Great Swamp Watershed

Water Quality Report Card

2015

Great Swamp Watershed Association

Acknowledgments

The 2015 Watershed Report Card took many hands to create. I would like to thank the amazing Stream Team Volunteers who give freely of their time and talents to collect water quality data, sample macroinvertebrates, and monitor and track the changes that take place within our watershed. Without their invaluable knowledge and support, our work would not be possible. Special thanks to Roger Edwards for helping with data analysis and helping me to sort out data that was collected before my time at GSWA.

Stream Team Volunteer Roger Edwards collects a water sample from Millington Gorge.

GSWA sincerely thanks our member, corporate, and foundation supporters whose generous contributions helped fund our water quality monitoring programs in 2015. It is the support of GSWA members that makes all of our programing possible. Thank you!

Finally, I would like to thank GSWA for entrusting me with the position of Director of Water Quality. My first year at the GSWA has been amazing and I look forward to many more years of data collection to come.

Prepared by Sandra LaVigne
Layout by Kelly Martin
Cover Photo by Blaine Rothauser

Great Swamp Watershed Association
The Passaic River **WATERKEEPER®** ALLIANCE Affiliate
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Volunteers Jessica Zhang and Kelsey Neale test water quality in the Passaic River

This report and supplemental materials are available online at GreatSwamp.org or by contacting Sandra LaVigne, GSWA Director of Water Quality Programs, at SandraL@GreatSwamp.org or 973-538-3500.

Introduction to the Great Swamp Watershed

The Great Swamp Watershed is a 55-square mile region in Morris and Somerset Counties that includes portions of ten towns (Bernards, Bernardsville, Harding, Chatham Township, Long Hill, Madison, Mendham Township, Mendham Borough, Morris Township, and Morristown). There are approximately 138,000 people living in these towns, with about 38,000 residing in the Great Swamp Watershed. The Great Swamp Watershed is a sub-watershed of the greater Passaic River watershed.

There are five main streams in the Great Swamp Watershed: Black Brook, Loantaka Brook, Great Brook, Primrose Brook, and the Passaic River. The first four streams flow into the Passaic River before it leaves the watershed through Millington Gorge. Downstream of the Great Swamp Watershed, the Passaic River provides drinking water for over 2.5 million people.

Land uses in the Watershed vary from parks and forested areas to residential neighborhoods and commercial areas. Developed areas typically have the greatest impact on streams. Large areas of impervious surfaces such as roads, roofs, and parking lots, do not allow rain water to soak into the ground. Instead, precipitation falling on these surfaces "runs off," picking up any pollutants in its path, such as animal waste, trash, motor oil, and more. Stormwater runoff, as it is often called, flows across impervious surfaces directly into the nearest stream, or into a storm drain, which eventually empties to a stream. Mown grassy areas like lawns and golf courses are also relatively impervious and contribute to runoff.

Stormwater runoff is the primary way that Watershed streams become impaired. Natural areas such as forests, wetlands, and meadows reduce runoff dramatically and allow precipitation and stormwater runoff to soak into the ground.

The 2015 Report Card

GSWA Intern Leanne Marinuk conducts a visual assessment

GSWA has been involved in monitoring the streams in our watershed since 1999. Througout that time monitoring parameters have varied and historic data sets range in scope. In 2015, chemical monitoring, conducted quarterly, used a combination of handheld meters to measure in-stream conditions and laboratory analysis of collected samples for expanded chemical data. Visual assessments were once again conducted biannually in the spring and fall by our Stream Team volunteers. Macroinvertebrate sampling was conducted in July and *E. coli* monitoring was conducted over a five week period during the summer. Additionally, temperature data was collected during chemical and *E. coli* monitoring. Continuous temperature data was also collected over short periods of time on select streams in the spring.

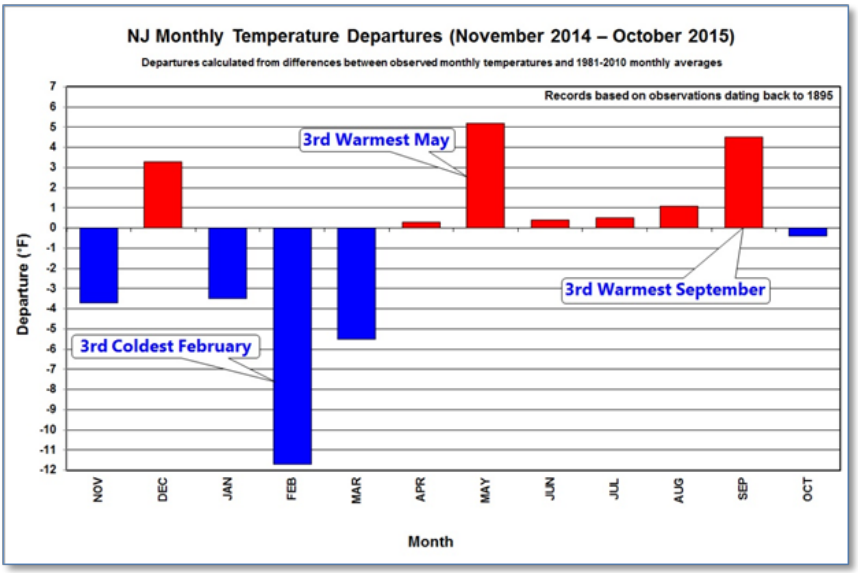
The 2015 Watershed Report Card collects all of the monitoring data collected by staff and volunteers throughout the year. 2015 is the second year of the Adopt Black Brook and Primrose Stream program which will conclude in 2016.

Each of the five Watershed streams is assessed separately in this report card, and each is referred to as a subwatershed. Data collected at the Watershed outlet at Millington Gorge is also graded separately and is considered to be representative of the quality of water leaving the Great Swamp Watershed and heading towards our neighbors downstream.

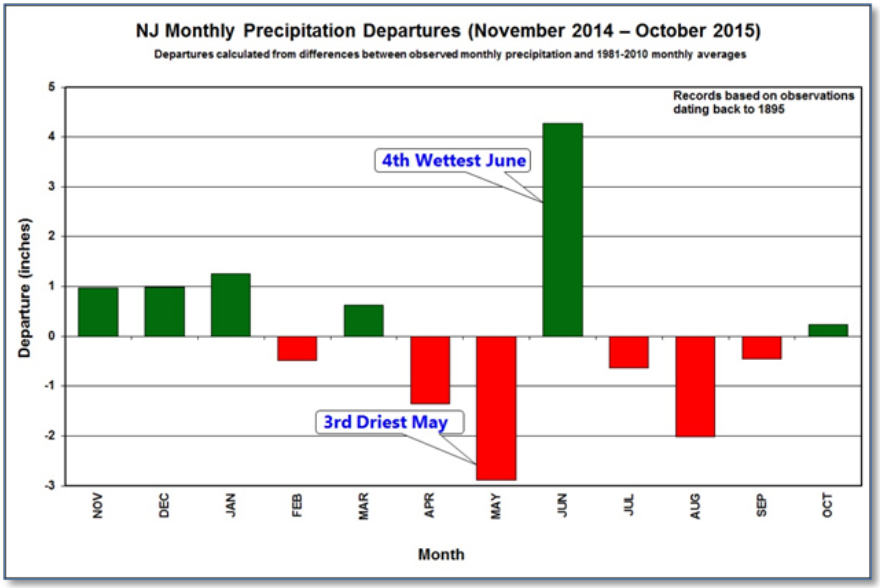
Land use and land cover data is from 2012 (the most recent year available), and is publicly available data published by NJDEP.

Climate and Water Quality

The climate, air temperatures and precipitation in the region, have a significant impact on the water quality in our watershed. In 2015, winter temperatures were well below normal with February of 2015 being the third coldest on record for our region according to the Rutgers Office of Climatology. Spring and summer brought average to above average temperatures with May and September each being the third warmest on record. Warm spring and summer months can negatively impact dissolved oxygen, bacteria and water temperature levels.



Early spring in 2015 saw unseasonably dry weather allowing soils to become dry and hard. This was followed by one of the wettest Junes on record with heavy rains interspersed with dry spells. This type of weather cycling increases erosion and pollutants in stormwater runoff impacting our water quality. Non-point source pollution is carried by the stormwater runoff into our streams, prolonged dry conditions can increase the velocity of this runoff as even the normally pervious areas, gardens, forests and meadows, become hardened.



How the 2015 Grades Were Created

Grading scales are based on New Jersey Department of Environmental Protection (NJDEP) or U.S. Environmental Protection agency (EPA) standards when applicable. For categories without such standards, grading scales are based on ecological impact and previous GSWA data.

Two changes have been made to our grading structure from 2014. Our macroinvertebrate grading scale has been changed to the NJ High Gradient Macroinvertebrate Index (HGMI). Previously we used the Benthic Index of Biotic Integrity (B-IBI). This change was made to bring our data in line with other agencies in New Jersey.

The second change was made to the scaling of water clarity as related to turbidity. The NJDEP standard (50 NTU) was too low to represent the waters in our watershed. All streams were rated as excellent on every visit with a more common rage of 3.00 NTU to 10 NTU. Using historic GSWA data, a stricter scale was developed so that we can more accurately monitor changes that are taking place in our watershed.

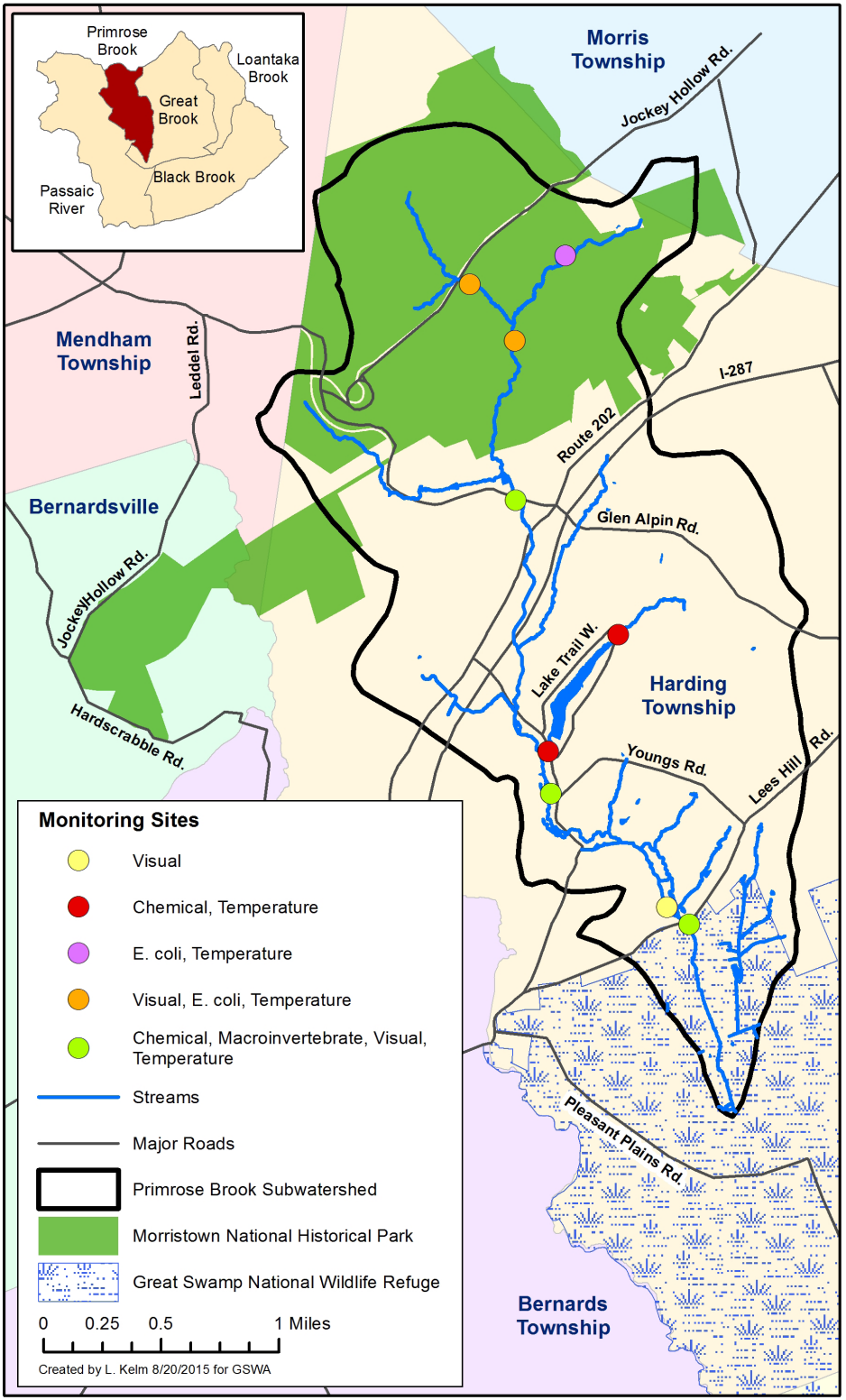
Primrose Brook

The Primrose Brook subwatershed is the second smallest at just over 5 square miles. It is comprised of primarily forested land (58%), with an additional 30% of its area developed. The upper reaches of the stream begin in and near the Jockey Hollow section of Morristown National Historical Park, and the stream traverses a relatively rural and suburban landscape to its outlet in the Great Swamp National Wildlife Refuge. An unnamed tributary, referred to by GSWA as the Mount Kemble Lake tributary, begins upstream of Mount Kemble Lake, flows into the Lake and then into the main stem of Primrose Brook. Primrose Brook is considered the healthiest stream in the Great Swamp Watershed, and two segments are classified as Category 1 by NJDEP, one of the highest stream classifications given by the State of New Jersey.

Category	Primrose Brook (Main Stem)	Mt. Kemble Lake Tributary
Macroinvetebrates	Good ↑	
Visual Assessment	Good	
Bacteria	Good ↓	
Dissolved Oxygen	Excellent	Good
Water Temperature	Excellent	Excellent
pH	Excellent	Excellent
Road Salt	Excellent	Excellent
Water Clarity	Excellent	Excellent
Nitrogen	Excellent ↑	Good ↑
Phosphorus	Excellent	Excellent

Comments

Primrose continues to be one of our healthiest streams in the watershed. The macroinvertebrate data showed a slight increase in overall health from 2014. Visual assessments continue to be good but show increasing sediment and erosion in the downstream areas, which could begin to impact water quality, most notably for macroinvertebrates in the future. Chemical data for both the main stem of Primrose, as well as the Mt. Kemble tributary, continue to be excellent overall. We saw a significant decrease in the nitrogen levels in both the main stem (reduced by half) and the tributary compared to 2014. This decrease may be due to the drier conditions in the spring compared to 2014. With the decrease in winter precipitation... ***Continued on page 22***


Primrose Brook
Loantaka Brook
Great Brook
Black Brook
Passaic River
Morris Township
Jockey Hollow Rd.
Mendham Township
Leddel Rd.
I-287
Route 202
Bernardsville
Glen Alpin Rd.
Jockey Hollow Rd.
Lake Trail W.
Harding Township
Hardscrabble Rd.
Youngs Rd.
Lees Hill Rd.
Pleasant Plains Rd.
Bernards Township
Monitoring Sites
Visual
Chemical, Temperature
E. coli, Temperature
Visual, E. coli, Temperature
Chemical, Macroinvertebrate, Visual, Temperature
Streams
Major Roads
Primrose Brook Subwatershed
Morristown National Historical Park
Great Swamp National Wildlife Refuge
0 0.25 0.5 1 Miles
Created by L. Kelm 8/20/2015 for GSWA

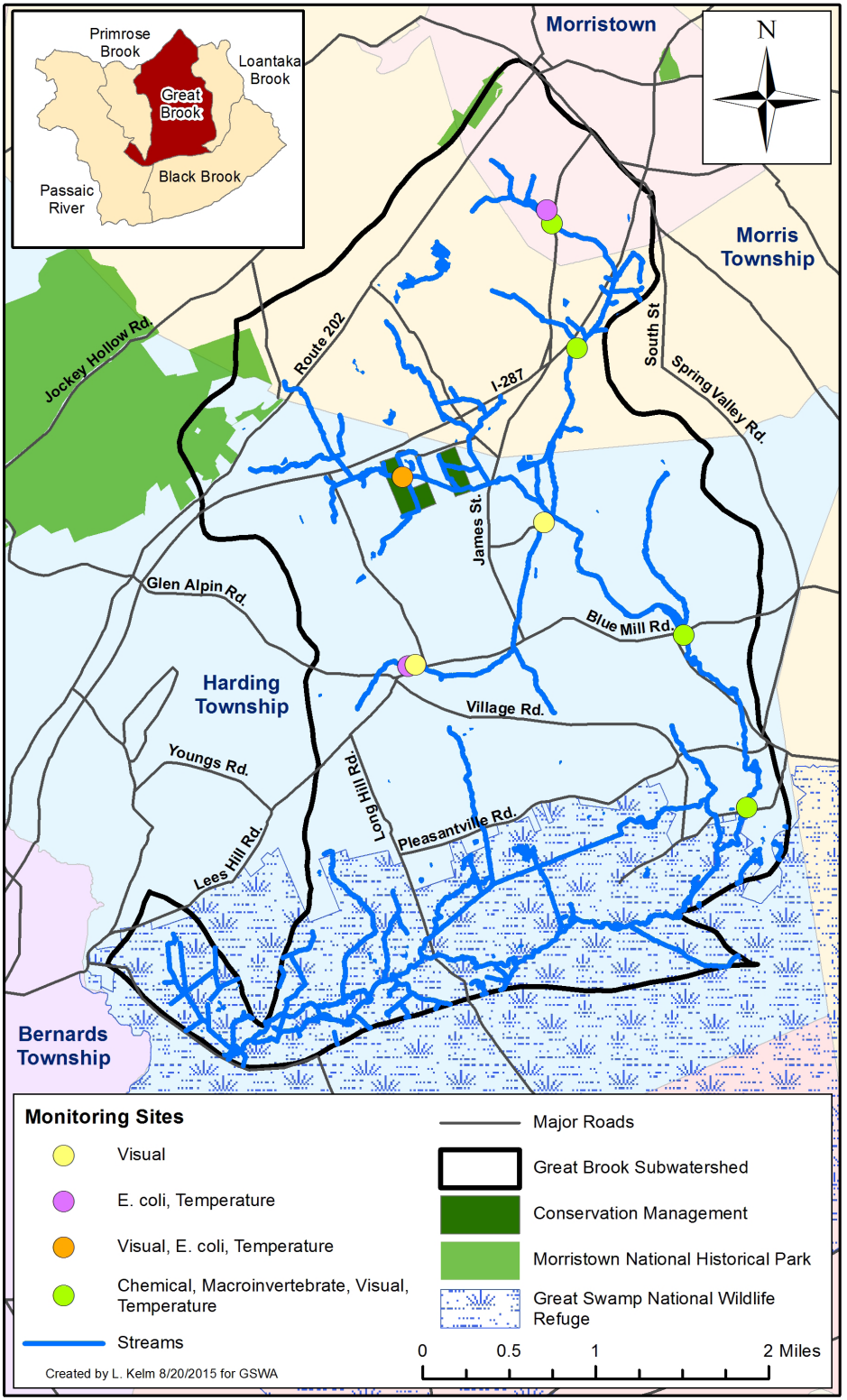
Great Brook

The Great Brook subwatershed encompasses almost 13 square miles of predominantly developed land (40%) with a mix of forest (26%), wetlands (24%), and agriculture (9%). Great Brook originates in four locations, with the main stem beginning in Morris Township at Spring Brook Country Club. Silver Brook, a tributary, begins in Morris Township and flows through Harding, including GSWA's Conservation Management Area. Bayne Brook, another tributary, flows through Harding's Bayne Park. The two tributaries meet east of James St. in Harding, and flow shortly thereafter into the main stem of Great Brook. After its urban and suburban origins, Great Brook passes through protected lands scattered among suburban and rural landscapes until it enters the Great Swamp National Wildlife Refuge.

Category	Great Brook (main Stem)	Bayne Brook	Silver Brook
Macroinvetebrates	Poor ↑		
Visual Assessment	Good	Poor	Poor
Bacteria	Good ↑	Excellent ↓	Very Poor ↓
Dissolved Oxygen	Excellent		
Water Temperature	Excellent	Excellent ↑	Excellent ↓
pH	Excellent		
Road Salt	F W S Sp		
Water Clarity	Good		
Nitrogen	Good ↓		
Phosphorus	Good		

Comments

Overall, the Great Brook water quality continues to remain in the middle of our streams, not the best but not the worst. The macroinvertebrate population was slightly more robust than in 2014 but still remains in the poor range. Our bacteria sampling of Great Brook improved significantly this year raising it from very poor to good standing. Only one out of the five bacteria samples collected exceeded the NJ state standard and only marginally. Road salt continues to be an issue in the main stem of Great Brook. For the 2015 report card, this data set has been broken down by season so we can catch the issues better... ***Continued on page 22.***


Primrose Brook
Loantaka Brook
Great Brook
Black Brook
Passaic River
Morristown
N
Morris Township
Jockey Hollow Rd.
Route 202
I-287
South St
Spring Valley Rd.
James St.
Glen Alpin Rd.
Blue Mill Rd.
Harding Township
Village Rd.
Youngs Rd.
Long Hill Rd.
Pleasantville Rd.
Lees Hill Rd.
Bernards Township
Monitoring Sites
Visual
E. coli, Temperature
Visual, E. coli, Temperature
Chemical, Macroinvertebrate, Visual, Temperature
Streams
Major Roads
Great Brook Subwatershed
Conservation Management
Morristown National Historical Park
Great Swamp National Wildlife Refuge
0
0.5
1
2 Miles
Created by L. Kelm 8/20/2015 for GSWA

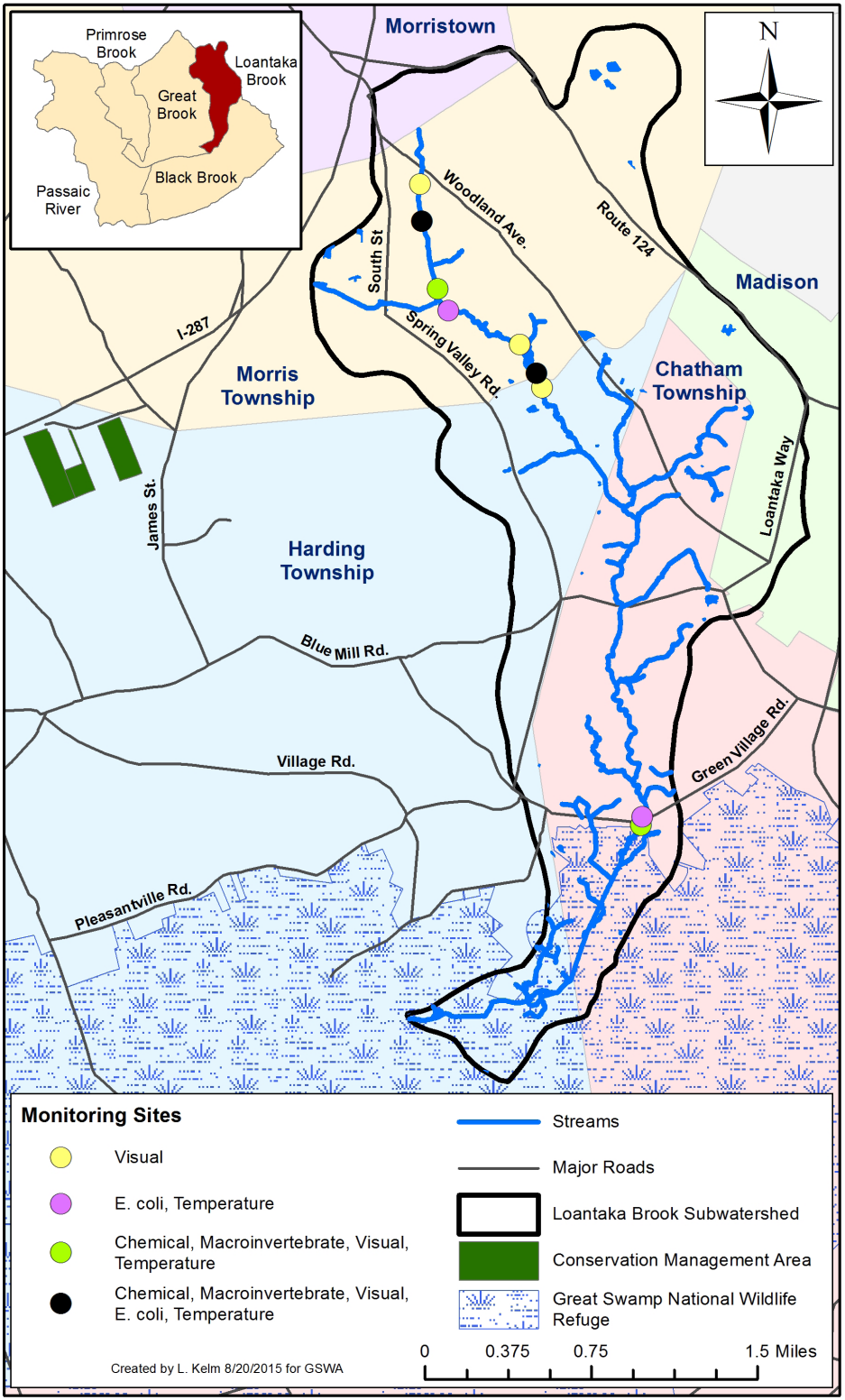
Loantaka Brook

At just over 5 square miles, Loantaka Brook is the smallest subwatershed. With its headwaters in Morristown and Morris Township, most of the land in the subwatershed is developed (53%), which tends to have a negative impact on the stream. There are, however, significant areas of wetlands (21%) and forest (19%). Shortly downstream from its origins, Loantaka Brook flows past mown fields, Morris Township's Ginty Pool, Seaton Hackney Stables (where GSWA recently completed a 3-year remediation project), and the Woodland Water Pollution Control Utility (wastewater treatment plant). Any of these sites may contribute to stream impairment through potential input of nutrients, bacteria, and chemicals. Below the headwaters region, Loantaka Brook continues into Morris County Park Commission's Loantaka Brook Reservation. Within the park, the stream is dammed at Kitchell Pond, and then continues downstream through Green Village and into the Great Swamp National Wildlife Refuge.

Category	Loantaka Brook
Macroinvetebrates	Very Poor ↓
Visual Assessment	Good
Bacteria	Very Poor ↓
Dissolved Oxygen	Excellent
Water Temperature	Excellent
pH	Excellent
Road Salt	Very Poor↓
Water Clarity	Good
Nitrogen	Very Poor ↓
Phosphorus	Very Poor ↓

Comments

Loantaka continues to be the most impaired stream in our watershed. Upstream land use and impervious cover continue to have negative impacts on the health of the stream. Visual assessments continue to monitor habitat, finding little further degradation of the area. However, an increase in sedimentation has negatively affected overall macroinvertebrate habitat and the macroinvertebrate index was lower in 2015. Improved buffer zones in these areas are needed to prevent further stream impairment and reduce nutrient loading and runoff impacts... ***Continued on page 23.***


Primrose Brook
Loantaka Brook
Great Brook
Black Brook
Passaic River
Morristown
N
Woodland Ave.
Route 124
South St
Madison
Spring Valley Rd.
I-287
Morris Township
Chatham Township
Loantaka Way
James St.
Harding Township
Blue Mill Rd.
Village Rd.
Green Village Rd.
Pleasantville Rd.
Monitoring Sites
Visual
E. coli, Temperature
Chemical, Macroinvertebrate, Visual, Temperature
Chemical, Macroinvertebrate, Visual, E. coli, Temperature
Streams
Major Roads
Loantaka Brook Subwatershed
Conservation Management Area
Great Swamp National Wildlife Refuge
0
0.375
0.75
1.5 Miles
Created by L. Kelm 8/20/2015 for GSWA

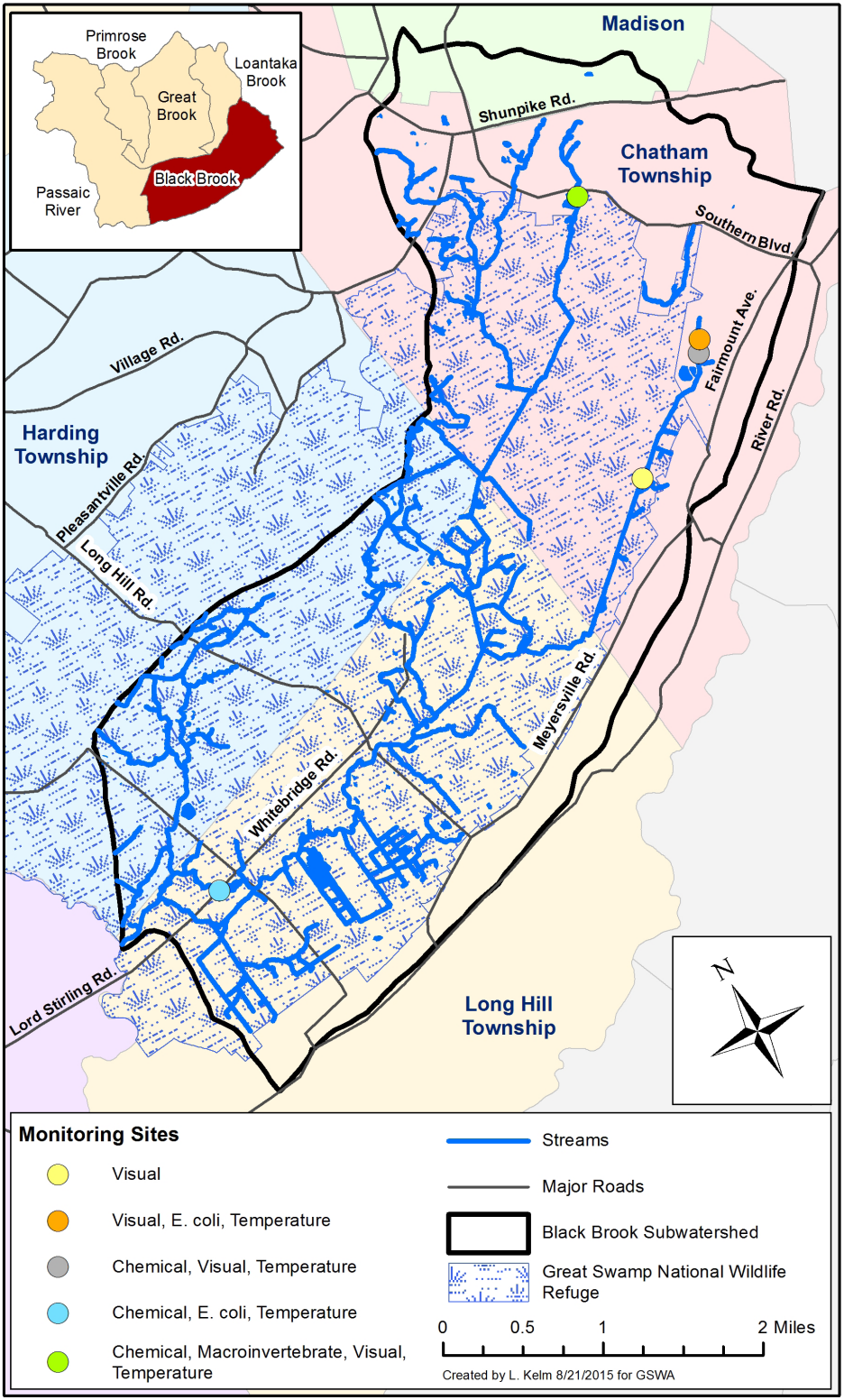
Black Brook

Black Brook, the second largest subwatershed with over 14 square miles, lies primarily within the Great Swamp National Wildlife Refuge. Reflective of this, wetlands are the predominant land cover (59%). Outside of the Refuge, much of the subwatershed is developed (27% total). The headwaters of Black Brook include several branches which begin in the developed areas of Chatham Township, with two originating in the Fairmount Country Club. After entering the Refuge, the branches converge and continue their course until joining the Passaic River. At sites near Whitebridge Road within the Refuge, the stream has taken on a darker "tea colored" appearance due to the decomposition of organic matter in the stream. Black Brook is a low gradient stream, meaning the elevation difference between the headwaters and the stream's outlet is relatively low. This causes the stream to generally have a slow flow.

Category	Black Brook
Macroinvetebrates	Very Poor ↓
Visual Assessment	Good ↑
Bacteria	Very Poor ↓
Dissolved Oxygen	Good
Water Temperature	Excellent
pH	Excellent
Road Salt	F / W / S / Sp
Water Clarity	Excellent
Nitrogen	Very Poor ↑
Phosphorus	Poor

Comments

In 2015, visual assessments along Black Brook indicated improvement in some stream buffers in the upstream areas close to the headwaters. Instream habitat continues to be impaired by high sedimentation and a lack of riffles and snags. The natural topography of Black Brook, being a low gradient stream, lends itself to these conditions. Macroinvertebrate sampling indicated a slight decline in diversity but was statistically similar to the 2014 data. The road salt data has again been broken down seasonally to highlight the differences seen in the winter sampling season. The headwaters of Black Brook, located in the Chatham area have increased... ***Continued on page 23.***


Primrose Brook
Loantaka Brook
Great Brook
Black Brook
Passaic River
Madison
Shunpike Rd.
Chatham Township
Southern Blvd.
Fairmount Ave.
River Rd.
Village Rd.
Harding Township
Pleasantville Rd.
Long Hill Rd.
Meyersville Rd.
Whitebridge Rd.
Lord Stirling Rd.
Long Hill Township
N
Monitoring Sites
Visual
Visual, E. coli, Temperature
Chemical, Visual, Temperature
Chemical, E. coli, Temperature
Chemical, Macroinvertebrate, Visual, Temperature
Streams
Major Roads
Black Brook Subwatershed
Great Swamp National Wildlife Refuge
0
0.5
1
2 Miles
Created by L. Kelm 8/21/2015 for GSWA

Great Swamp Watershed W

Stream	Macro-invertebrates*	Visual Stream Assessment	Bacteria	Dissolved Oxygen	Tem
Black Brook	Very Poor ↓	Good ↑	Very Poor ↓	Good	Ex
Great Brook (main stem)	Poor ↑	Good	Good ↑	Excellent	Ex
Bayne Brook		Poor	Excellent ↓		Ex
Silver Brook		Poor	Very Poor ↓		Ex
Loantaka Brook	Very Poor ↓	Good	Very Poor ↓	Excellent	Ex
Passaic River (main stem)	Good ↑	Good ↓		Excellent ↑	Ex
Branta Pond			Good ↓		Ex
Primrose Brook (main stem)	Good ↑	Good	Good ↓	Excellent	Ex
Mount Kemble Lake Tributary				Good	Ex
Great Swamp Watershed Outlet			Very Poor ↑	Excellent ↓	Ex

Key				
Excellent	Good	Poor	Very Poor	No Data

Arrows indicate a >.5 change from the 2014 data and correspond to the grade (not the measurement).

Water Quality Report Card

Water Temperature	pH	Road Salt**	Water Clarity	Nitrogen	Phosphorus
Excellent	Excellent	Winter / Fall / Spring / Summer	Excellent	Very Poor ↑	Poor
Excellent	Excellent	Winter / Fall / Spring / Summer	Good	Good ↓	Good
Excellent ↑					
Excellent ↓					
Excellent	Excellent	Very Poor↓	Good	Very Poor ↓	Very Poor ↓
Excellent ↑	Excellent	Winter / Fall / Spring / Summer	Good	Excellent ↑	Excellent
Excellent					
Excellent	Excellent	Excellent	Excellent	Excellent ↑	Excellent
Excellent	Excellent	Excellent	Excellent	Good ↑	Excellent
Excellent ↓	Excellent	Winter / Fall / Spring / Summer	Poor	Excellent	Good

*Macroinvertebrate (MIV) scores are much lower than 2014, but this may be due to changes in analysis methods (e.g. identifying 100 instead of 200 MIVs per site, identifying all specimens to genus level, different scoring metric)

**Road salt data has been broken up by season to better capture the impact of salt runoff in the winter months.

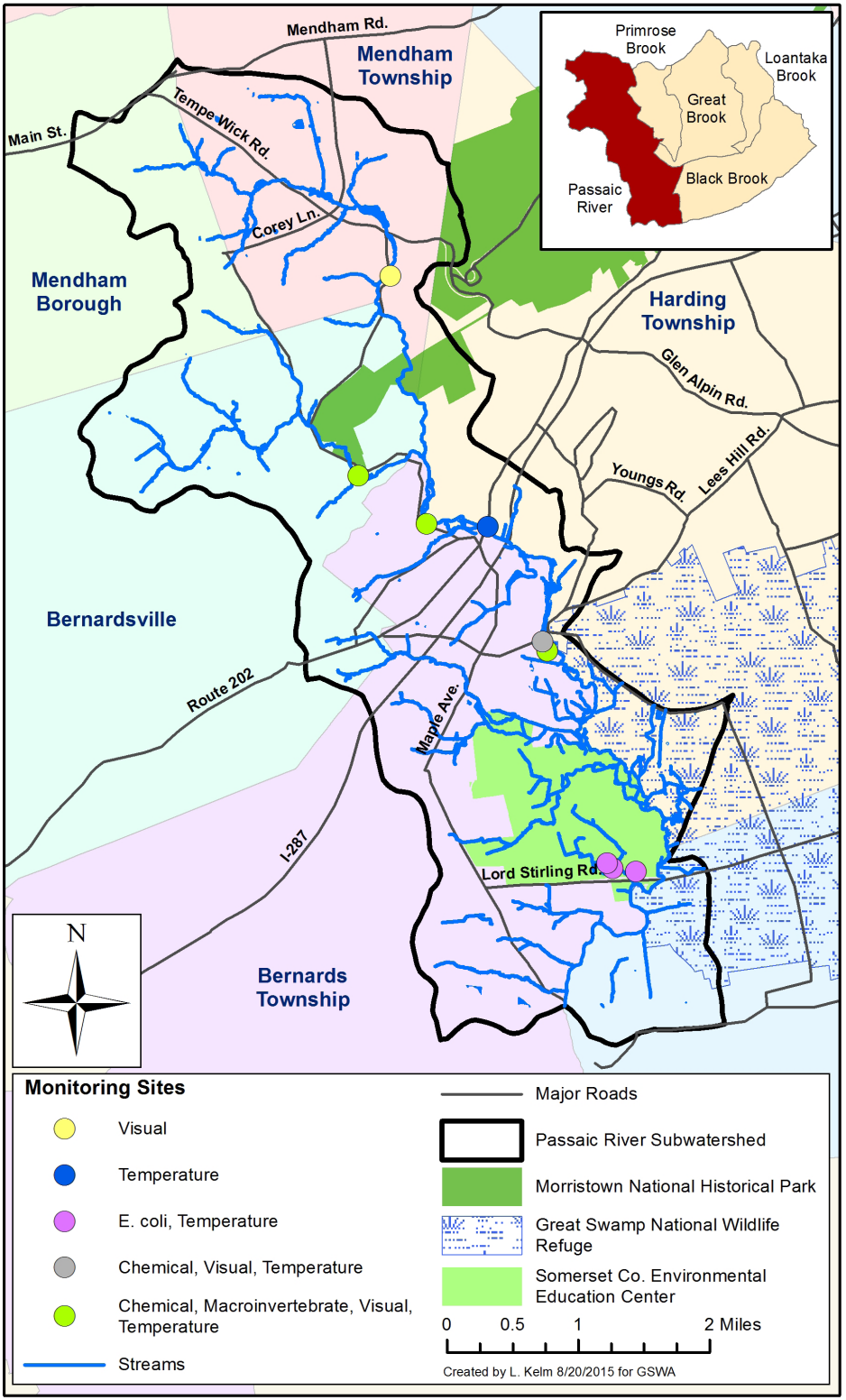
Passaic River

At almost 17 square miles, the Passaic River subwatershed is the largest within the Great Swamp Watershed. The headwaters of the Passaic River begin in downtown Mendham Borough and Mendham Township, and the river then flows through a heavily forested area before reaching more dense development along Route 202 and I-287. In total, 43% of the subwatershed is developed while 33% is forested. Like Primrose Brook, a segment of the Passaic River (above Osborne Pond) is classified by NJDEP as Category 1, one of the highest stream classifications given by the State of New Jersey. The Passaic River within the Great Swamp Watershed is considered, with Primrose Brook, to be one of the healthiest Watershed streams. A tributary, Indian Grave Brook, is often considered the reference stream for the Great Swamp Watershed due to its consistently high water quality. Branta Pond, located within the Somerset County Environmental Education Center, flows into the Passaic River downstream of Lord Stirling Road.

Category	Passaic River	Branta Pond
Macroinvetebrates	Good ↑	
Visual Assessment	Good ↓	
Bacteria		Good ↓
Dissolved Oxygen	Excellent ↑	
Water Temperature	Excellent ↑	Excellent
pH	Excellent	
Road Salt	F / W / S / Sp	
Water Clarity	Good	
Nitrogen	Excellent ↑	
Phosphorus	Excellent	

Comments

The Upper Passaic River waters, classified as Category 1 (C1) by the NJ-DEP, are held to a higher standard of water quality than non C1 waters. As the data collected throughout the Passaic River, within the Great Swamp Watershed, these standards were applied to the upstream areas and then averaged with the less stringent standards below Osborne Pond to come up with the overall water quality grade. The three parameters that this affects are water temperature, dissolved oxygen and water clarity. As these waters are considered trout production waters by NJDEP, these water quality parameters are important as they relate to the health of the trout... ***Continued on page 24.***


Mendham Rd.
Mendham Township
Main St.
Tempe Wick Rd.
Corey Ln.
Mendham Borough
Harding Township
Glen Alpin Rd.
Youngs Rd.
Lees Hill Rd.
Bernardsville
Route 202
Maple Ave.
I-287
Lord Stirling Rd.
Bernards Township
N
Primrose Brook
Loantaka Brook
Great Brook
Black Brook
Passaic River
Monitoring Sites
Visual
Temperature
E. coli, Temperature
Chemical, Visual, Temperature
Chemical, Macroinvertebrate, Visual, Temperature
Streams
Major Roads
Passaic River Subwatershed
Morristown National Historical Park
Great Swamp National Wildlife Refuge
Somerset Co. Environmental Education Center
0
0.5
1
2 Miles
Created by L. Kelm 8/20/2015 for GSWA

Great Swamp Outlet

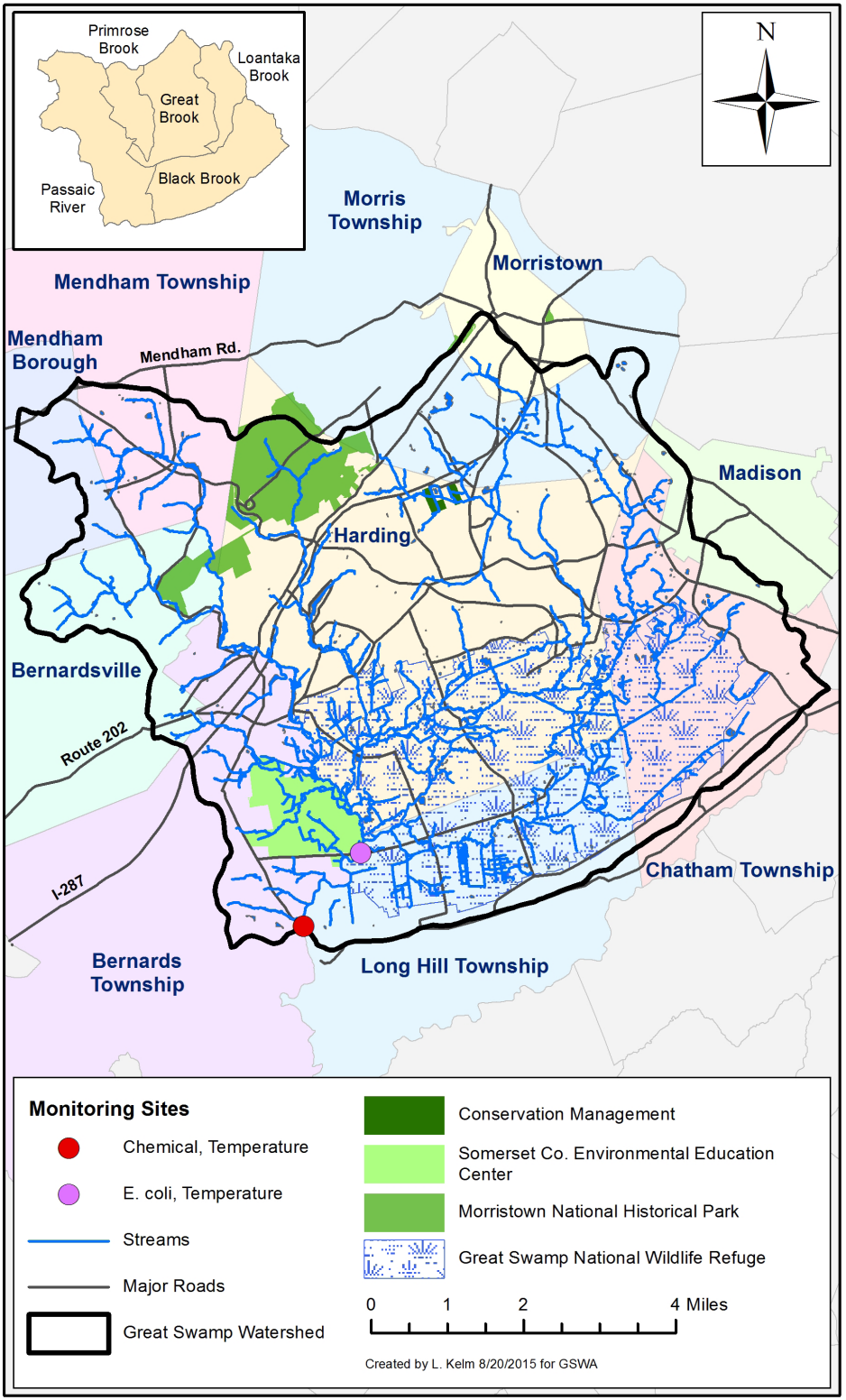
The outlet of the Great Swamp Watershed at Millington Gorge gives a snapshot of the combined water quality of all upstream sites. The results are directly impacting our downstream neighbors, and those whose drinking water comes from the Passaic River. Note that some data was collected upstream from Millington Gorge at the Fishermen's Parking Lot on the Passaic River. This site was considered to be a Watershed outlet site since it is below where all major tributaries empty into the main stem of the Passaic River, and data taken there also serves as an indicator of the quality of water leaving the Great Swamp Watershed.

Category	Great Swamp Outlet
Macroinvetebrates	
Visual Assessment	
Bacteria	Very Poor ↑
Dissolved Oxygen	Excellent ↓
Water Temperature	Excellent ↓
pH	Excellent
Road Salt	F W S Sp
Water Clarity	Poor
Nitrogen	Excellent
Phosphorus	Good

Comments

Since the watershed outlet is a combination of water quality input from all other streams, we would expect to see it negatively impacted by poorer quality streams or certain parameters. Conversely, higher quality streams would serve to dilute pollutants flowing from more impaired streams. In looking at the data, it appears that a larger area of land draining to the outlet, and subsequently higher stream flow than elsewhere in the Watershed, serve to dilute most negative inputs. The wetland itself works as a sponge to absorb many of the nutrients that flow through it so that the water that drains out the other side is cleaner.

Water quality at the outlet remains good overall. Though bacteria levels met the NJDEP... ***Continued on page 24.***


Primrose Brook
Loantaka Brook
Great Brook
Black Brook
Passaic River
N
Morris Township
Morristown
Mendham Township
Mendham Borough
Mendham Rd.
Madison
Harding
Bernardsville
Route 202
I-287
Chatham Township
Bernards Township
Long Hill Township
Monitoring Sites
Chemical, Temperature
E. coli, Temperature
Streams
Major Roads
Great Swamp Watershed
Conservation Management
Somerset Co. Environmental Education Center
Morristown National Historical Park
Great Swamp National Wildlife Refuge
0
1
2
4 Miles
Created by L. Kelm 8/20/2015 for GSWA

A look downstream at Primrose Brook site PB3

Continued Comments

Primrose Brook (*continued from page 8*)
...the runoff from snowmelt was also decreased carrying less organic materials into the streams. Cat Swamp Pond, located within Jockey Hollow, does not receive flow from, or contribute to, Primrose Brook but continues to be monitored by GSWA for bacteria as it is a popular spot for hikers and fisherman. The bacteria results from Cat Swamp Pond continue to be excellent.

Great Brook (*continued from page 10*)
In 2014, the average of all the data collected placed road salt in Great Brook in the good range, however, what that did not show was the high levels noted in the winter data set. In 2015, road salt continues to be a major issue in the winter months placing it in the very poor category, even with the decreased precipitation compared with 2014. In spring and fall levels were better with the best levels recorded in the summer sampling.

Visual assessments continue to indicate poor conditions and elevated sedimentation rates in Bayne Brook and Silver Brook. We are hoping to work with Harding land Trust to make stream habitat improvements along the Silver Brook in the near future.

Bacteria continue to be an issue in the Silver Brook with all five samples exceeding the NJ standard. This issue is under investigation and we are working with NJ DEP to try to narrow the source of the issue and begin looking for solutions.

Loantaka Brook (*continued from page 12*)
Bacterial sampling in 2015 also indicated high levels of bacteria in the area. This may have been due in part to the heavy rains during the June sampling dates. The areas of impervious cover and mowed sports fields adjacent to the stream allow stormwater runoff to carry animal waste, especially from geese and pets, more easily into the stream.

Road salts, as indicated by total dissolved solids, were also elevated throughout the year, as were both phosphorus and nitrogen. These may all have been impacted by the weather conditions as well. Spells of dry weather followed by heavy rainfall increase contaminates carried by stormwater runoff.

Black Brook (*continued from page 14*)
...population density requiring more attention to road conditions in the winter months. This causes excessive runoff issues when the snowmelt carries the salt into the stream.

Bacteria results in 2015 were also similar to those collected in 2014 with a decrease seen in our upstream site (adjacent to Fairmount Country Club) and an increase seen at the downstream site (Whitebridge Road). The heavy rainfall during our sampling may have affected these results as high flow volume would dilute the faster moving areas upstream and allow for more volume to push through the wetland swamp areas downstream flushing the bacteria which can build up in wetland soils.

Overall nutrient levels in Black Brook continue to be higher than desired. However, these elevated levels are likely due in part to the natural breakdown of organic materials in the wetland soils. With the transfer of the Chatham Township Main Water Pollution Control Utility outfall from the Black Brook site it will be interesting to see how the chemical levels change as time moves on.

Passaic River *(continued from page 18)*
...population. Low water temperature and high levels of dissolved oxygen are necessary for a healthy trout community.

In 2015, water quality in the Passaic showed overall improvement in almost all areas. Macroinvertebrate index was better than in 2014 and chemical parameter averages were all above the expected standards. The one exception was the winter road salt average which was considered poor, and was slightly higher than in 2014. Nitrogen, which was elevated in 2014, was significantly lower in 2015 (reduced by half overall).

Branta Pond at the Somerset County Environmental Education Center, which flows into the Passaic River, is monitored for bacteria and temperature. The bacteria levels were slightly elevated compared to 2014 but still considered good overall. The elevation was likely due to elevated air temperatures and rain events which increased runoff during sampling.

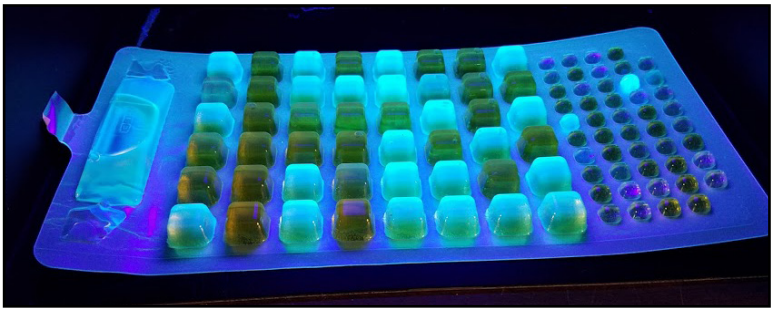
Great Swamp Outlet *(continued from page 20)*
...standard during dry weather, higher levels were noted following rain events. As the wetland soils increase the breakdown of organics, this can increase bacteria levels which can be flushed out by the stormwater flow.

Warmer air temperatures throughout the spring and summer influenced the water due to the slow flow and openness of the swamp area just upstream of the outlet causing the water temperature at the outlet to be slightly higher than in 2014 but still well within the standard. Road salt followed the same pattern at the outlet as throughout the watershed. Elevated levels of road salt were noted in the winter months with measurements being within the standard during the rest of 2015.

How Water Quality is Measured

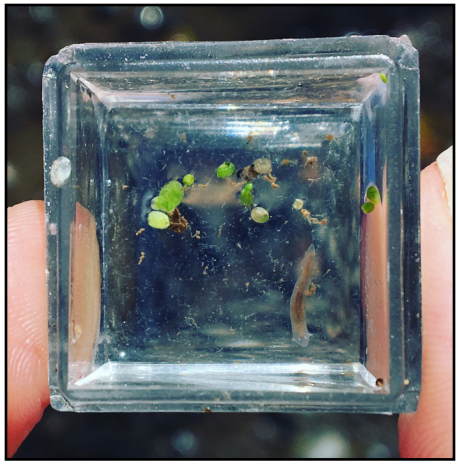
Dissolved Oxygen is just what it says: the amount of oxygen dissolved in the water. Just like humans, aquatic life needs oxygen to survive. Poorly oxygenated water can harm and even kill animals that live in the water. Dissolved oxygen is introduced into streams from contact with the air, aquatic plants, and in places of stream turbulence such as waterfalls and shallow, rocky areas (also known as riffles). Low dissolved oxygen can be caused by algal blooms, high water temperatures, and slow flowing water (for example, due to impoundments). To help keep dissolved oxygen levels high in streams, you can plant trees near stream banks to shade the stream and keep water temperatures cool.

E. coli is a type of bacteria normally found in the intestines of mammals (including humans) and birds. Most strains of *E. coli* are harmless but can indicate the presence of fecal matter, which may contain harmful viruses. No natural body of water will be entirely free of *E. coli* because of the animal life surrounding it, but high levels can indicate fecal contamination which could be due to a failing septic system, broken sewer pipe, wildlife, or stormwater runoff carrying fecal matter deposited by wildlife and pets on land into the water. *E. coli* data was used to score the bacteria level of each subwatershed. One easy way to reduce *E. coli* levels in local streams is always to pick up after your dog, even in your yard. Remember stormwater runoff flowing from your yard eventually winds up in a water body. If you have a septic system, be sure to perform regular maintenance on it to ensure that it is working properly.



Samples positive for E. coli glow under a black light

Macroinvertebrates are small animals without backbones that live in the water, such as crayfish, insect larvae, and worms. These creatures can be used as a marker of water quality since some types of macroinvertebrates need high quality water and others can tolerate different levels of water pollution. The macroinvertebrates have life spans of anywhere from a few weeks to a few years, so the presence (or absence) of different types of macroinvertebrates tells the recent history of the water quality in the stream. While we think of the chemical data as a snapshot of what is happening in the stream at the moment of collection, macroinvertebrate data helps us see long term effects of water quality. Some of the factors that influence the variety and quantity of macroinvertebrates in streams include water temperature, dissolved oxygen, nitrogen, phosphorus, road salt, and aquatic habitats. Macroinvertebrates are a food source for fish, birds, and other wildlife.



A Planaria slides through a water sample

Nitrogen is an essential nutrient for plants and animals, so there is naturally some nitrogen in streams. Because it is necessary for plant growth, nitrogen is also found in fertilizer. Too much nitrogen in streams, lakes, and ponds can work like fertilizer for aquatic plants, dramatically increasing plant growth and algal blooms. Algal blooms can compete with other aquatic plants for resources, such as nutrients and sunlight. When algae die off, it can lead to decreases in dissolved oxygen, which can suffocate aquatic animals. Nitrogen can come from many sources and often gets into local water bodies via stormwater runoff. In addition to fertilizer, animal waste (including from humans), and organic material such as leaves also contain nitrogen. You can reduce your impact on nitrogen in streams by picking up after your dog, reducing fertilizer use on your property, and ensuring that your septic system is functioning properly.

pH is a measure of how acidic or alkaline (basic) water is. The pH scale ranges from 0 to 14. Water with a low pH is considered acidic, while a high pH is considered alkaline or basic. Although 7 is considered neutral, streams in our area have an expected pH between 6.5 and 8.5. If the water in a stream is too acidic or basic, fish, plants, and other life forms cannot survive. People at home can reduce the human effect on the pH of streams by conserving energy. Power plants release chemicals into the air which can cause acid rain (which then falls into our streams), so reducing the amount of energy you use in your home reduces the pollution output of the power plants.

Phosphorus, like nitrogen, is an essential nutrient for plants and animals, so it is naturally occurring in streams. Too much phosphorus, like too much nitrogen, can lead to algal blooms. Algal blooms compete with aquatic plants for resources and can kill off those plants and decrease dissolved oxygen in the stream, leaving the water uninhabitable for aquatic life. Phosphorus can come from animal waste, specialized fertilizers, organic matter, and household products such as dish detergent and laundry detergent. To reduce the impact of phosphorus in streams, use household cleaning products that are labeled phosphate free. If you use a service for lawn maintenance ask them to reduce the amount of fertilizer used on your lawn and to use fertilizers without phosphorus. Though the fertilizers sold to homeowners no longer contain phosphorus, professional landscaping companies are still able to purchase and apply them.

Excess nutrients, like phosphorus and nitrogen, can lead to algae blooms, resulting in a decrease in dissolved oxygen

Road Salt is the primary pollutant in Great Swamp Watershed streams. Winter use of road salt easily contaminates streams (through runoff from impervious roads, driveways, parking lots, and sidewalks). It can be deadly to aquatic life and plants on stream banks. Fish, insects, and macroinvertebrates often cannot tolerate high levels of road salt and may die when the levels are too high. Non-aquatic animals can also be negatively affected by road salt. As a homeowner, you can help to decrease road salt in the environment by using less or no road salt on driveways and walkways in the wintertime. If you must use salt, apply according to package directions and choose a product that is more environmentally benign. Sodium chloride has the highest environmental impact and should be avoided, while calcium magnesium acetate has the lowest environmental impact. Additionally, support municipal efforts to utilize lower salt alternatives such as brining.

Visual Stream Assessments are a way of assessing the condition of a stream segment that cannot be easily measured quantitatively. These assessments cover a range of topics, such as tree canopy cover over the stream, the presence of suitable habitats for aquatic life, and nearby land uses which might impact water quality. To learn more about visual assessments and see exactly what data is collected on the data sheet, visit GreatSwamp.org.

A group of students from Passaic Valley Community College show off their tools after conducting visual, chemical, and macroinvertebrate testing on the Passaic River.

Water Clarity should be high to allow the plants living in the stream to thrive. Underwater plants serve many purposes in a stream ecosystem, from providing food for animals to oxygenating the water. However, plants need sunlight in order to thrive, and muddy, opaque water does not let light in. Additionally, poor water clarity frequently is a sign of excess sediment which can impact aquatic life by burying stream bottom habitat and making it harder for aquatic life to survive. To help improve water clarity, you can allow natural vegetation to grow along stream banks by planting trees and shrubs or simply reducing or eliminating mowing there. Taller vegetation acts as a filter, catching sediment before it enters the stream. If you have large areas of exposed soil due to construction, use silt fencing to keep it in place.

Fish have trouble navigating when water clarity is poor.

Water Temperature is critical because the fish, amphibians, and invertebrates that live in streams are cold-blooded, and the temperature of the stream can dictate whether they can survive and thrive. Different species of fish live best in different temperatures of water, and water that is consistently too hot or too cold for the native fauna will not support an ecosystem well. For example, trout are very sensitive to water temperature and cannot live in streams that are too warm. High water temperatures can also decrease dissolved oxygen levels, further negatively impacting aquatic life. To decrease water temperatures, trees and shrubs should be planted along streams to provide shade.

Recommendations & Conclusion

Water monitoring data from 2015 showed several pervasive issues impacting watershed streams. Fortunately there are also many potential solutions:

High Water Temperatures

- Taller plants next to a stream, pond, or lake, can provide shade and help to keep water temperatures cool.

Sediment

- Multi-stemmed plants, such as shrubs and ground cover, next to a stream can act as a filter, catching sediment in stormwater runoff before it reaches a stream.
- Plants with complex root systems, such as those of many native plants, help hold soil in place, reducing soil erosion.
- Individuals and municipalities should ensure that any exposed soil on their property is surrounded by a silt fence to keep soil in place.

Stormwater Runoff

- Reducing impervious surfaces will reduce the volume of stormwater runoff. Pervious pavement options abound, or unused impervious cover can be removed and replaced it with pervious cover.
- The volume of stormwater runoff can be reduced through the use of rain barrels or cisterns to capture and store (or slowly release) roof runoff.
- Runoff from impervious surfaces can be directed into rain gardens or drainage swales where it will be absorbed.

Poor Stream Buffers

- Multi-stemmed plants, such as shrubs and ground cover, growing along a stream can slow down the flow of stormwater runoff, allowing it to soak into the ground decreasing erosion and absorbing excess nutrients.
- Larger native plants with deep and complex root systems can absorb stormwater runoff soaking into the ground. The wider a buffer is, the more time it has to slow down and soak up stormwater runoff and nutrients.

A Great Blue Heron is visible through a vegetated buffer on Foote's Pond

High Bacteria

- Pet owners should pick up after their pets, even in their yard. Homes with septic systems should monitor and clean systems regularly to prevent seepage.

Road Salt

- Only use salt when necessary and follow package directions. Consider using alternative compounds like Calcium Magnesium Acetate which is more environmentally friendly and is pet friendly. Support municipal efforts to employ lower salt alternatives such as brining.

Conclusion

The five streams in the Great Swamp Watershed range in water quality from pristine, like Primrose Brook, to impaired, like Loantaka Brook. The biggest issues we saw in 2015 were road salt, elevated localized bacteria levels, and continued nutrient loading from runoff. By implementing these recommendations, everyone can help to protect and improve our waters.

Great Swamp Watershed Association

The Passaic River

WATERKEEPER® ALLIANCE AFFILIATE

The Great Swamp Watershed Association is dedicated to protecting and improving the water resources of the Passaic River region, from the Great Swamp headwaters to Newark Bay, for present and future generations. Through education, advocacy, science, land preservation and stewardship, in collaboration with partners, we work to instill our communities with an awareness of water's effect on health and the beauty of the environment, from source to sea.

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