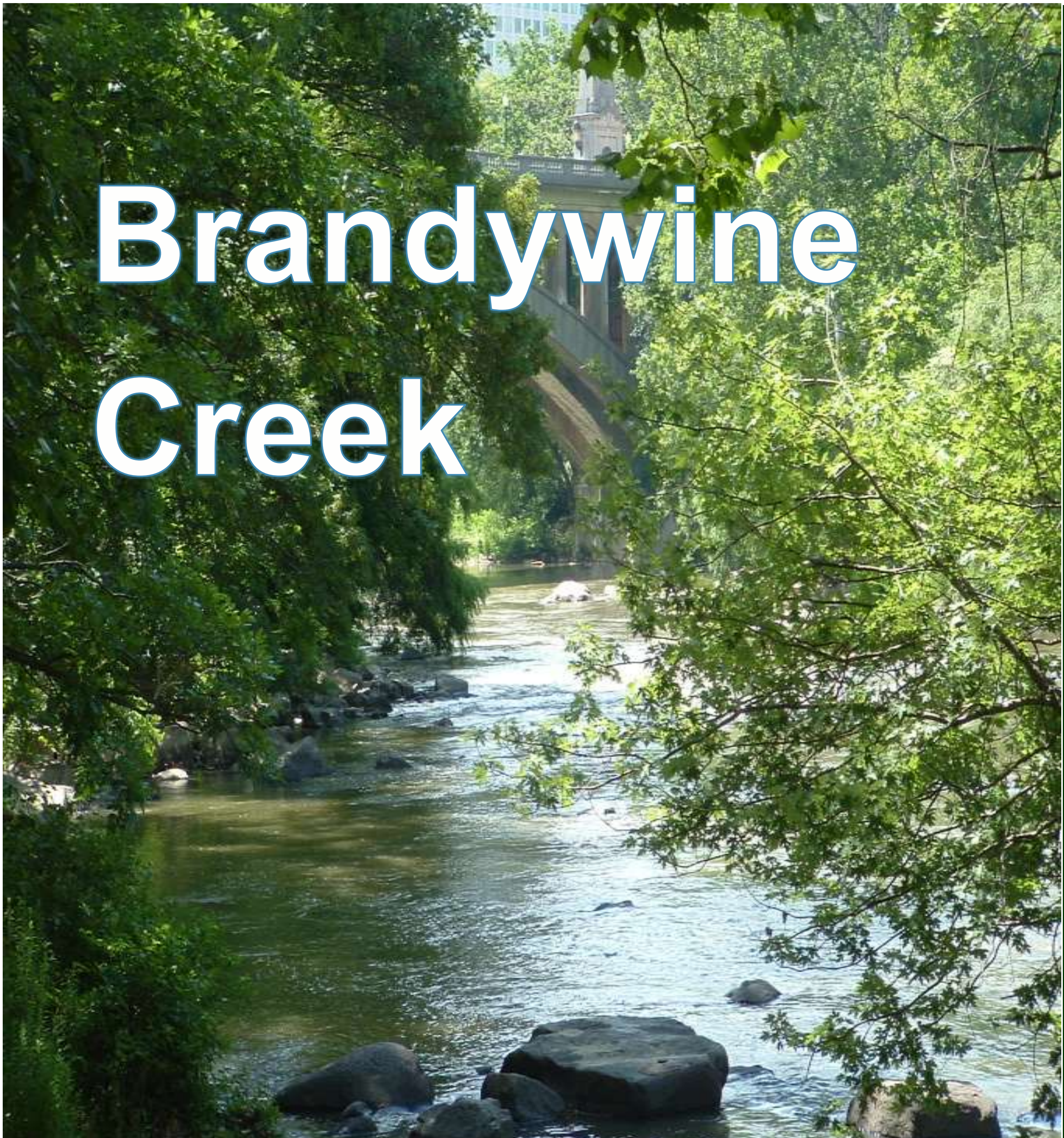
Brandywine Creek



Delaware Stream Watch

Volunteer Data Summary

2006 - 2015

Delaware Nature Society

Delaware Stream Watch

Data Summary 2006 - 2015

Delaware Stream Watch was established in 1992 to engage volunteers in providing baseline chemical and physical data on waterways primarily in the Christina Basin in Northern Delaware.

Volunteers in Delaware Stream Watch Technical Monitoring program monitor designated long-term monitoring sites on a monthly basis, testing for dissolved oxygen, pH, alkalinity, nitrate nitrogen, phosphates, conductivity, and temperature. Annual quality control helps to ensure consistency and control in sampling techniques. Data is collect through a combination of field test kits and meters.

Special thanks to the dedicated volunteers who take time out of their busy schedules to make a difference for our waterways!

Delaware Stream Watch

Delaware Stream Watch is a citizen science program, run by the Delaware Nature Society, that engages volunteers in monitoring the quality of local waters.

Data is shared on the Delaware Nature Society website and is used to inform watershed planning and outreach efforts.

Learn more & become involved:

Delnature.org/streamwatch

The Brandywine Creek Watershed

The Watershed

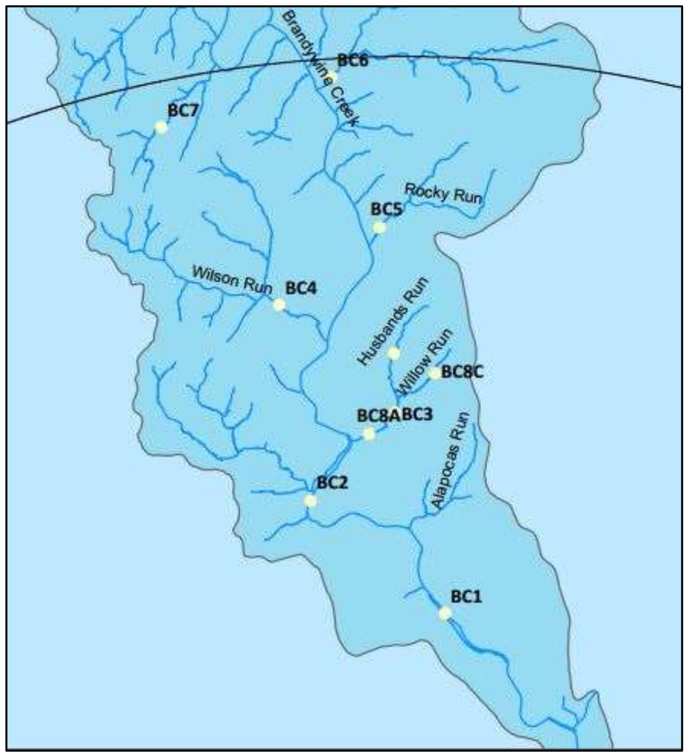
The Brandywine Creek watershed is part of the larger Christina Basin, which flows into the Delaware River. While most of the 325 square mile Brandywine Creek watershed lies in Pennsylvania, the mouth of the creek is located in Delaware. The Brandywine Creek is the drinking water supply for the City of Wilmington and provides recreational value to tens of thousands of people who use the creek to fish, canoe, and hike along.

Major land uses in the Brandywine include agriculture (45%) followed by forest/wetland (35%), and urban (19%).

The Monitoring Sites

Technical Monitoring volunteers monitored 10 locations along the Brandywine Creek and its tributaries in Delaware collecting chemistry data on a monthly basis.

Site	Location
BC1	Brandywine Zoo (mainstem)
BC2	Hagley Museum (mainstem)
BC3	Husbands Run
BC4	Wilson Run
BC5	Rocky Run
BC6	Beaver Run
BC7	Meadow Brook @ Flint Woods
BC8A	Husbands Run @ DuPont Country Club
BC8B	Husbands Run @ Country Club Drive
BC8C	Willow Run



Summary Result

A ***Summary result*** of **Good**, **Average** or **Poor** is included next to each parameter. This rating is provided as a quick summary of the overall findings for that specific parameter across sites.

Chemical Data Collected 2006 - 2015 in the Brandywine Creek Watershed

Dissolved Oxygen (DO) ***Summary result: Good***

Dissolved oxygen (DO) is an important water quality indicator for aquatic life. DO levels below 3-5mg/L can harm or kill fish and other aquatic organisms. Temperature influences DO levels - the warmer the water is, the less dissolved oxygen it can hold. Cold water can hold more dissolved oxygen. Wind or wave action or turbulence from churning over rocks can add oxygen to water. Aquatic plants both add (photosynthesis) and consume (respiration) oxygen. DO levels can vary by time of day and by time of year.

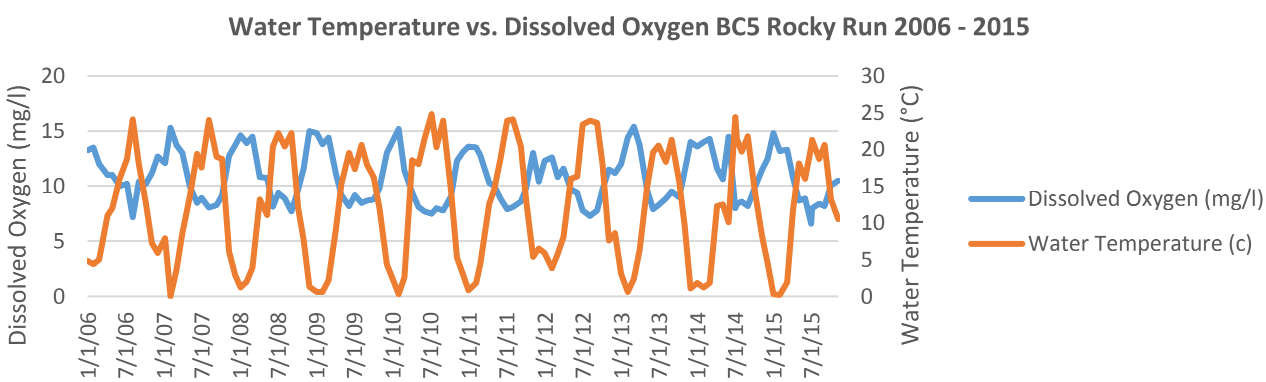
Oxygen levels may be reduced by elevated water temperatures (e.g. removal of trees that shade the water or by industrial/municipal discharges) or by the excessive growth and subsequent oxygen depleting decomposition of algae. A DO reading measures how much oxygen is dissolved in the water but not how much oxygen the water is capable of holding at that time and temperature. When water holds all the DO it can hold at a given temperature, it is said to be 100% saturated with oxygen. Percent saturation therefor refers to the amount of DO in the water compared to the amount that could be present at the same temperature. Levels between 80 – 120% are ideal.

Data was collected using Fisher brand Traceable Dissolved Oxygen Meters.

Site	Year(s)	Summer DO Average (mg/l)
BC1	2006	4.6
	2007	4.5
BC8B	2011	4.5
	2010	4.7
BC8C	2011	4.2

The DO standards set by the State of Delaware are a minimum of 4.0 mg/L for most waters. In general, DO levels were good throughout the watershed although several sites (left) exhibited rather low averages during warm summer months. The average percent saturation of oxygen was also low (below 80%) at those sites. As data was collected during the daytime, the lowest dissolved oxygen levels (typically found near dawn) may not be truly reflect.

The inverse relationship between dissolved oxygen and temperature is clearly indicated below by data collected from Rocky Run.



pH *Summary result: Good*

pH is a measure of how acidic or basic the water is based on the hydrogen ion concentration of the water. The pH scale ranges from 0 to 14. A pH of 7 is neutral. A pH less than 7 is acidic while a pH greater than 7 is basic. Because values of pH are based on a logarithmic scale, each 1.0 change in pH represents a factor of ten change in acidity. This means that a pH of 3.0 is 10 times more acidic than a pH of 4.0.

LaMotte pH field kits were used for data collection.

pH readings in the Brandywine Creek consistently fell within the standard range of 6.5 to 8.5. A few isolated 9.0 data readings were recorded but these were not considered problematic. pH levels appear to be holding consistent over time.

Alkalinity *Summary result: Good*

Alkalinity measures the acid neutralizing, or buffering, capacity of a solution. Most natural waters, based on their underlying geology, contain certain ions that can neutralize acidic ions. Streams that flow through limestone deposits have the highest alkalinity values and therefore the highest buffering capacity. The alkalinity of streams can vary due to the amount of rainfall, the season, as well as the geology of the watershed.

Data was collected using LaMotte Alkalinity field kits.

Generally alkalinity values were all above the State standard of 20 ppm. Sites such as BC7 (Flint Woods) averaged lower values due to the small size of the stream and underlying soils/geology.

Nitrate-Nitrogen *Summary result: Good*

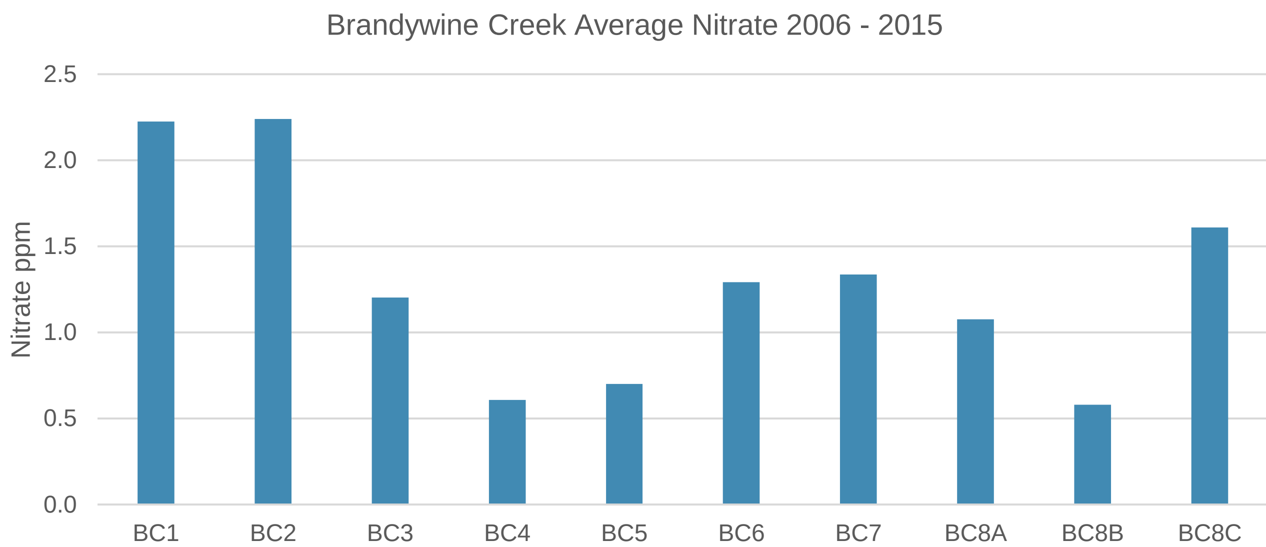
Nitrogen makes up about 80% of the air we breathe. It is an essential component of proteins and is found in the cells of all living things. Inorganic nitrogen may exist as a gas, or as nitrites, nitrates, or ammonia. Nitrates represent the most completely oxidized states of nitrogen commonly found in water. Nitrates in water come from soil, fertilizer runoff, malfunctioning septic systems, sewage treatment plants, manure from livestock animal wastes and from car exhausts. In abundance, these nitrates become detrimental to aquatic systems through a process called eutrophication. Eutrophication refers to the natural aging process of a water body that may be greatly accelerated by human activities, causing algal blooms and a corresponding decrease in dissolved oxygen. Data was collected using LaMotte Nitrate Nitrogen Field Kits.

BC7: Flint Woods

The target level for total nitrogen (all forms of nitrogen combined) in Delaware freshwater is below 3.0 mg/L. Delaware Nature Society volunteers measure nitrate-nitrogen, which is only one component of total nitrogen.

Nitrate-nitrogen level did not exceed 3.0 mg/l at any of the monitored Brandywine sites. Only sites BC3 (Husband's Run), BC4 (Wilson Run), and BC5 (Rocky Run) had averaged nitrate values below 1.0

mg/l. As volunteers only measure nitrate, not total nitrogen, the data indicate that total nitrogen could be higher and potentially exceed the upper target range of 3.0 mg/l. Overall the trend in nitrate levels stayed fairly consistent with 6 sites showing no change in trend, 1 site showing a very minor increase and 3 sites with a very minor decrease.



Phosphate ***Summary result: Average***

Phosphorus is an essential nutrient naturally found in small amounts in water. Small increases can have large effects on aquatic systems. Excess phosphates can cause extensive algal blooms and a corresponding decrease in dissolved oxygen. Excess phosphates in water can result from fertilizer, sewage, manure from livestock, industrial discharges and from air pollution.

Hach Orthophosphate Field Kits were used to collect the data.

Delaware considers total phosphorus (which includes organic phosphorus) levels higher than 0.2 mg/l as a potential problem. Stream Watch measures orthophosphate, the inorganic dissolved form of phosphate that is readily available to aquatic plants. As our results only measure a component of total phosphorus, values approaching 0.2 mg/l could be considered high. Sites with median orthophosphate value above 0.15 included: BC1 (Brandywine Zoo), BC2 (Hagley Museum), BC3 (Husbands Run), BC8A, BC8C. Small streams such as BC7 (Flint Woods) had low (0.02 mg/l) values.

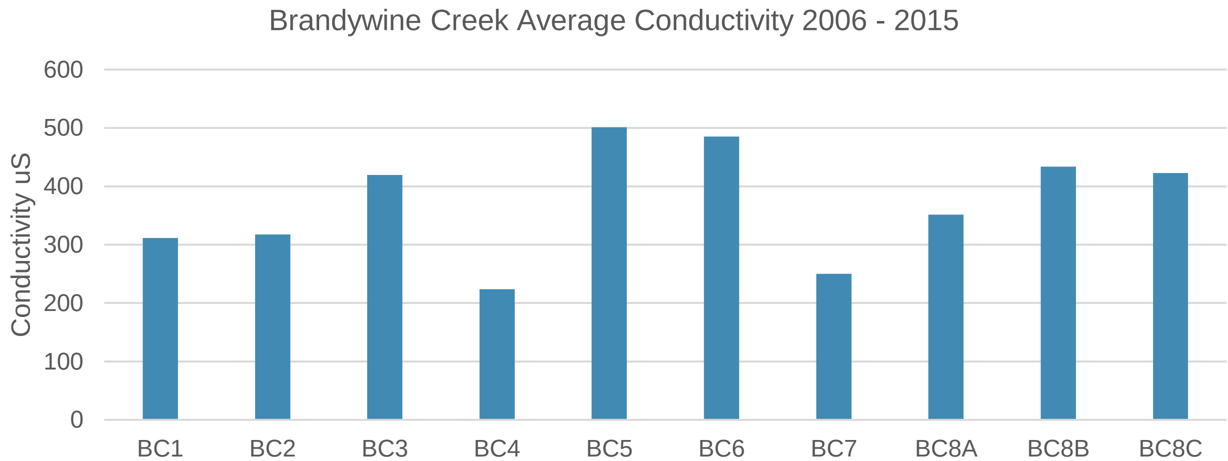
As 50% of sites had an average value > 1.5 mg/l, overall phosphates at the sites could be summarized as average.

BC5: Rocky Run

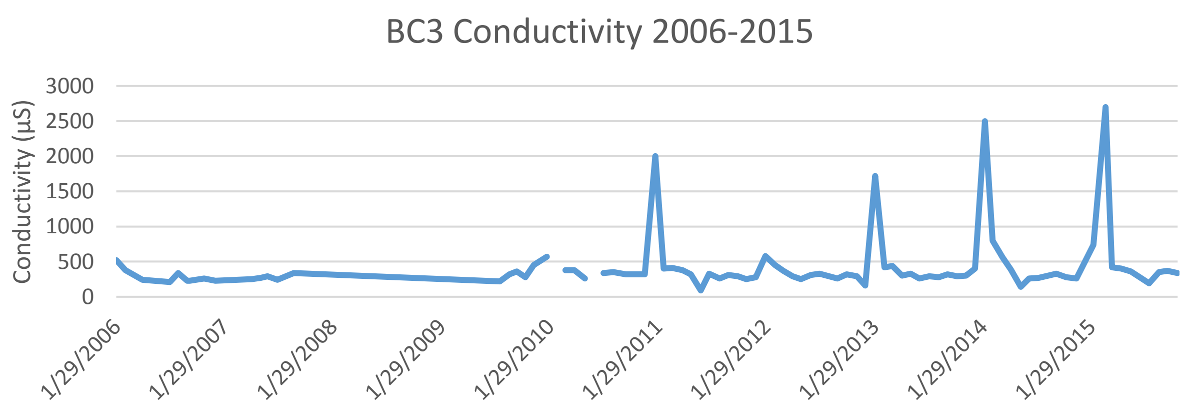
Conductivity ***Summary result: Average***

Conductivity is a measure of water's capability to pass electrical flow. This ability is directly related to the concentration of ions in the water. These conductive ions come from dissolved salts and inorganic materials such as chlorides, sulfides and carbonate compounds. Geology can naturally influence the base conductivity level of streams. The application of road salt during winter months and runoff from urbanized areas can result in high conductivity levels. National and regional data sets point to winter road salt application as a potential concern as salts may accumulate in soils and shallow groundwater and slowly enter streams throughout the year.

The average conductivity values in the Brandywine Creek watershed fell within the typical range of piedmont streams. BC7 (Flint Woods) exhibited the lowest average conductivity which might be explained by it being the smallest stream sampled. The highest average and median conductivity was found at BC6 (Beaver Run) and BC5 (Rocky Run). Both sites showed high spikes during winter sampling dates, most likely due to road salt applications. The headwaters of BC5 (Rocky Run) receives drainage from the urbanized Concord Mall area of Rte. 202.



Other sites, such as BC3: Husbands Run, also showed periodic high conductivity although all high values where during winter sampling dates. The high spikes at multiple sites account for the **Average** summary result.



Water Quality Trends in the Brandywine Creek Watershed in Delaware

In general, most sites stayed fairly consistent across the monitored parameters over the 9 year period. No significant (r-squared > 0.5) increase/decrease in trend were determined for any parameter.

The fact that site values stayed fairly consistent over the time frame can be viewed in a positive light as the population in the watershed has increased. That said, volunteers were not able to measure all forms of nitrogen and phosphorous so the true amount of these nutrients passing through the sites may be underestimated.

Several sites showed a slight increasing trends in conductivity, a trend being observed nationally due to increasing road salt application. Enhanced monitoring of conductivity at select sites would be useful in the future.

While not reported here, habitat and macroinvertebrates were surveyed at a subset of sites between 2010 –2015. Combined with the chemistry, these data point to the negative impact of stormwater runoff (e.g., eroded streambanks, low diversity of pollution sensitive taxa) associated with non-point source pollution.

2006 – 2015 Average site chemistry

	Alkalinity (mg/l)	ph	Conductivity µS	Nitrate N (mg/l)	Phosphate (mg/l)	Water Temp (°C)	DO (mg/l)	% DO Saturation
BC1	60	7.7	311	2.2	0.22	16	7.3	73.5
BC2	60	7.7	317	2.2	0.22	16	7.0	70.4
BC3	47	7.0	420	1.2	0.22	14	8.6	83.3
BC4	39	7.1	224	0.6	0.09	17	8.7	87.5
BC5	49	7.2	501	0.7	0.02	12	10.8	96.8
BC6	66	7.3	485	1.3	0.01	12	10.7	96.3
BC7	29	7.0	250	1.3	0.04	12	9.5	86.5
BC8A	40	7.0	352	1.1	0.18	13	8.1	76.2
BC8B	52	7.0	434	0.6	0.11	12	7.8	70.4
BC8C	48	7.2	423	1.6	0.35	13	8.0	75.8

Brandywine Creek Summary Date 2006 - Dec. 2015

SITE 1: BC1 - Brandywine Zoo

	Alkalinity (mg/l)	ph	Conductivity µS	Nitrate N (mg/l)	Phosphate (mg/l)	Water Temp (°C)	DO (mg/l)	% DO Saturation
Minimum	40	6.5	63	0.5	0.03	2.9	4.1	42.4
Maximum	76	9.0	435	7.0	0.70	33.0	12.0	104.1
Average	60	7.7	311	2.2	0.22	16.0	7.3	73.5
Medium	60	7.5	320	2.0	0.19	16.8	7.3	70.8
# of samples	101	101	99	100	101	100	95	95

SITE 2: BC2 - Hagley Museum

	Alkalinity (mg/l)	ph	Conductivity µS	Nitrate N (mg/l)	Phosphate (mg/l)	Water Temp (°C)	DO (mg/l)	% DO Saturation
Minimum	40	7.0	194	0.5	0.03	2.7	2.6	32.6
Maximum	80	9.0	428	4.0	0.62	35.1	13.8	109.9
Average	60	7.7	317	2.2	0.22	16.2	7.0	70.4
Medium	60	7.5	310	2.0	0.18	16.8	6.9	69.6
# of samples	98	99	97	98	99	95	90	89

SITE 3: BC3 - Husbands Run

	Alkalinity (mg/l)	ph	Conductivity µS	Nitrate N (mg/l)	Phosphate (mg/l)	Water Temp (°C)	DO (mg/l)	% DO Saturation
Minimum	20	7.0	90	0.3	0.00	0.5	6.0	51.9
Maximum	65	8.0	2700	4.0	0.67	26.0	13.5	123.5
Average	47	7.0	420	1.2	0.22	14.3	8.6	83.3
Medium	50	7.0	320	1.0	0.2	15.25	8.1	84.5
# of samples	91	91	89	88	89	90	86	85

SITE 4: BC4 - Wilson Run

	Alkalinity (mg/l)	ph	Conductivity µS	Nitrate N (mg/l)	Phosphate (mg/l)	Water Temp (°C)	DO (mg/l)	% DO Saturation
Minimum	26	6.5	160	0.3	0.00	4.5	4.8	49.2
Maximum	58	7.5	410	3.0	0.45	27.7	14.0	136.0
Average	39	7.1	224	0.6	0.09	17.3	8.7	87.5
Medium	38	7.0	210	0.5	0.06	19.0	8.0	86.5
# of samples	31	31	31	30	31	30	30	30

SITE 5: BC5 - Rocky Run

	Alkalinity (mg/l)	ph	Conductivity µS	Nitrate N (mg/l)	Phosphate (mg/l)	Water Temp (°C)	DO (mg/l)	% DO Saturation
Minimum	32	7.0	135	0.1	0.00	0.0	6.6	73.0
Maximum	71	8.0	4120	1.5	0.15	24.8	15.4	128.7
Average	49	7.2	501	0.7	0.02	12.1	10.8	96.8
Medium	48	7.3	325	0.8	0.00	12.6	10.35	96.2
# of samples	120	120	120	118	120	120	120	120

SITE 6: BC6 - Beaver Run								
	Alkalinity (mg/l)	ph	Conductivity µS	Nitrate N (mg/l)	Phosphate (mg/l)	Water Temp (°C)	DO (mg/l)	% DO Saturation
Minimum	42	7.0	270	0.3	0.00	0.0	5.5	63.7
Maximum	92	8.0	1890	3.0	0.10	25.3	15.1	115.9
Average	66	7.3	485	1.3	0.01	12.2	10.7	96.3
Medium	65	7.25	390	1.0	0.00	12.8	10.0	96.4
# of samples	121	121	121	120	120	121	121	121

SITE 7: BC7 – Meadow Brook @ Flint Woods								
	Alkalinity (mg/l)	ph	Conductivity µS	Nitrate N (mg/l)	Phosphate (mg/l)	Water Temp (°C)	DO (mg/l)	% DO Saturation
Minimum	18	6.5	84.6	0.3	0.00	0	5.9	63.6
Maximum	48	7.5	380	4.0	0.60	29	19.0	168.3
Average	29	7.0	250	1.3	0.04	12	9.5	86.5
Medium	26	7.0	250	1.0	0.02	11.5	9.6	83.8
# of samples	92	93	91	90	93	94	86	86

SITE 8: BC8A								
	Alkalinity (mg/l)	ph	Conductivity µS	Nitrate N (mg/l)	Phosphate (mg/l)	Water Temp (°C)	DO (mg/l)	% DO Saturation
Minimum	24	6.8	120	0.3	0.00	0.0	4.4	41.7
Maximum	60	7.5	1170	3.0	0.54	28.8	14.0	145.5
Average	40	7.0	352	1.1	0.18	12.5	8.1	76.2
Medium	40.5	7.0	260	0.8	0.2	12.0	8.0	74.5
# of samples	73	73	71	70	72	73	68	68

SITE 8: BC8B								
	Alkalinity (mg/l)	ph	Conductivity µS	Nitrate N (mg/l)	Phosphate (mg/l)	Water Temp (°C)	DO (mg/l)	% DO Saturation
Minimum	20	6.5	100	0.3	0.00	0.0	2.8	31.1
Maximum	74	7.8	2000	1.5	0.40	25.8	14.6	111.5
Average	52	7.0	434	0.6	0.11	11.7	7.8	70.4
Medium	52	7.0	270	0.5	0.10	11.0	8.1	72.8
# of samples	73	72	69	68	72	73	69	69

SITE 8: BC8C								
	Alkalinity (mg/l)	ph	Conductivity µS	Nitrate N (mg/l)	Phosphate (mg/l)	Water Temp (°C)	DO (mg/l)	% DO Saturation
Minimum	24	6.8	100	0.3	0.00	0.0	2.5	20.1
Maximum	62	7.8	1710	4.0	1.00	26.8	14.3	115.5
Average	48	7.2	423	1.6	0.35	13.2	8.0	75.8
Medium	48	7.0	340	1.5	0.38	12.3	8.2	78.9
# of samples	73	74	72	71	72	74	72	72

Making a Difference

Healthy waterways are important community assets providing opportunities for recreation, a source of drinking water, and habitat for wildlife. Stream monitoring provides data on the quality of these waters but each of us can also play a part in improving the health of our waterways.

Many opportunities exist to directly improve the health of our local streams – join us in making a difference!

- **Go green to help protect blue (water that is):** Make protecting water part of your everyday life – little changes in our behavior can go a long way to improving our environment. Many opportunities exist to help the environment so go wild naturally**.** delnature.org/greenlivingguide
    - Choose household cleaners that are the least toxic
    - Pick-up pet poo
    - Volunteer at a stream clean-up

- **Branch out:** Native trees, shrubs, and plants help to improve water quality by filtering pollutants and helping to absorb excess water. An added bonus, native plants are adapted to our climate and need little extra care including extra water or fertilizers.
    - Volunteer at a local tree planting or other habitat restoration project. Establishing a restoration project such a rain garden is wonderful for our waterways but these projects need to be maintained over time. Contact Delaware Nature Society or other local conservation organization to help maintain a habitat or restoration project.
    - Improve water while supporting wildlife by creating a ***Certified Wildlife Habitat*** at your home, school, business or place of worship – learn more: delnature.org/CWH
    - Install a raingarden or rain barrel

- **Voice it!** Let your elected officials know that you care about clean water. Sign-up for the Delaware Nature Society's **Voice It!** alerts for information on upcoming policy changes that might impact water, the protection of our natural lands and other environmental issues.
    - Follow and participate in the **Clean Water: Delaware's Clear Choice Campaign** cleanwaterdelaware.org/

Water Connect Us All