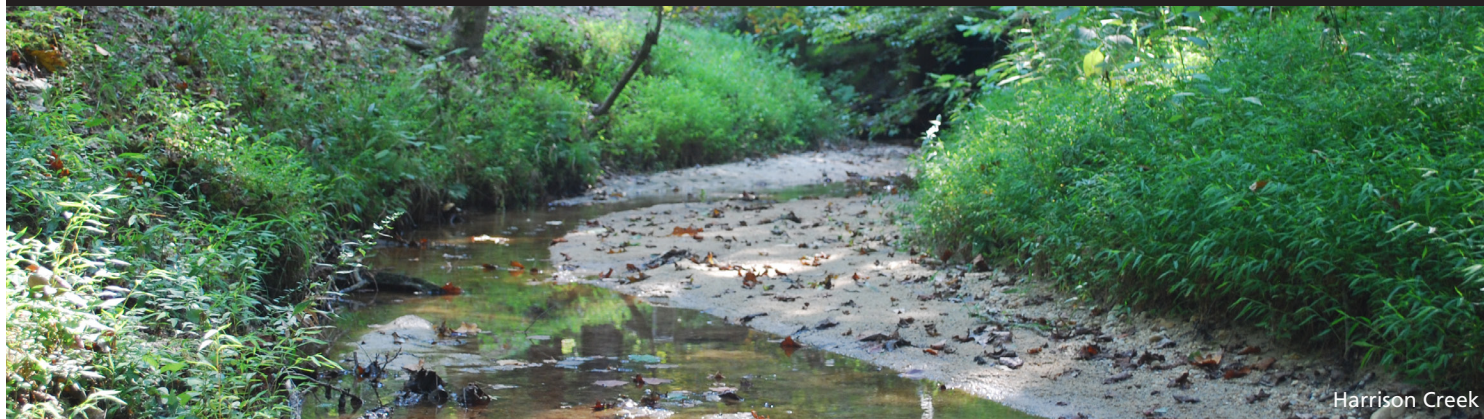




Harrison Creek

An Introduction to the Water Resources of Petersburg National Battlefield

For over nine and a half months in 1864–1865, Union and Confederate forces fought for control of Petersburg. Many of the associated battlefields are now protected as Petersburg National Battlefield (PETE). Though the park was initially established to protect these historically significant areas, it also conserves a number of ecosystems and associated natural resources. This brief provides an introduction to the water resources of PETE.

Landscape Setting and Land Use

It is important to describe the landscape surrounding PETE to better understand the water resources. Land

use is particularly important because it has a large influence on the protection or pollution affecting a stream. Land use is also the feature on the landscape which we control through management, policy, or other human activities.

PETE is located in the Coastal Plain region of south-central Virginia. The park consists of 2,740 acres in ten separate units. These units are surrounded by a mosaic of urban development, forests, agricultural fields, wetlands, and streams.

The two dominant holdings of PETE (Eastern Front and Five Forks) straddle the divide between the Chesapeake Bay (CBW) and the Albemarle Sound Watersheds (ASW). The Eastern Front area drains to the CBW, and Five Forks drains to the ASW. All of the stream systems in PETE are classified as low gradient, coastal plain streams. The surrounding region is underlain by sedimentary rocks and unconsolidated sands, clays, and gravels. These landforms support a wide variety of land uses which include forests, agriculture, and urban development.

Within park boundaries, forests make up most of the landscape (82%; see table and map, page 2). Agriculture and developed land are limited to 8% and 6%, respectively. However, much of the upstream landscape outside the park is developed or utilized for

Headwater Streams

- All of the streams in PETE are headwater streams (i.e. drain small watersheds).
- Healthy headwater streams are generally well-shaded with fully forested riparian communities.
- In aggregate, headwater streams play a major role in nutrient and sediment delivery downstream.
- These small streams can be highly influenced by riparian disturbance and nearby land use.

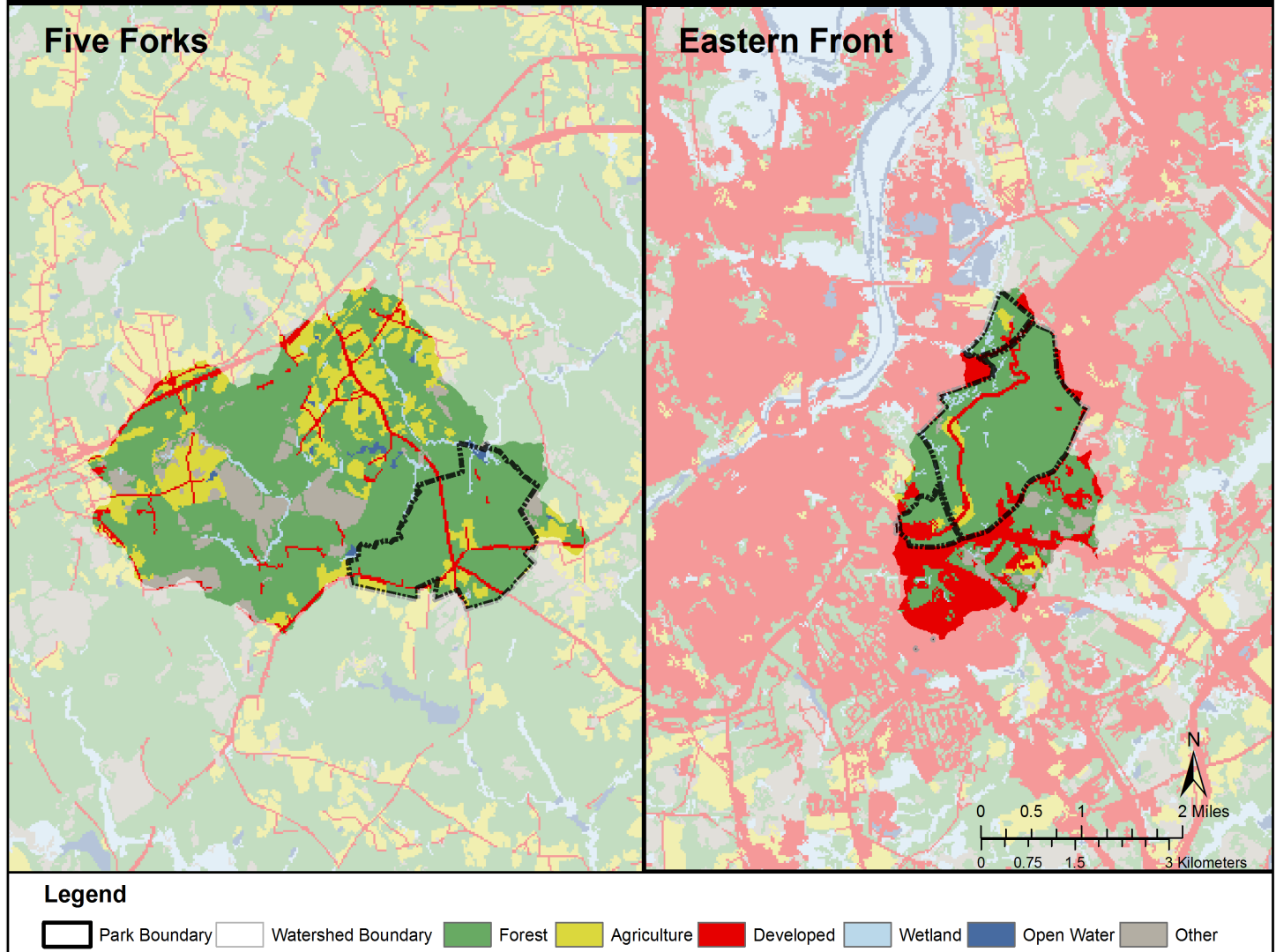
agriculture. These upstream land uses can degrade water quality and stream habitat downstream in PETE. Urbanization is the primary threat to aquatic resources in the Eastern Front unit. At the Five Forks unit, the primary water quality concern is upstream agricultural use. In contrast, within the park, forested watersheds (and associated stream buffers) have the ability to improve stream conditions. Forests and buffers can remove nutrients, limit water temperature increases, and protect physical habitat.

Estimates of wetlands in PETE range from 75 to 175 acres. Some of these wetland types are rare in the region. Five Forks contains important marshy wetland habitat created through beaver activity. Although no wetland species of special concern have been documented, this area has excellent habitat for wetland plants.



Gravelly Brook

Petersburg National Battlefield - Land Use



Land Use Type	Within Park		Within Surrounding Watershed		Within Chesapeake Bay Watershed		Within Albemarle Sound Watershed	
	%	Area (km ²)	%	Area (km ²)	%	Area (km ²)	%	Area (km ²)
Forest	81.7	8.9	61.7	21.8	54.7	91,329	42.5	19,340
Agriculture	8.2	0.9	16.6	4.8	24.6	40,996	22.1	10,044
Developed	5.9	0.6	11.9	4.2	11.0	18,432	7.0	3,189
Wetland	3.1	0.3	2.6	0.9	6.4	10,665	17.0	7,695
Other	1.1	0.1	10.2	3.6	3.3	5,535	11.4	5,205

Land use map and table. Note that PETE and the surrounding watershed contain a higher percentage of forested lands and a lower percentage of developed and agricultural lands when compared to the Chesapeake Bay and Albemarle Sound watersheds.

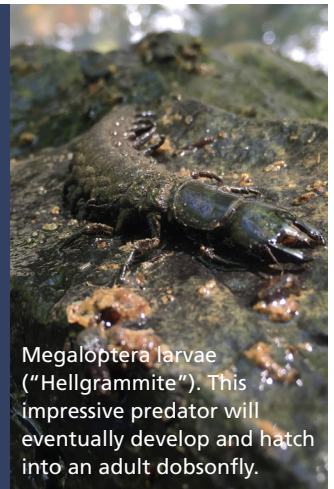
Aquatic Resources

The National Park Service (NPS) manages 27 km (17 miles) of streams at PETE. There are also several small ponds (0.1 – 4.0 acres) within and adjacent to park boundaries. All of the streams in PETE are small, headwater streams. Typical of headwater streams, these smaller streams support less diverse fish populations. However, 22 species of fish have been documented in PETE. There are some notable records for the NPS Mid-Atlantic Network Inventory and Monitoring Program (MIDN) due to the low-gradient coastal systems present in PETE. These include the bowfin

(*Amia calva*), chain pickerel (*Esox niger*), and two species of lamprey (*Lampetra aepyptera* and *Petromyzon marinus*). Thirty-four genera of benthic macroinvertebrates have been collected in PETE by MIDN inventory and monitoring efforts. In addition, 22 species of amphibians have been observed (13 frogs and 9 salamanders). These aquatic systems are important because they provide protected habitat in an ecoregion which has less land in conservation than many of the other ecoregions found in Virginia.

Benthic Macroinvertebrates

In order to monitor stream health, MIDN also collects information about benthic macroinvertebrate communities in PETE. Benthic macroinvertebrates are aquatic invertebrates that can be observed with the naked eye. In PETE, benthic macroinvertebrate sampling occurs at two sites. MIDN is able to calculate an “index of biological integrity” (IBI) based on the number and types of invertebrates that are present. This index can then be used to assess the health of the stream. Macroinvertebrate data from 2009-2012 suggest that some streams might be impaired. IBI scores for Harrison Creek and Gravelly Brook have scored both above and below the threshold for healthy conditions. MIDN has also documented other potential concerns in some streams (see “Water Quality Impairment” box, page 4). Though many sites have low pH and low dissolved oxygen levels, these are likely related to natural conditions and not due to pollutants. These waters are more ecologically like swamps, where low pH and low DO are expected (see Water Quality Assessment, below).



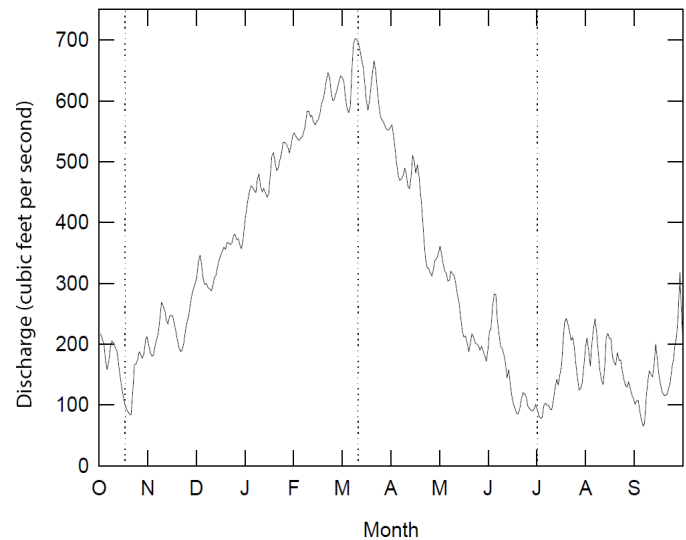
Megaloptera larvae (“Hellgrammite”). This impressive predator will eventually develop and hatch into an adult dobsonfly.

Water Quality Assessments

Historical water quality data for PETE is limited. Even so, the Commonwealth of Virginia did assess many waters in the park during the 2014 assessment cycle. Both within and surrounding the park, many of these waters are considered to be impaired (see map, page 4). In the Eastern Front Unit, Harrison Creek and Poor Creek have impaired regulatory status due to *E. coli* bacterial contamination. This contamination is likely a result from agricultural activity or other sources in these watersheds. In the Five Forks Unit, Hatcher’s Run has fish consumption advisories due to elevated mercury levels.

Most recently, MIDN in partnership with PETE has been monitoring water quality and benthic macroinvertebrates to assess stream conditions at PETE. Several locations have low pH and low dissolved oxygen (DO) levels that are below state standards, primarily in the Five Forks unit (see Water Quality Impairment box and map, page 4). Nevertheless, in most of these locations, these low levels are considered to be natural. Many of these waters function ecologically like swamps where low pH and low DO are expected. In these slow moving “blackwater” streams, decaying vegetation and organic sediments can lower pH and DO values. Though these parameters may be below state standards, these streams may not be ecologically impaired.

Benthic macroinvertebrate monitoring suggests that a number of streams in PETE might have slightly unhealthy ecologically conditions. It is possible that these streams are



Hydrograph

The figure above shows a representative hydrograph that reveals patterns of stream discharge (cubic feet per second) for waters in PETE. There is a trend of increasing flow from mid-October to mid-March, followed by a trend of decreasing flow from mid-March to July. The lowest flow period is from July to mid-October. These patterns can help interpret stream conditions during the year. For example, during low flow periods, dissolved oxygen readings are generally lower. This occurs due to lower stream flows, higher seasonal air and water temperatures, and other associated ecosystem processes.



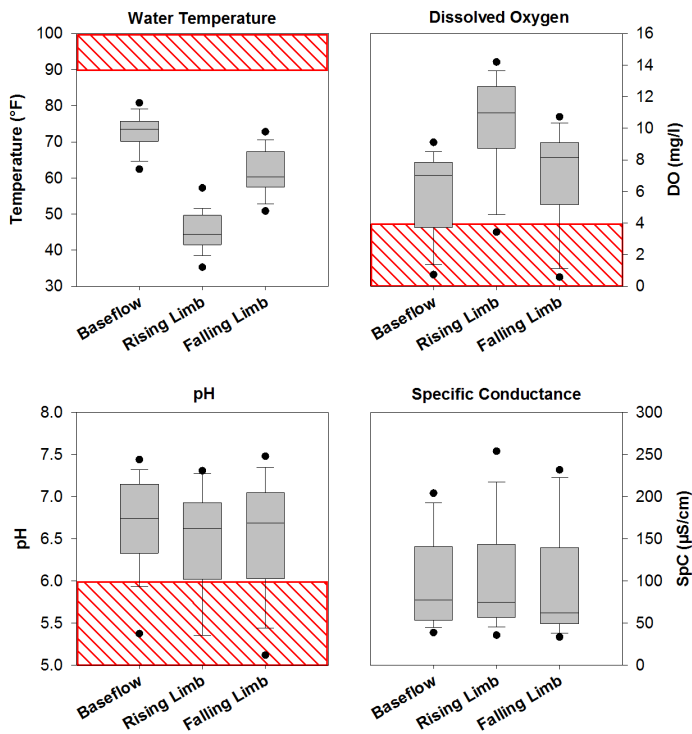
Water Quality Sampling

Long-term monitoring of water resources in PETE

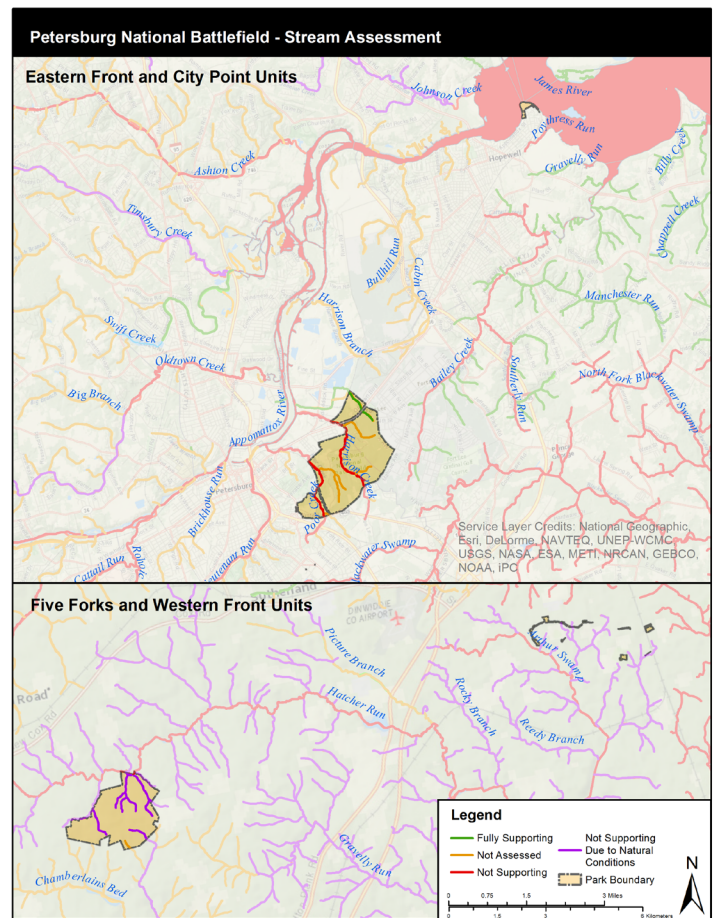
In order to better monitor the status and trends of wadeable streams at PETE, MIDN has established several long-term monitoring sites. These sites were placed in streams of significant value as determined by PETE and MIDN staff. Ten sites are currently monitored. At least one site is in each of the following streams: Branch Cr., Harrison Cr., Taylor Cr., Poor Cr., Hatcher Run, Beaverdam Cr., Boulder Cr., Gravelly Brook, and an unnamed tributary to the Appomattox River. At each site, MIDN staff measure water temperature, specific conductance, pH, and dissolved oxygen concentrations. Some sites contain automated equipment that records this information many times a day. In some sites, data on benthic macroinvertebrates is also collected.

Water Quality Assessments continued...

impaired due to development activity or agricultural pollutants. Further research is needed. For additional information, please visit https://science.nature.nps.gov/im/units/midn/monitor/water_quality.cfm.



Boxplots of water quality parameters in PETE (above). See “Water Quality Impairment” box below for details.



PETE stream assessment map (above). See “Water Quality Impairment” box to left for details.

Water Quality Impairment

Generally speaking, when discussing water quality, the term “impairment” refers to the failure to meet standards as required by the Clean Water Act. The figures above show boxplots for “core” water quality parameters measured in PETE by MIDN (2010-2013). The data are grouped by hydrologic season (see “Hydrograph” box, page 3). Red hatched areas show where impairment occurs as determined by the Commonwealth of Virginia. (At present, there is no impairment threshold for specific conductance). Based on MIDN data, several sites show values exceeding state standards for dissolved oxygen (DO) and pH (primarily in the Five Forks area). However, these low pH and DO values are naturally occurring conditions in these swamp-like ecosystems. The Commonwealth of Virginia also assessed several streams in PETE during 2014 (see map, right). Impairments occur primarily due to bacterial contamination from agriculture and other sources. Fish consumption advisories are also in effect in Hatcher’s Run due to mercury levels. This mercury is likely deposited from the atmosphere during precipitation events.



Photos by Jo Ann Buys (front header) and the National Park Service.

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Parks monitored: Appomattox Court House NHP • Booker T. Washington NM
• Eisenhower NHS • Fredericksburg & Spotsylvania NMP • Gettysburg NMP •
Hopewell Furnace • NHS Petersburg NB • Richmond NBP • Valley Forge NHP