Allegheny County Parks Streams Assessment

Phase 1 Report

Hartwood Acres, Harrison Hills, and White Oak Parks

December 2022

Penn State Extension

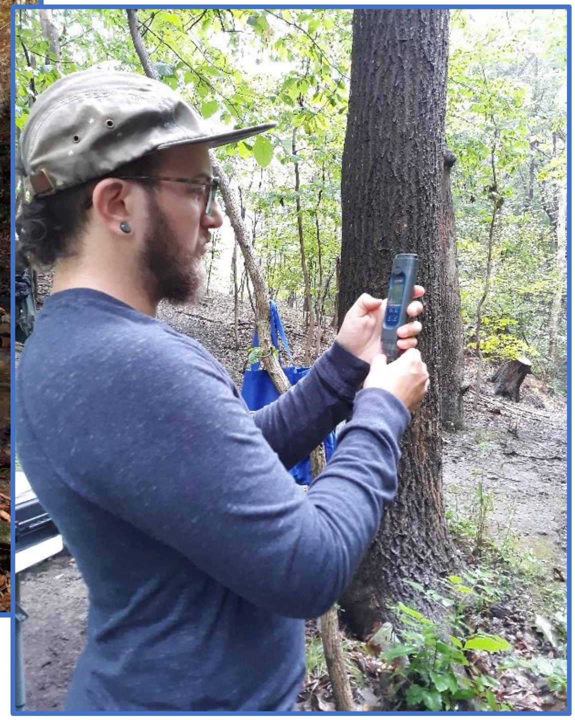
Allegheny Watershed Steward Program of Allegheny County

TEAM	2021 - 2022 Phase 1	2022-2023 Phase 2	2023-2024 Phase 3
North	Hartwood Acres Park	Deer Lakes Park	North Park
East	Harrison Hills Park	Round Hill Park	Boyce Park
South/ West	White Oak Park	Settlers Cabin Park	South Park

Allegheny County Parks Foundation

PennState Extension

Master Watershed Steward Program



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FORWARD

In March of 2019, at a meeting between Penn State Extension employees and Allegheny County Parks Department staff, the new coordinator of the Master Watershed Steward (MWS) program in Allegheny County asked the Parks Director if an assessment of the streams of the county parks would be of interest. The strong reply of “Absolutely!” set into motion a series of steps that have led to new partnerships and profound advances in experience and engagement for the Allegheny Master Watershed Steward program.

The development of this project was fortuitous as the “lock-down” due to the COVID-19 epidemic just a year later would prevent volunteers from meeting in-person inside for over a year. Stream assessments, however, are considered an ‘essential service’ of the Extension program, so even during the COVID-19 epidemic, more than 15 Allegheny Master Watershed Stewards were able to get training in stream assessment work, expand their expertise and strengthen their network during the following year.

This assessment project has created partnerships with the Allegheny County Department of Parks, Allegheny County Parks Foundation, and Allegheny County GIS Department that have been truly exemplary and are deeply appreciated. As a one-staff program within a large bureaucracy, the Master Watershed Steward program in Allegheny County has limited capacity to fulfill the various administrative and technical aspects of the project. The collaborative spirit with which each organization shared their knowledge and/or resources to the project has allowed the work to proceed despite the epidemic and “COVID Sludge” which has slowed but not defeated it.

Other partners have provided vital assistance as well: Laura Branby and Wendy Kedzierski of Allegheny College’s Creek Connections, Brady Porter of Duquesne University, and Audubon Society of Western Pennsylvania. Invaluable work by the GIS department of Allegheny County has enabled mapping of data collected during this study.

Funding from the Foundation for PA Watersheds through a grant to the Allegheny County Parks Foundation was critical to the implementation of this study. The funds allowed the purchase of three sets of assessment equipment, enabling three teams to simultaneously assess waterways in three parks and capture the data in a GIS-based database.

The Master Watershed Stewards who have implemented the protocols described in this report have been stellar in their commitment to the project. They contributed over 880 hours of work to Phase 1and assessed roughly 10.5 miles of streams in all seasons and all weather. There are always opportunities to learn more, and these stewards have proven they are receptive to ongoing learning and improvement in techniques and knowledge. They exemplify the dedication and passion of Master Watershed Stewards and deserve enormous credit for this effort.

INTRODUCTION

- History of Allegheny Master Watershed Steward program

The Penn State Master Watershed Steward program was established in 2013 to "strengthen local capacity for management and protection of watersheds, streams, and rivers, by educating and empowering volunteers across the Commonwealth." Programs were initially formed in southeast PA where focus on the Susquehanna and Delaware watersheds prompted rapid adoption of the program. A program was launched in 2016 in Allegheny County but needed focused leadership, so a coordinator was hired in 2019. Since that time, four training courses have increased the roster to 53 stewards. The Master Watershed Steward program is now active in 42 counties across PA.

- Partnership with Allegheny County Parks Foundation

To complete the assessment of streams in county parks, an array of equipment would be needed. The coordinator was directed to the Allegheny County Parks Foundation as a potential collaborator for seeking grant funds to meet that need. The foundation's Executive Director was receptive to that strategy, and thus Caren Glotfelty and Mary W. Wilson jointly drafted a proposal submitted by the foundation to the Foundation for PA Watersheds for the needed equipment. The proposal was accepted in the winter of 2020 with a slight reduction in the amount of funding provided.

In addition to collaborating on the grant development, the County Parks Foundation was committed to being a full partner and offered to purchase the equipment needed and then turn it over to the MWS program. Since COVID-19 hit shortly after the receipt of the grant, this process was much more challenging than it would have been otherwise, but Parks Foundation Project Manager Nicole Oeler persevered and got the materials in hand over an18-month period. The Creek Connections program supplemented the equipment until the HACH order was fully filled.

Annual renewals of supplies and some supplemental materials are needed as the project expands into larger parks. The Foundation has continued to manage equipment purchases for the ongoing work.

- Purpose of Project

The Allegheny County Department of Parks and the Parks Foundation have been working with the Western Pennsylvania Conservancy for several years to generate ecological assessments of the parks. That work has focused on the analysis of *terrestrial* ecosystems and their vulnerabilities as well as identifying opportunities for enhancement to improve and enhance the quality and the experience for visitors.

The Conservancy's studies do reference stream conditions, primarily in relation to stormwater runoff, erosion, and opportunities to mitigate any related concerns. The current study of streams within the parks complements those studies by delving more deeply into the condition of the streams through the assessment of their chemistry, macro-invertebrate biological community, and physical condition using standardized procedures over a one-year period in each park. This process provides a limited baseline for comparison in the future. While a one-year study provides valuable data, it should be noted that a 3 to 5 - year study is recommended for baselines due to yearly fluctuations in weather conditions. This baseline information can be valuable in tracking benefits of site management strategies such as AMD treatment, erosion control measures, etc.

Conducting three types of assessments concurrently provides insight into short-term fluctuations in flows and chemistry, into the long-term stability of the stream channel as it is impacted by weather and land use over decades, and the health of the biological community occupying the stream which is impacted by both long- and short-term conditions.

The purpose of this study is to provide user-friendly information for Parks and Foundation staff and administration to guide decisions in land use, land management, or restoration activities. Toward that end, the Master Watershed Steward program coordinator engaged the services of the Allegheny County GIS Department to create databases that interface with the County's parks data. Thus, data and observations are readily available for review.

In line with the end-goal of enhancing the condition of the parks and visitors' experiences and the environmental quality of the natural resources, specific concerns that were identified and recommendations for addressing them are provided.

- 9 - Park Plan

The streams assessment is being conducted over a three-year period with three parks assessed for one year each. The schedule for assessment of the parks is:

TEAM	2021-2022	2022-2023	2023-2024
North (Team 1)	Hartwood Acres	Deer Lakes	North Park
East (Team 2)	Harrison Hills	Round Hill	Boyce
South/West (Team 3)	White Oak	Settlers Cabin	South Park

A kick-off meeting is held with the managers of the parks prior to the launch of the assessment in their parks.

PROTOCOLS

Stream assessments can face multiple challenges due to weather. Severely cold conditions can freeze low-flowing streams and/or prevent equipment from operating. Similarly, while high flow events might make conditions unsafe for conducting in-stream activities, dry conditions can make flow/discharge or other measurements impossible.

Physical conditions in or around the stream can also make work hazardous or unfeasible. The presence of extremely dense brush, poison ivy and/or steep slopes or other barriers can make it difficult or impossible for stewards to safely access a stream channel. Safety is the first priority of the Master Watershed Steward program and volunteers are encouraged to use their discretion in assessing the conditions in the field with that in mind.

Chemical and biological assessment sites were chosen for several considerations:

- to capture the most impact of park activity & management
- safe to access
- perpetual flow – if possible.

Hartwood Acres Sites 1 & 2, White Oak Sites 1 & 2, were near park perimeters where streams exit the park boundary, Harrison Hills Site 1 & 2 were upstream and downstream along the main stream through the park. An alternate site was abandoned due to a historical glass dump presenting hazards.

Teams were strongly urged to capture data directly on Samsung tablets with paper record back-up. As the GIS data base and electronic data capture were new for this project, full adoption of this procedure varied among teams, but data was ultimately transferred to the online database. Furthermore, as fieldwork progressed, numerous adjustments to the database were identified and implemented by the GIS team.

- Chemical Assessment

Chemical assessments provide *snapshots* of the condition of the stream at the time of the sampling. Without ongoing monitoring by autonomous electronic probes installed in a stream, sampling captures an intermittent record that provides only a sketch of the performance of a stream as it reacts to weather, chemical impacts from road salt, etc. or land management activity.

Each of the three teams of Master Watershed Stewards is equipped with Hach "Stream Kits" for measuring temperature, pH, dissolved oxygen, phosphates, and nitrates. "Expert CTS ThermoFisher" conductivity meters and "PCE Instruments" turbidity meters were used to measure those parameters. Flow (discharge) [cubic feet per second] was approximated by measuring the time a float took to travel a section of a stream with a defined/measured cross-section.

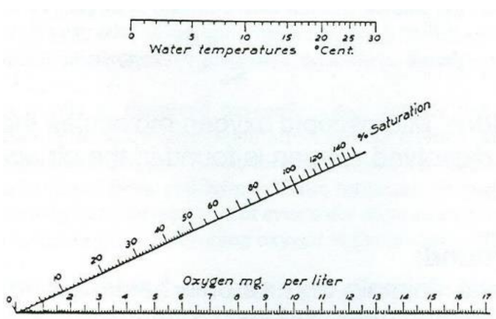
Chemical parameters were measured monthly as feasible, with duplicate testing conducted as staffing allowed. As the biological and visual assessments were launched, the time demands of chemical testing led stewards to modify their process as needed. If large disparities were seen, additional runs were conducted as necessary. If tests were not run or considered reliable because equipment was not calibrating correctly, for example, values of 9999 were entered when the database required a value to be recorded. If entered in the data, questionable values are denoted on a blue field.

Chemical Parameters for Healthy Streams

- pH: Most aquatic organisms have adapted to survive in water that has a pH range between 6 and 9 but sensitive species prefer 6.5 – 7.5. The pH of the environment influences the ability of biological and chemical processes to function effectively.

- Dissolved Oxygen (DO): Dissolved oxygen in a stream may vary from 0 – 18 mg/L. DO is inversely proportionate to temperature: colder water can hold more dissolved oxygen than warm water. Water can be "super saturated" with oxygen.

-



To determine percent saturation: Multiply your DO level (mg/L) by an atmospheric pressure correction factor

Elev. 542-1094 = .98 factor

Elev. 1094-1688 = .96 factor Find this corrected DO level on the bottom horizontal line and draw a straight line to connect to the water temperature (top line).

Source: Allegheny College Creek Connections

Dissolved oxygen gets into water by contact with the atmosphere, through aeration in turbulent areas, and through photosynthesis of aquatic plants. It is consumed during normal metabolic functions of aquatic organisms but can be depleted if excessive nutrients disrupt the balance and cause an excess of plant growth followed by decay. Dissolved oxygen levels in natural aquatic systems follow daily and seasonal cycles.

Range of Tolerance for Dissolved Oxygen in Fish										
mg/L dissolved oxygen										
0	1	2	3	4	5	6	7	8	9	10…
<3.0 mg/L too low for fish populations			3.0 – 5.0 mg/L 12-24 hr. range of tolerance/ stressful condition			6.0 mg/L supports spawning	> 7 ppm Supports growth/activity	>9 mg/L Supports abundant fish populations		

Adapted from the Water Research Center

Most aquatic organisms need at least 5 mg/L of dissolved oxygen to survive. Different aquatic insects and fishes have different oxygen demands. For example – some Northern Pike, a cold-water fish, require 6.0 mg/L DO and Black Bullhead catfish only need 3.3mg/L to survive. An animal's oxygen demands can change with environmental conditions. For example, a trout requires six times more DO at 75 degrees Fahrenheit compared with 41degrees Fahrenheit due to higher metabolic demands.

- Phosphate (Orthophosphate): Most unpolluted streams have levels below 0.03 mg/L. Phosphate levels can be elevated by fertilizer or detergent entering a stream through run-off or attached to sediment washed into the stream.

- Nitrate: Unpolluted waters have nitrate levels below 4.4 mg/L. Nitrate is another pollutant related to fertilizer or animal waste entering the stream. Both Phosphate and Nitrate can contribute to elevated algae growth which can deplete DO if/when killed off by low water levels or cold weather.

  The Hach nitrate test uses a colorimetric measurement, comparing a treated sample to an untreated one. The amount of nitrate is indicated by the presence and intensity of a pink coloration in the test sample. Chloride is an oxidizing agent and disrupts the test by producing a peach/orange tone. Tests with that result are voided and recorded as 9999 -- an invalid score.

- Conductivity: Conductivity is the measurement of the ability of water to conduct a current and is an indicator the number of ions in a stream, such as those produced by road salt or other ionizing compounds entering the stream and going into solution. According to the EPA, inland fresh-water streams that support good mixed fisheries range from 150 -500 mS/cm (microsiemens per centimeter.)

- Turbidity is an optical measure of the clarity of water which can be impacted by solids suspended in the water column. The lower the NTU (nephelometric turbidity units) value for turbidity, the clearer the water.

  High levels of turbidity can affect stream health by warming the stream, thus reducing Dissolved Oxygen levels and promoting algal growth. Furthermore, sediment can transport pollutants into the stream. Suspended materials can clog fish gills and affect egg and larval development. If the particles settle and blanket the stream bottom, they can smother fish eggs and benthic macroinvertebrates.

- Visual Assessment

The physical condition of streams was scored using the USDA's Stream Visual Assessment Protocol. This protocol prescribes a 10 – 1 (best – worst) score for attributes of:

- Water appearance (clear, cloudy, discolored, or filmy)
- Channel condition (extent of manmade alteration or armoring)
- Bank stability (presence or severity of erosion)
- Embeddedness (extent of sediment deposition on stream floor)
- Fish barriers (presence of man-made barriers to fish movement up/downstream)
- In-stream fish cover (types of shelter from predators)
- Invertebrate habitat (types of structure for egg-laying and sheltering)
- Riparian zone (condition of streamside vegetation)
- Canopy cover (extent of shade by forest vegetation)
- Nutrient enrichment (indication of excess algae or other growth)

The presence of any indication of AMD (abandoned mine drainage), manure, or sewage is captured as well.

A score of 10 would be the condition met in an undisturbed forest stream with a healthy trout population, while a 1 would be a concreted drainage canal in California. *Segments* are areas that have consistent overall character and land use around them. Scores are based on the overall score for the segment's condition, recognizing that some specific areas might differ, which is recognized in the scoring parameters. (See Bank Stability example below.)

Bank Stability			
Banks are stable; at elevation of active flood plain; 33% or more of eroding surface area of banks in outside bends is protected by roots that extend to the base-flow elevation.	Moderately stable; at elevation of active flood plain; less than 33% of eroding surface area of banks in outside bends is protected by roots that extend to the base-flow elevation.	Moderately unstable; banks may be low, but typically are high (flooding occurs 1 year out of 5, or less frequently); outside bends are actively eroding (overhanging vegetation at top of bank, some mature trees falling into stream annually, some slope failures apparent).	Unstable; banks may be low, but typically are high; some straight reaches and inside edges of bends are actively eroding as well as outside bends (overhanging vegetation at top of bare bank, numerous mature trees falling into stream annually, numerous slope failures apparent).
10 9 8	**7 6 5 4**	**3 2**	**1**

Photographs were taken of notable features or conditions within the stream channel and at waypoints designating segment start- and endpoints.

- Biological Assessment

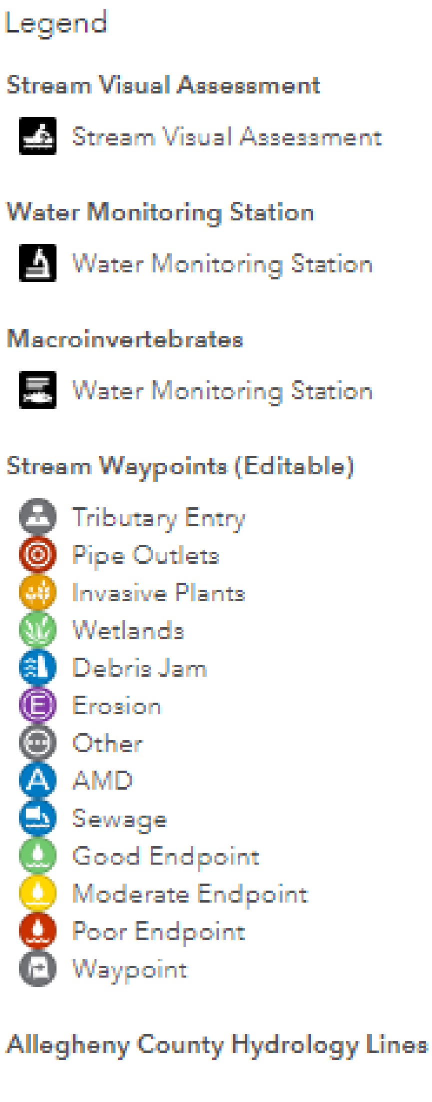
Biological assessments survey the living aquatic community of a waterbody. Several techniques are available for this process. A common one was applied here to inventory the types of benthic (bottom-dwelling) macroinvertebrates (animals lacking vertebral columns that can be see without a microscope). These can include crayfish, clams, snails, aquatic worms and leeches, and an array of insects' larval stages. Because all these organisms spend extended periods to all their lives in the water and have recognized tolerance levels to water conditions, they provide a gauge of the conditions of a stream over a long period. Benthic macroinvertebrate insects are generally less than one inch in length, and most have external gills that are vulnerable to sediment and chemical disruption. They provide the primary food source for many fish and other aquatic life and are valuable in breaking down organic debris entering the stream. Sensitive species native to streams in southwest Pennsylvania generally prefer sediment-free rocky bottoms in flowing streams where they have high levels of oxygen and can be safe from predation. Macroinvertebrate insect populations generally peak in the spring and fall as over-wintering species or summer-maturing species are approaching "emergence" as flying adults. Surveys are generally conducted during spring and fall months.

Macroinvertebrate surveys were conducted using a 1mX1m kick net which is anchored in the bottom of the stream. A 1-meter square area of substrate immediately upstream of the net is "kicked" (disturbed) for a set length of time to flush animals into the net. Sampling is done in different types of habitats to identify animals with different feeding and habitat preferences. Animals captured were scored using the "Hoosier Riverwatch Biological Monitoring" score sheet which weighs each taxonomic order present based on their sensitivity to pollution and generates a Pollution Tolerance Index (correlated to water quality) of "poor", "fair", "good", or "excellent". The scoring system applied does not address individual counts for each taxonomic Order but provides an appropriate level of assessment for this study.

- Quality Assurance and Control

Early assessments identified mal-functioning pH meters in two teams which were subsequently replaced by HACH. Other challenges with technology, data capture and protocol techniques guided occasional modifications to study technique and resources. Duplicates run at each assessment for dissolved oxygen were prioritized as this parameter is key for determining invertebrate viability in a stream. A mid-year meeting of team leaders provided a check-in on confidence in results and an opportunity to address difficulties with the calibration sample for one team's conductivity meter and order a replacement vial. Year-end scrutiny of results provided an opportunity to identify gaps and irregularities in the on-line data and allowed for correction or explanation of the posted results. See notes under Chemical Assessment above regarding the validity of data.

Key to GIS Symbols on Data Maps:



RESULTS – YEAR 1

- GIS Data map:

All data and photo images for the three parks studied are available at the following interactive link.

https://alcogis.maps.arcgis.com/apps/dashboards/de70025d4c8943d383d6e266dd8579dd

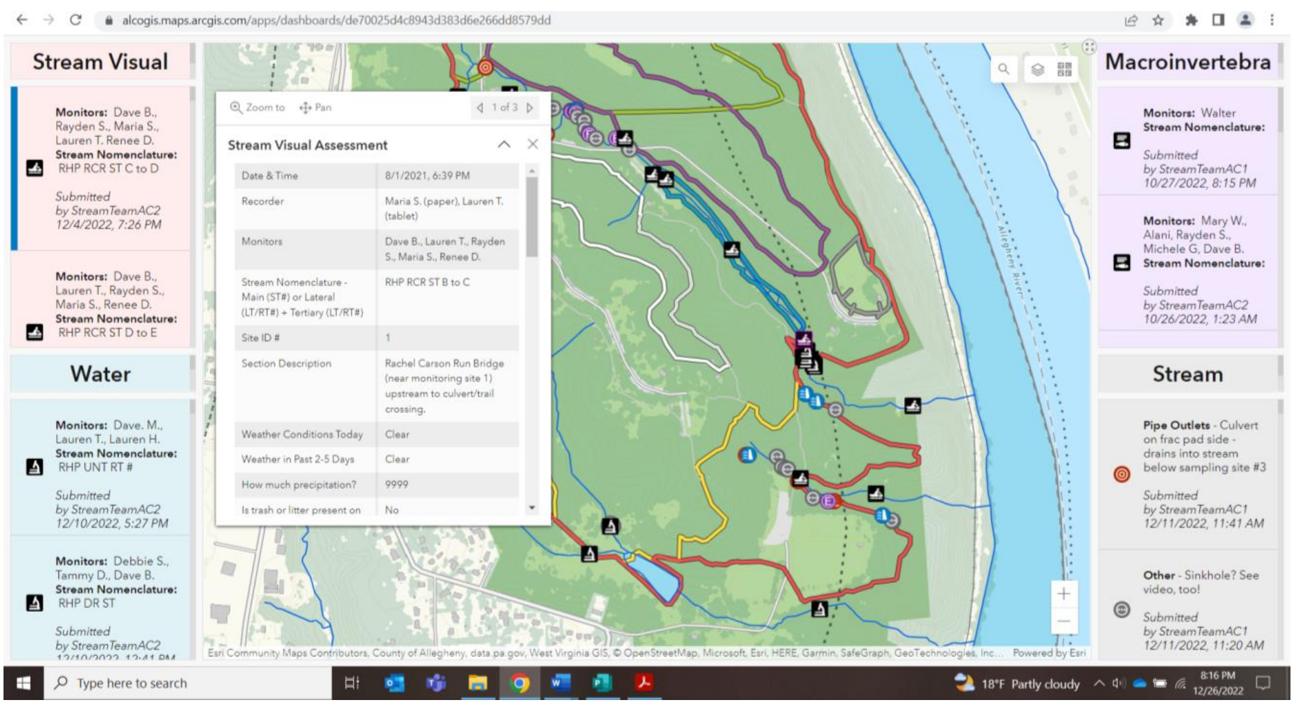
**** This website is not currently intended for public access. ****

You will need to log onto an ARCGIS account to access the link above. Using the cursor, you can drag the map image to the park in question and then use the + and – buttons to zoom in or out on the map.

The side panels of the dashboard display the different icons corresponding to the different assessments conducted. Icon locations indicate where the data was captured. To reveal the data or photograph for that location, click on the data point. Photographs or waypoints may be coded for the type of image content captured such as erosion, debris jam, outflow, etc.

A new mapping tool has been developed that allows teams to color code segments of streams based on their score in the visual assessment, but this is a separate graphic tool and reflects the scores captured in the data behind the page above.

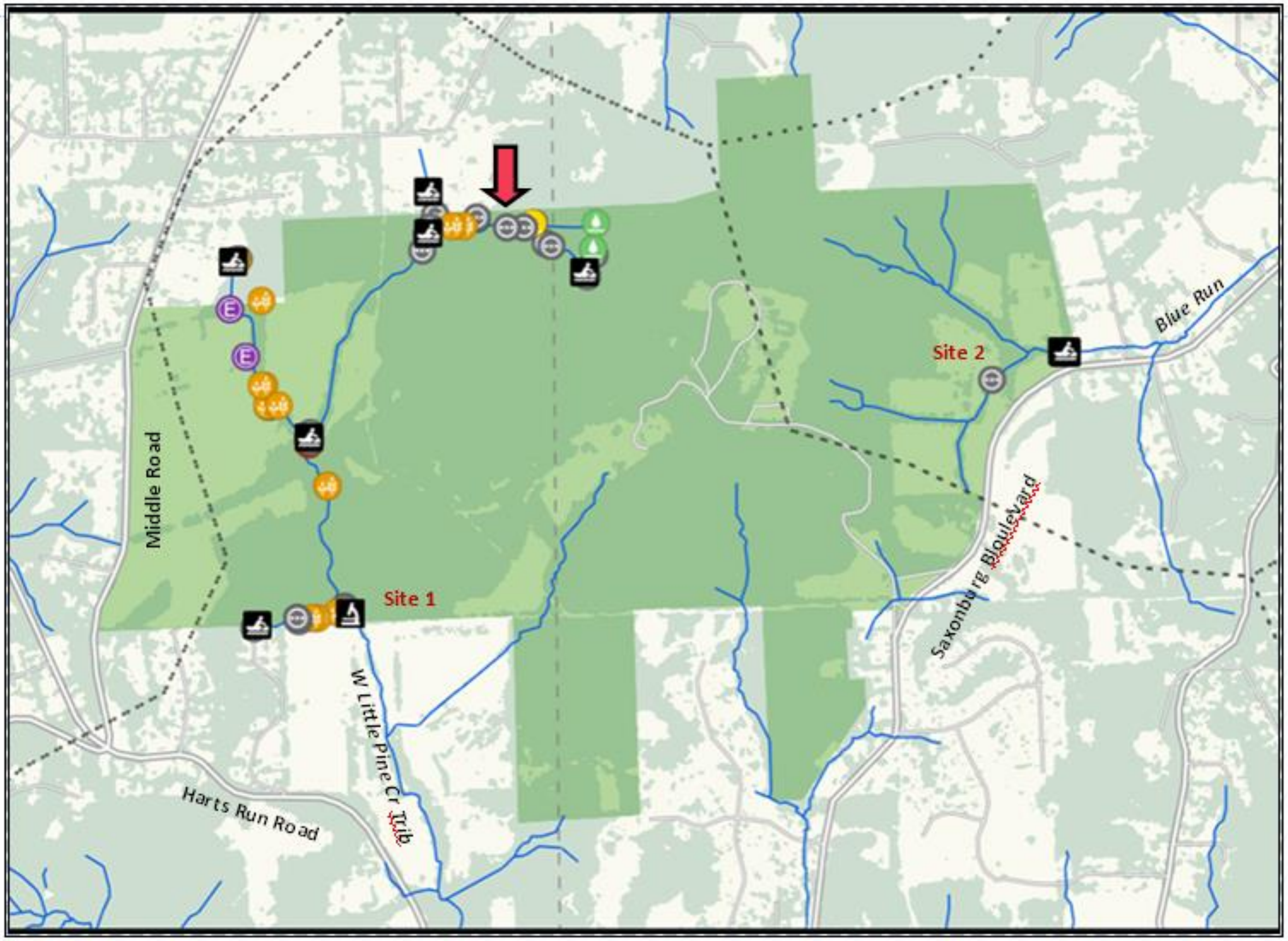
<u>NOTE:</u> The GIS Department staff would like to modify the map format for external viewers in the future with input from prospective viewers. The format seen below is active for the current data set.



Results for each park are captured here in four components:

- Screen shot of the GIS-based map with icons indicating photographs and type of data available
- Chemical Assessment: Tabulated data for the principal parameters assessed
- Physical Assessment: Tabulated data for the 13 parameters within the scoring protocol and final score
- Biological Assessment: Tabulated results for the presence/absence of 22 benthic macroinvertebrate Orders surveyed and final score of Pollution Tolerance Index

HARTWOOD ACRES PARK



See page 12 for key to symbols

Hartwood Acres Park - CHEMICAL ASSESSMENT RESULTS

Values highlighted in orange are outside normal range; Blue highlighted number = value might be invalid

Date	Precipitation in the past 24 hours	How much precipitation? (in)	Precipitation Current	Discharge (cf/s)	Air Temperature - Sample A (*F)	Air Temperature - Sample B (*F)	Water Temperature - Sample A (*F)	Water Temperature - Sample B (*F)	Dissolved Oxygen - Sample A (mg/L)	Dissolved Oxygen - Sample B	Total Phosphates - Sample A (mg/L)	Total Phosphates - Sample B	Nitrate Nitrogen - Sample A (mg/L)	Nitrate Nitrogen - Sample B	Conductivity - Sample A (NTU)	Conductivity - Sample B	pH - Sample A	pH - Sample B	Turbidity - Sample A (µS/cm)	Turbidity - Sample B
SITE 1 WEST LITTLE PINE @ HODIL FARM																				
8/14/2021	Storm		Overct	9999	72	72	66	66	11	11	0.12	0.12	1.5	0.66	560	560	7.3	7.3	3.53	3.05
9/12/2021	Clear	0	Clear	0.384	70	70	64	64	9	9	0.0008	0.0008	0.05	0.1	560	550	7.5	7.4	0.88	0
10/20/2021	Clear	0	Clear	0.056	66	66	57	57	9	10	0.02	0.02	0.01	0.01	630	630	7.1	7.1	0.22	0
12/5/2021	Clear	0	Clear	9999	44	44	41	41	13	13	0.02	0.023	0	0	605		7.2		3.53	0
2/20/2022	Snow	0	Clear	2.367	54		42		12		0		0		470		7.2		5.57	
3/31/2022	Rain	.04	Clear	0.65	61		56		10		0.03		0.22		610		8.2		12.64	
6/22/2022	Showers	.43	Rain	0.24	73		69		10		0.3		0.44		650		7.8		0.72	
7/21/2022	Rain	.21	Clear	0.181	70		68		8		0.14		0		690		7.9		3.45	

Note: The general correlation between elevated turbidity (cloudiness) of the water and precipitation is evident when weather of the last 24 hours is compared with turbidity scores. There can be a lag time between when precipitation occurs and water chemistry changes depending on the intensity and type of precipitation.

Hartwood Acres Park - CHEMICAL ASSESSMENT RESULTS (continued)

Date	Precipitation in the past 24 hours	How much precipitation? (in)	Precipitation Current	Discharge (cf/s)	Air Temperature - Sample A (*F)	Air Temperature - Sample B (*F)	Water Temperature - Sample A (*F)	Water Temperature - Sample B (*F)	Dissolved Oxygen - Sample A (mg/L)	Dissolved Oxygen - Sample B	Total Phosphates - Sample A (mg/L)	Total Phosphates - Sample B	Nitrate Nitrogen - Sample A (mg/L)	Nitrate Nitrogen - Sample B	Conductivity - Sample A (NTU)	Conductivity - Sample B	pH - Sample A	pH - Sample B	Turbidity - Sample A (µS/cm)	Turbidity - Sample B
SITE 2 BLUE RUN																				
8/14/2021	Storm	.61	Overct	2.25	76		68		9		5.5		0		580		6.8		11.53	
9/12/2021	Clear	0	Clear	0.184	77		65		7		0.007		0.22		620		6.8		4.46	
11/21/2021	Overcast	Min	Rain	0.31	46	45	45	46	20	20	0.5	0.5	0	0	580	540	7.9	8.3	0.48	1.7
2/20/2022	Clear	0	Clear	1.21	39		39		12		0.24		0.176		280		7.8		16.35	
3/31/2022	Rain	.04	Clear	1.68	52		51		10		0		0.22		360		8.2		27.33	

Note: The general correlation between elevated turbidity (cloudiness) of the water and precipitation is evident when weather of the last 24 hours is compared with turbidity scores. There can be a lag time between when precipitation occurs and water chemistry changes depending on the intensity and type of precipitation. The elevated discharge rates at this site that correspond with high turbidity values suggest erosion or run off is contributing to the turbidity.

Hartwood Acres Park - VISUAL ASSESSMENT RESULTS

Date	Section Description	Channel condition	Riparian zone	Bank stability	Water appearance	Nutrient enrichment	Fish barriers	In-stream fish cover	Embeddedness	Insect/Invertebrate habitat	Canopy cover	Acid Mine Drainage (if applicable)	Sewage (if applicable)	Manure presence (if applicable)	**Total Score**
6/18/2022	Tributary to West Little Pine from Green Valley Drive cul-de-sac to sampling site at Hodil Farm	9	7	7	10	10	10	3	9	7	3			yes	7.09
6/18/2022	West Little Pine from Hodil Farm sampling site to culvert behind bandstand	9	9	8	9	9	2	9	9	9	9				9.3
6/18/2022	West Little Pine from culvert to behind Central School	9	9	8	9	9	2	9	9	9	9				7.3
6/18/2022	West Little Pine from main culvert under road near dog park to park property line at Wagner Road **	9	10	9	9	9	10	8	9	8	10				9.1
6/18/2022	Blue Run along Saxonburg Blvd	4	10	9	8	7	5	5	6	8	9				6.6
10/12/2022	West Little Pine trib along north boundary	8	9	5	4	8	8	3	4	4	3				5.6
10/12/2022	Northwest flowing trib to West Little Pine along north boundary of park	8	9	7	0*	0*	9	2	5	3	7	* No flow			6.25
< 6.0	Poor														
6.1 – 7.4	Fair														
7.5 – 8.9	Good														
> 9.0	Excellent														

Note: See red arrow on map at location of segment receiving "Poor" score

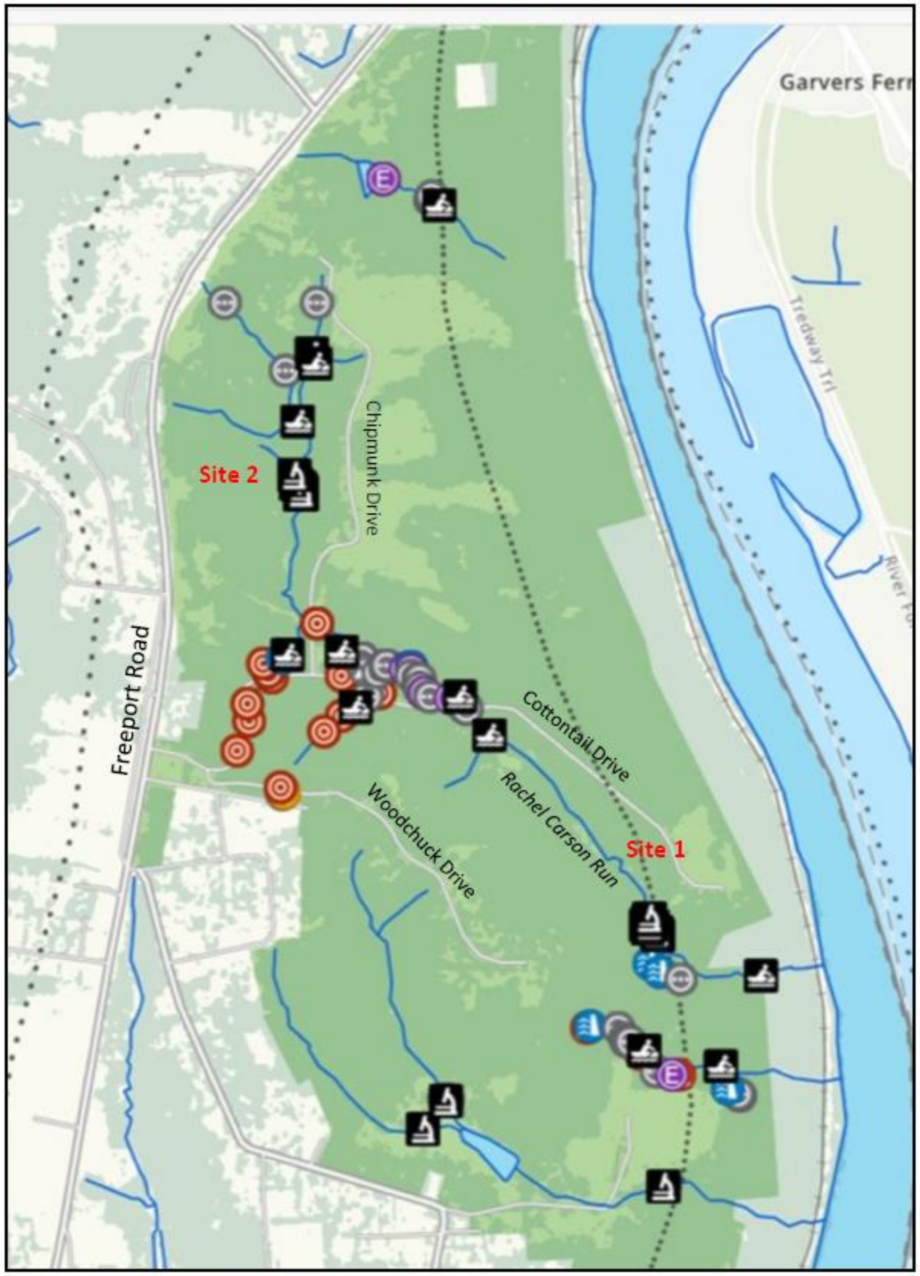
Hartwood Acres Park - BIOLOGICALASSESSMENT RESULTS

Date	Site	Are Stonefly nymph present?	Are Mayfly nymph present?	Are Caddisfly larva present?	Are Riffle Beetle present?	Are Dobsonfly larva present?	Are Right-handed or Gilled Snail present?	Are Water Penny present?	Number of Group 1 TAXA represented (Intolerant)	Are Damselfly nymph present?	Are Dragonfly nymph present?	Are Scud present?	Are Sowbug present?	Are Cranefly larva present?	Are Clam/Mussel present?	Are Crayfish present?	Number of Group 2 TAXA represented (Moderately Intolerant)	Are Leech present?	Are Midge larva present?	Are Planaria/Flatworm present?	Are Black fly larva present?	Number of Group 3 TAXA represented (Fairly Tolerant)	Are Aquatic worm present?	Are Blood midge larva (red) present?	Are Rat-tailed Maggot present?	Are Left-Handed or Pouch Snail present?	Number of Group 4 TAXA represented (Very Tolerant)	**Pollution Tolerance Rating**
11/2021	1	Yes	Yes	Yes	No	No	No	No	3	No	No	No	No	Yes	No	No	1	No	No	No	No	0	Yes	No	No	No	1	16
6/2022	1	Yes	Yes	Yes	No	Yes	No	Yes	5	No	Yes	No	No	Yes	No	Yes	3	No	Yes	Yes	No	2	Yes	No	No	No	1	34
10/2022	2	No	No	Yes	No	No	No	No	1	No	Yes	No	No	No	No	No	1	No	No	No	No	0	Yes	No	No	Yes	1	8

Pollution Tolerance Index Ratings	
23 or More	Excellent
17 - 22	Good
11 - 16	Fair
10 or Less	Poor

NOTE: See narrative for discussion of results

HARRISON HILLS PARK



See page 12 for key to symbols

Harrison Hills Park - CHEMICAL ASSESSMENT RESULTS

Values highlighted in orange are outside normal range; Blue highlighted number = value might be invalid

Date	Precipitation in the past 24 hours	How much precipitation? (in)	Precipitation Current	Discharge (cf/s)	Air Temperature - Sample A (*F)	Air Temperature - Sample B (*F)	Water Temperature - Sample A (*F)	Water Temperature - Sample B (*F)	Dissolved Oxygen - Sample A (mg/L)	Dissolved Oxygen - Sample B	Total Phosphates - Sample A (mg/L)	Total Phosphates - Sample B	Nitrate Nitrogen - Sample A (mg/L)	Nitrate Nitrogen - Sample B	Conductivity - Sample A (µS/cm)	Conductivity - Sample B	pH - Sample A	pH - Sample B	Turbidity - Sample A (NTU)	Turbidity - Sample B
SITE 1 RACHEL CARSON RUN AT BRIDGE BELOW OX ROAST SHELTER																				
8/29/2021	Clear		Clear	9999	83	71.3	71.3		40		0		2.2		640		0		2.04	
9/5/2021	Rain	<1"	Rain	1.93	68		64		10	10	0		0.44		420	420	7.3	7.3	5.83	4.88
		Not available due to culvert replacement																		
12/5/2021	Clear	0	Clear	0.54	37	38	39.8	40	9999	9999	0	9999	9999		580	600	8.1	8.2	0.57	1.39
1/30/2022	Clear	none	Snow	9999	22	22	32	32	12	12	0	9999	0.264	0.025	590	600	6.25	6.5	9999	9999
2/27/2022	Snow	0.125	Snow	4.5	41	41	44	44	12	13	0.04	9999	9999	9999	390	400	8.1	8.2	9.92	11.62
3/20/2022	Rain	.5"	Rain	8.09	43	43	44	44	12	13	0	9999	0.55	8.8	510	510	7.4	7.4	4.49	4.67
4/24/2022	Clear	0	Clear	3.25	81	81	60	60	13	9999	0	9999	0.22	9999	420	420	7.2	7.3	7.64	8.37
5/15/2022	Overc't	0	Clear	1.68	72	72	60.1	61	14	12	0	9999	9999	9999	400	400	7.5	7.7	6.1	7.36
6/18/2022	Overc't	0	Clear	9999	63	63	60	61	10	10	0	9999	9999	9999	630	590	8.1	7.8	14.66	18.4

NOTE: Scores highlighted in pink are questionable as they fall far outside usual ranges.

Harrison Hills Park - CHEMICAL ASSESSMENT RESULTS (continued)

Date	Precipitation in the past 24 hours	How much precipitation? (in)	Precipitation Current	Discharge (cf/s)	Air Temperature - Sample A (*F)	Air Temperature - Sample B (*F)	Water Temperature - Sample A (*F)	Water Temperature - Sample B (*F)	Dissolved Oxygen - Sample A (mg/L)	Dissolved Oxygen - Sample B	Total Phosphates - Sample A (mg/L)	Total Phosphates - Sample B	Nitrate Nitrogen - Sample A (mg/L)	Nitrate Nitrogen - Sample B	Conductivity - Sample A (µS/cm)	Conductivity - Sample B	pH - Sample A	pH - Sample B	Turbidity - Sample A (NTU)	Turbidity - Sample B
SITE 2 RACHEL CARSON RUN NORTH OF ENVIRONMENTAL CENTER																				
7/26/2021	Clear	0	Clear	0.06	9999	76	68	66	10	7	0	0	0	0	9999	9999	9999	9999	9999	9999
9/5/2021	Rain	<1"	Overc't	0.63	70		64	64	10	10	0.08	0.4	1.1		430	430	7.6	7.6	2.7	2.89
10/3/2021	Rain	Trace	Overc't	0.049	68	68	59.5	64.5	11	10		0	0.25	0.25	630	630	8.2	8.1	0.14	0.08
11/7/2021	Clear	0	Clear	0	45	45	43.5	41	10	11	0	0	0.75	0.8	570	570	8.4	8.5	1.41	0.17
12/5/2021	Clear	0	Overc't	0.19	36	36	38	39	9999	9999	0	0	0	0	610	610	8.3	8.3	0.21	0.38
1/30/2022	Clear	0	Snow	9999	21	21	32	32	10	9999	0	0	0.374	0.374	409	390	7	7	9999	9999
2/27/2022	Snow	0.125	Snow	1.05	36	36	44	44	14	14	0	9999	9999	9999	310	330	8.5	8.5	11.37	9.3
3/20/2022	Rain	.5'	Rain	0.45	40	40	42	42	11	12	0	0	3.3	1.43	400	390	7.4	7.5	0.64	0.34
4/24/2022	Clear	0	Clear	0.548	79	79	59	59	10	9999	0	9999	0.528	0.352	370	380	7.9	7.8	2.96	0.43
5/15/2022	Overc’t	0	Clear	0.34	69	69	69	59	14	13	0	9999	0.22	0.22	350	320	8	8	4.24	4.52
6/18/2022	Clear	0	Overc't	9999	58	58	58	58	11	11	0	0	9999	9999	630	640	8.1	8	18.05	10.95

Note: Two additional sites were tested one time each but are not included here as monitoring was not ongoing.

Harrison Hills Park - VISUAL ASSESSMENT RESULTS

Date	Section Description	Channel condition	Riparian zone	Bank stability	Water appearance	Nutrient enrichment	Fish barriers	In-stream fish cover	Embeddedness	Insect/Invertebrate habitat	Canopy cover	Acid Mine Drainage (if applicable)	Sewage (if applicable)	Manure presence (if applicable)	**Total Score**
9/19/2021	Rachel Carson mid-section	9	10	8	10	9	9	10	9	10	9				9.3
11/21/2021	HHP Trib 01 to Rachel Carson Run along Cottontail Dr. west of Chipmunk Dr.	9	8	8	10	9	3	3	9	8	8				7.5
11/21/2021	HHP Trib 02 to Rachel Carson Run (RCR) from Woodchuck Dr. inlet downstream across Cottontail Dr. to RCR. No flow in upstream end (headwaters) to measure.	9	9	9	10	9	5	5	8	9	9				9.2
9/19/2021	HHP RC Main Stem Waypoint 4 to 5	9	10	8	10	9	9	10	9	10	9				9.3
12/5/2021	Trib from North pond	8	9	8	8	8	3	5	7	7	8				7.1
5/15/2022	Between monitoring Site 1 and 3, Separate stream	8	3	8	9	9	7	3	9	3	8				6.7
5/15/2022	Between monitoring Site 1 and 3, Separate stream in downstream end	9	9	8	9	9	9	5	9	10	9				8.6
6/18/2022	RCR Allegheny River to footbridge near site.	10	9	9	7	8	7	10	8	10	9				8.8
6/18/2022	Tributary thru Bob White Parking Lot. Partially culverted under newly paved/asphalted parking lot. Minimal to no flow.	7	9	8	7	7	4	3	7	7	7				6.6

Harrison Hills Park - VISUAL ASSESSMENT RESULTS (continued)

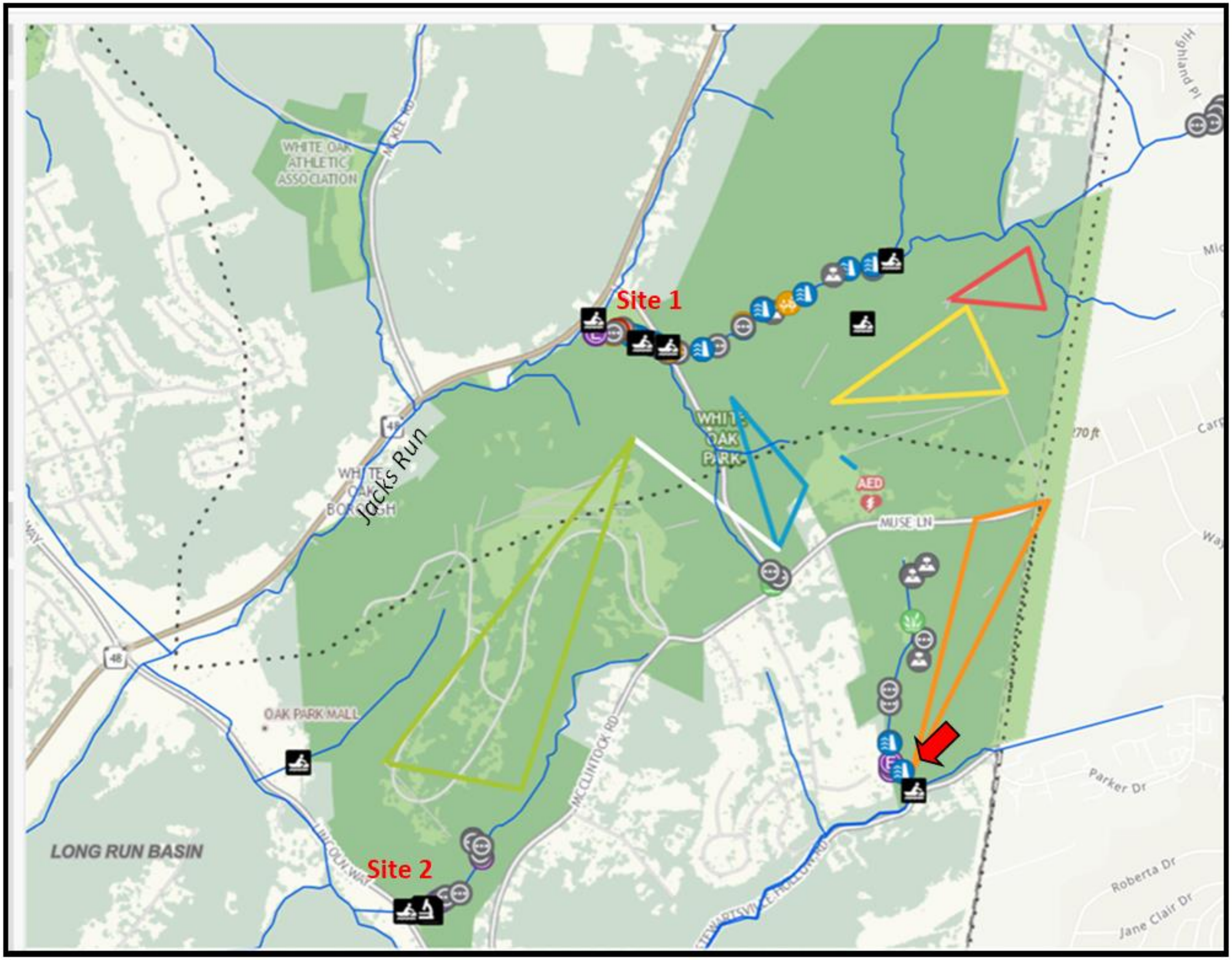
Date	Section Description	Channel condition	Riparian zone	Bank stability	Water appearance	Nutrient enrichment	Fish barriers	In-stream fish cover	Embeddedness	Insect/Invertebrate habitat	Canopy cover	Acid Mine Drainage (if applicable)	Sewage (if applicable)	Manure presence (if applicable)	**Total Score**
6/18/2022	Trib to Rachel Carson Run upstream of Site 2 encompassed by Green trail.	9	10	9	9	9	8	6	7	9	9				8.5
6/18/2022	Trib to Rachel Carson Run, upstream of site 2, Green trail west of stream, gravel road east.	9	9	8	9	9	7	8	7	9	8				8.3
6/18/2022	Trib to Rachel Carson Run, upstream of site 2, hook to east.	9	9	8	9	9	9	8	7	9	9				8.6
< 6.0	Poor														
6.1 – 7.4	Fair														
7.5 – 8.9	Good														
> 9.0	Excellent														

Harrison Hills Park - BIOLOGICAL ASSESSMENT RESULTS

Date	Site	Are Stonefly nymph present?	Are Mayfly nymph present?	Are Caddisfly larva present?	Are Riffle Beetle present?	Are Dobsonfly larva present?	Are Right-handed or Gilled Snail present?	Are Water Penny present?	Number of Group 1 TAXA represented (Intolerant)	Are Damselfly nymph present?	Are Dragonfly nymph present?	Are Scud present?	Are Sowbug present?	Are Cranefly larva present?	Are Clam/Mussel present?	Are Crayfish present?	Number of Group 2 TAXA represented (Moderately Intolerant)	Are Leech present?	Are Midge larva present?	Are Planaria/Flatworm present?	Are Black fly larva present?	Number of Group 3 TAXA represented (Fairly Tolerant)	Are Aquatic worm present?	Are Blood midge larva (red) present?	Are Rat-tailed Maggot present?	Are Left-Handed or Pouch Snail present?	Number of Group 4 TAXA represented (Very Tolerant)	**Pollution Tolerance Rating**
9/2021	2	No	Yes	No	No	No	No	No	1	Yes	No	No	Yes	No	No	No	2	No	Yes	No	No	1	Yes	No	No	No	1	13
4/2022	2	Yes	Yes	Yes	Yes	Yes	No	No	5	No	No	No	Yes	Yes	No	Yes	3	Yes	No	No	Yes	2	Yes	No	No	No	1	34
10/2022	1	Yes	No	No	Yes	No	No	Yes	3	No	Yes	No	Yes	Yes	No	Yes	4	No	Yes	Yes	No	2	No	Yes	No	No	1	29

Pollution Tolerance Index Ratings	
23 or More	Excellent
17 – 22	Good
11 – 16	Fair
10 or Less	Poor

WHITE OAK PARK



See page 12 for key to symbols

White Oak Park - CHEMICAL ASSESSMENT RESULTS

Values highlighted in orange are outside normal range; Blue highlighted number = value might be invalid

Date	Precipitation in the past 24 hours	How much precipitation? (in)	Precipitation Current	Discharge (cf/s)	Air Temperature - Sample A (*F)	Air Temperature - Sample B (*F)	Water Temperature - Sample A (*F)	Water Temperature - Sample B (*F)	Dissolved Oxygen - Sample A	Dissolved Oxygen - Sample B	Total Phosphates - Sample A	Total Phosphates - Sample B	Nitrate Nitrogen - Sample A	Nitrate Nitrogen - Sample B	Conductivity - Sample A	Conductivity - Sample B	pH - Sample A	pH - Sample B	Turbidity - Sample A (µS/cm)	Turbidity - Sample B
SITE 1 - NEXT TO CHESTNUT SHELTER																				
7/11/2021	Overc't	0	Overc't	9999	65	65	68	68	9	9999	0.013	0.013	0.23	0.2	710	700	7.8	7.7	1.38	1.17
8/8/2021	Overc't	0	Overc't	0.56	70	70	70	69	8	10	0.013	0.013	0.5	0.3	780	740	8.3	8.2	0.24	0.3
9/12/2021	Overc't	0	Clear	9999	69	69	63	63	9	9	0.007	0.007	0.3	0.25	700	710	8.4	8.2	1.45	1.95
10/10/2021	Showrs	.10	Overc't	0.68	62	62	60	60	6	7	9999	0.007	0.06	0.02	640	640	8.3	8.2	0.34	0.35
11/20/2021	Showrs	.1	Clear	0.9	30	30	39	40	6	6	0.007	0.007	0	0	670	670	8.6	8.9	9999	0
12/11/2021	Showrs	.43	Showrs	5.22	46	46	53	52	12	9	0.007	0.02	0.23	0.12	440	430	8.3	8.3	18.56	19.29
1/9/2022	Showrs	.4	Showrs	20.92	40	40	40	40	7	4	0.007	0	0	0	2.5	2.8	8.6	8.7	78	78
2/6/2022	Overc't	0	Clear	3.92	12	12	36	32	14.6	14.6	0.007	0.007	0	0.5	880	830	7.5	7.7	2.91	2.44
3/13/2022	Clear	.2	Snow	9999	17	17	31	31	13.6	13.6	9999	9999	9999	9999	1220	1250	7.7	8.3	1.76	1.28
5/15/2022	Overc't	0	Overc't	0.8	63	63	61	60	10	8	0.015	0.007	0	0	550	550	8.4	8.2	0	0
6/24/2022	Rain	.04	Overc't	9999	73	73	64	64	9	9	0	0	0	0	710	680	8	8	1.89	2.52

NOTE: Scores highlighted in pink are outside the normal range and may be due to faulty equipment function.

White Oak Park - CHEMICAL ASSESSMENT RESULTS (continued)

Date	Precipitation in the past 24 hours	How much precipitation? (in)	Precipitation Current	Discharge (cf/s)	Air Temperature - Sample A (*F)	Air Temperature - Sample B (*F)	Water Temperature - Sample A (*F)	Water Temperature - Sample B (*F)	Dissolved Oxygen - Sample A	Dissolved Oxygen - Sample B	Total Phosphates - Sample A	Total Phosphates - Sample B	Nitrate Nitrogen - Sample A	Nitrate Nitrogen - Sample B	Conductivity - Sample A	Conductivity - Sample B	pH - Sample A	pH - Sample B	Turbidity - Sample A (µS/cm)	Turbidity - Sample B
SITE 3 - BEHIND WHITE OAK SAFE ANIMAL HAVEN																				
8/8/2021	Overc't	0	Overc't	9999	70	70	71	72	6	6	0.013	0.013	0.4	0.57	950	960	7.8	7.8	0.1	0.14
9/12/2021	Clear	0	Overc't	9999	69	69	69	67	8	9	0.007	0.007	0.38	0.4	830	830	8.5	8.1	3.38	3.97
10/10/2021	Overc't	0	Overc't	9999	62	62	62	62	6	5	0.007	0.007	0	0	860	860	8	8.1	1.36	0.38
11/20/2021	Overc't	0	Overc't	9999	31	31	42	42	5	8	0.007	0.007	0	0	840	850	8.2	8.2	0.17	0.39
12/11/2021	Showrs	.4	Showrs	9999	60	60	57	58	7	8	0.01	0.007	0.2	0.01	540	520	8.3	8.3	25.47	25.22
1/9/2022	Showrs	.4	Showrs	9999	40	40	37	37	7	7	0.007	0.007	0	0	700	920	8.6	8.3	9999	9999
4/10/2022	Overc't	0	Overc't	9999	34	34	43	43	9999	9999	9999	9999	9999	9999	610	610	8.6	8.6		9999
5/15/2022	Overc't	0	Overc't	9999	63	63	61	60	9999	9999	0.007	0.0003	0.01	0	790	780	8.2	8	0.11	0.2
6/24/2022	Overc't	.4	Overc't	9999	75	75	64	64	6	6	0	0	0	0	890	880	8	8	1.89	1.79

White Oak Park - VISUAL ASSESSMENT RESULTS

Date	Section Description	Channel condition	Riparian zone	Bank stability	Water appearance	Nutrient enrichment	Fish barriers	In-stream fish cover	Embeddedness	Insect/Invertebrate habitat	Canopy cover	Acid Mine Drainage (if applicable)	Sewage (if applicable)	Manure presence (if applicable)	Total_score
6/27/2021	Jacks Run Road by playground to McClintock Rd bridge	8	5	8	9	9	7	5	8	9	5				7.3
8/29/2021	By White Oak animal shelter to waterfall/ small pool	8	9	6	6	7	3	6	4	6	9				6.4
8/29/2021	McClintock Rd culvert under road forested area	7	10	8	9	8	10	10	9	9	9				8.9
7/23/2022	Confluence Stewartsville Hollow run	5	7	4	9	10	10	2	3	3	7				6
7/31/2022	Forested to out of park boundary (residential)	10	9	6	9	8	7	6	8	7	10				7.1

< 6.0	Poor
6.1 – 7.4	Fair
7.5 – 8.9	Good
> 9.0	Excellent

Note: See red arrow on map at location of segment receiving "Poor" score

White Oak Park - BIOLOGICAL ASSESSMENT RESULTS

Date	Site	Are Stonefly nymph present?	Are Mayfly nymph present?	Are Caddisfly larva present?	Are Riffle Beetle present?	Are Dobsonfly larva present?	Are Right-handed or Gilled Snail present?	Are Water Penny present?	Number of Group 1 TAXA represented (Intolerant)	Are Damselfly nymph present?	Are Dragonfly nymph present?	Are Scud present?	Are Sowbug present?	Are Cranefly larva present?	Are Clam/Mussel present?	Are Crayfish present?	Number of Group 2 TAXA represented (Moderately Intolerant)	Are Leech present?	Are Midge larva present?	Are Planaria/Flatworm present?	Are Black fly larva present?	Number of Group 3 TAXA represented (Fairly Tolerant)	Are Aquatic worm present?	Are Blood midge larva (red) present?	Are Rat-tailed Maggot present?	Are Left-Handed or Pouch Snail present?	Number of Group 4 TAXA represented (Very Tolerant)	Pollution Tolerance Rating
8/21	1	Yes	Yes	Yes	No	No	No	No	3	No	No	Yes	Yes	Yes	No	Yes	4	No	No	No	No	0	No	No	No	No	0	24
4/22	1	Yes	Yes	Yes	No	No	No	No	3	Yes	No	No	Yes	Yes	No	No	3	No	No	No	No	0	Yes	No	No	No	1	22
10/22	1	Yes	Yes	Yes	No	No	No	No	3	Yes	No	No	Yes	Yes	No	No	3	No	No	No	No	0	Yes	No	No	No	1	22

Pollution Tolerance Index Ratings	
23 or More	Excellent
17 – 22	Good
11 – 16	Fair
10 or Less	Poor

OBSERVATIONS & RECOMMENDATIONS

- General Comments

The three parks under study contain headwater streams travelling steep gradients. Many streams flow only seasonally or intermittently and are not conducive to year-round chemical testing. For example, although Site 2 in Harrison Hills Park is at the end of a long stream channel it often had low or no-flow periods because of its steep gradient. Macroinvertebrate sampling was not feasible in that setting because the animals being surveyed need a consistently wet environment and chemical testing was intermittent.

The pervasive presence of invasive plant species must be acknowledged, even if their impact on aquatic systems is not fully understood. Any opportunity to reduce, control or eliminate them in conjunction with streambank stabilization, riparian buffer installation or enhancement, or debris removal should be considered.

- Chemical Assessment

Streams tend to have characteristic chemical profiles or "norms" based on the geology, hydrology and land uses of the area. More extended study would help to identify those norms and highlight changes due to storm events, etc.

The key parameter of Dissolved Oxygen fell within normal healthy ranges but some streams showed consistently higher values than others. The stream at Site 1 in Harrison Hills had consistently higher values than White Oak or Hartwood Acres, except during February and March when White Oak Park Site 1 saw significant increases.

Phosphate levels and nitrate levels remained low, which is in line with fertilizer and animal waste not being significant factors within the parks under study, beyond occasional horse traffic.

Turbidity levels spiked occasionally, with most elevated levels corresponding to rain events.

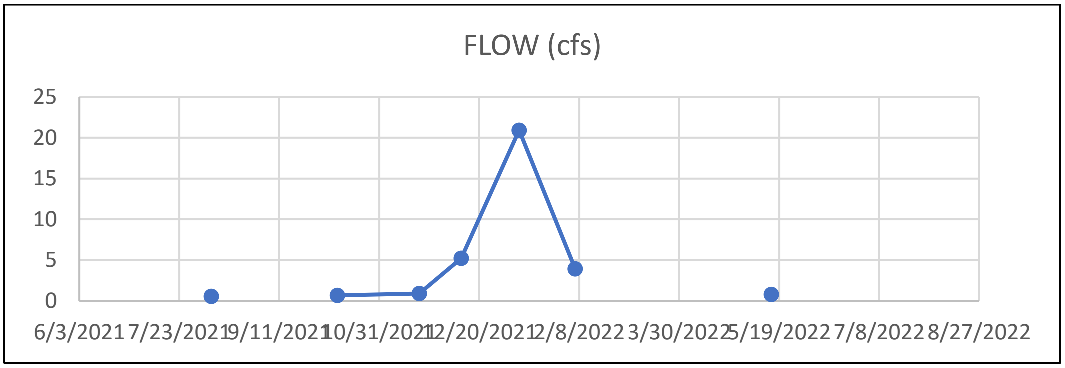
Baseline conductivity values differed between parks with White Oak showing higher regular values than Hartwood Acres or Harrison Hills. Whether this is because of differences in geology or other factors is not clear. Residual road salt is known to remain in concrete to leech out slowly in urban settings. Whether a similar dynamic is at work in White Oak is not clear.

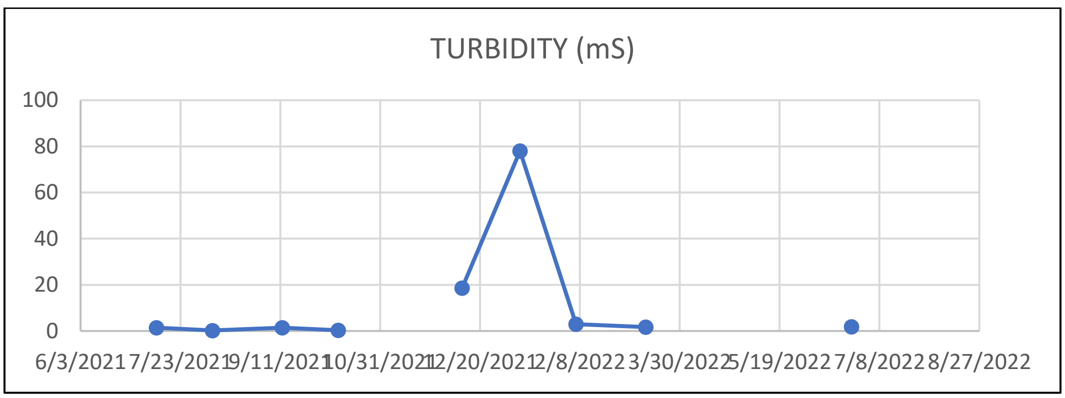
Notable high and low values of different parameters are highlighted against an orange field in the data tables. It is valuable to assess them based on any impact on flow from weather which is why weather and discharge are placed at the left side of the tables.

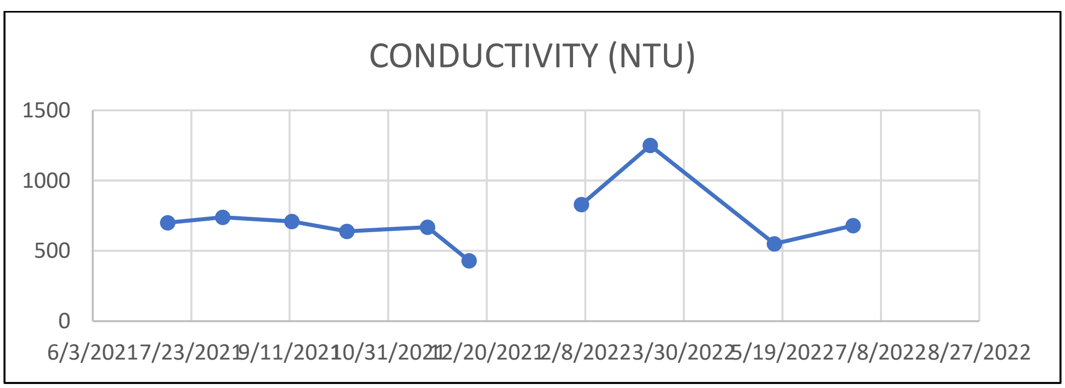
The three parameters of turbidity, conductivity and flow can show similar patterns depending on the timing of sampling relative to a weather event as indicated in the following three graphs from Site 1 of White Oak Park. This study site is at the bottom of a long steep slope with a road between the stream and a tributary. High volumes of water from upstream roadbeds likely contributes to this dynamic.

Looking at the chemical conditions in a stream tells only part of the story. With strong DO values in place fairly consistently, we know that at least one condition is met for sustaining healthy biological communities. Looking at the condition of the physical environment helps to provide additional information for the full story. And as noted earlier, the type of biological community present is a result of the physical and chemical conditions combined.

Flow, Turbidity and Conductivity at White Oak Park



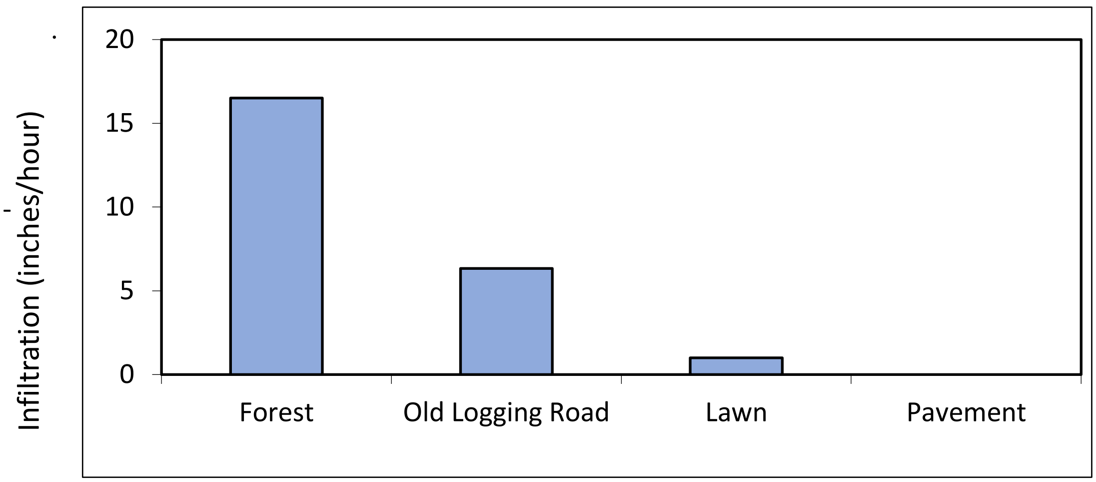




- Visual Assessment

The topography and geology of western Pennsylvania's landscape impacts stream behavior significantly. Headwater streams naturally erode as they are the first line of collection in the system, but that erosion can be exacerbated by unstable soils, fractious bedrock, strong storms, and inadequate vegetation to stabilize streambanks. The region's history of logging, agriculture and convention of laying sewer lines in stream channels can also factor into stream channel erosion.

More modern impacts of directing stormwater from roads to discreet outflows, and maintenance of extensive lawn areas can also impact stream channel conditions. Lawn is nearly as impervious as cement due to compression of soil pore spaces by repeated heavy mowing equipment and foot traffic.



Credit: Bryan Swistock, Penn State University

Due to safety and accessibility concerns and time constraints, not all streams in all parks received visual assessment. Streams that were assessed consistently had low scores for fish cover or the presence of fish barriers but as these streams generally were too small to support fish populations so those parameters scores are not a source of concern. Reduced scores due to erosion, sedimentation (embeddedness), and less than optimal riparian buffer or canopy coverage were also prevalent and of greater concern.

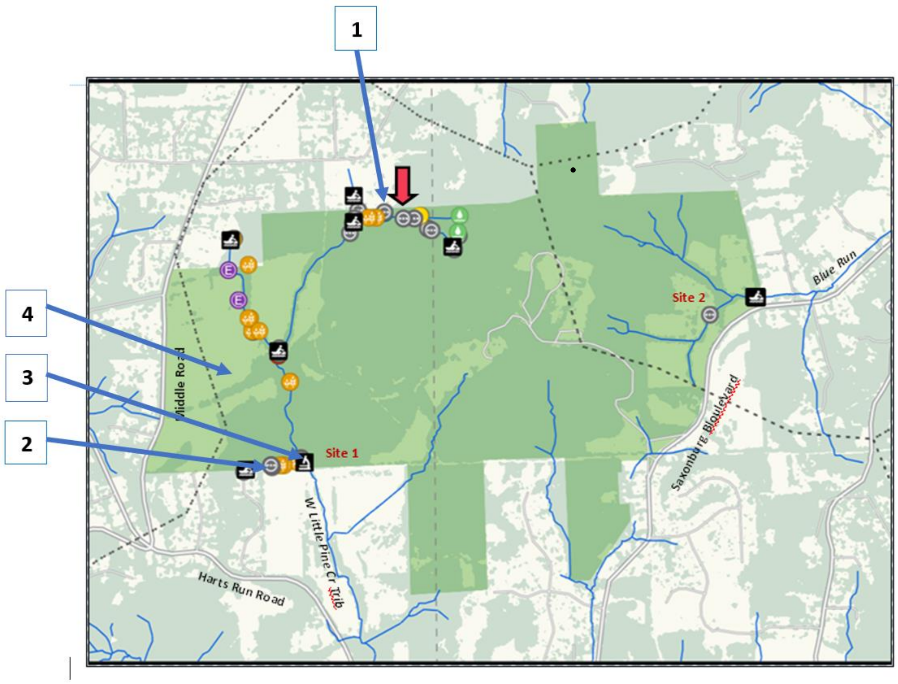
In light of the suburban context of these parks the overall condition of the streams was generally good. Specific opportunities for improvement are presented for each park after a review of the study's findings.

- Biological Assessment

Each park received at least one "Excellent" score for the Pollution Tolerance Index during the year, indicating that the streams surveyed are able to support animals requiring pollution-free water. Two "Poor" and one "Fair" score were attributed to Hartwood Acres and Harrison Hills, respectively. The late year survey (Nov 2021) and low flows (Oct 2022) at Hartwood might have accounted for the low scores there. Many insects would have emerged by November and larvae from the summer broods would not be evident yet. Site 2 at Harrison Hills was heavily silted and had low flows in June 2021, which might have contributed to the low score at that time.

RECOMMENDATIONS

- Hartwood Acres Park



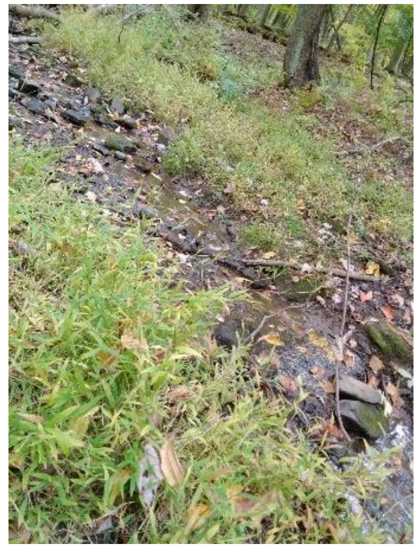
The Ecological Assessment and Action Plan for Hartwood Acres Park produced by the Western Pennsylvania Conservancy described stormwater issues related to the heavily used area along Middle Road. The recommendations for riparian buffer development and enhancement on the western bank of Little Pine Creek facing the dog park and extensive recommendations for meadow development and expansion in the park will improve infiltration and reduce run-off. Similarly, the ongoing efforts to expand the riparian buffer along Blue Run parallel to Saxonburg Blvd will help promote infiltration.

<u>Riparian Buffers</u>

Two smaller opportunities for riparian buffer work within the park merit consideration:

1) The northern boundary of the park along near the fence has had some canopy reduced by invasive vines pulling trees down (see photos to right) and insect damage. This has left the area open to invasive species colonization and stream degradation. A planting of species like those cited by the Conservancy in this area, as well as forest canopy restoration would promote infiltration and reduce erosion and siltation in the stream downstream.

(See pictures following page.)

2) The significant erosion and sedimentation of reach of stream in the northern portion of the park is extensive considering the mild gradient of the terrain. This might reflect an agricultural history from which the soils are unstable and highly erodible. Reforestation of any gaps there will potentially slow further erosion of the channel.

3) The trail that is a major access point for residents in the Green Valley Drive runs under a power line and along a small first-order stream. (See photo below.) The majority of the vegetation along the small tributary and trail is comprised of invasive species. An effort to eliminate invasive species and restore a native shrub community would be beneficial in that location by providing more consistent shade to the stream and potentially reduce siltation.

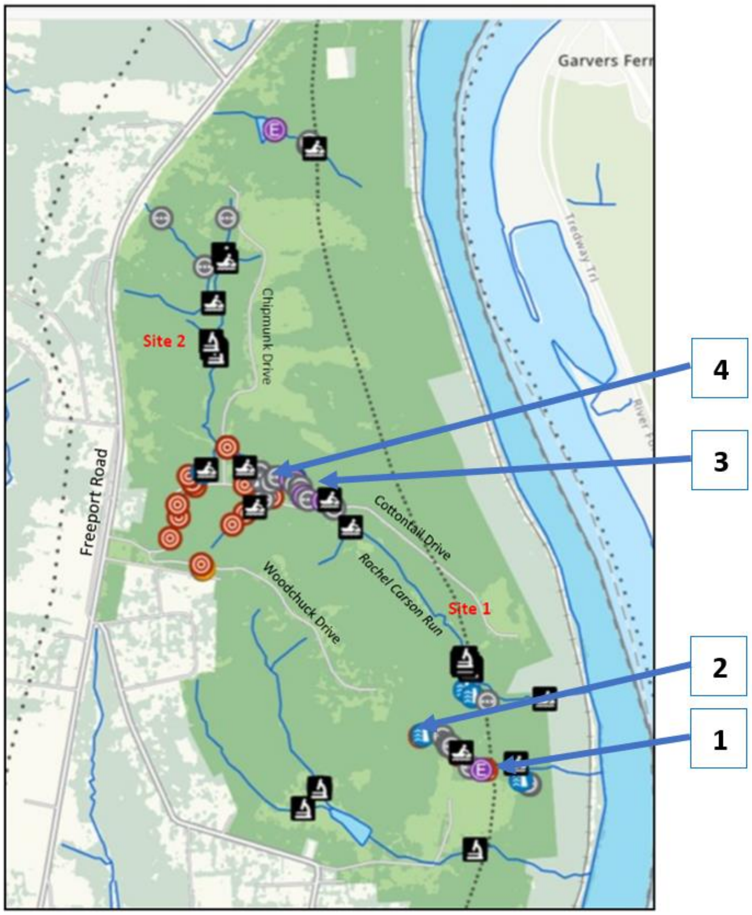
Stream Crossing

3) Horse and pedestrian traffic cross Little Pine Creek at the confluence of the trail from Green Valley Drive, creating significant sediment as they traverse the stream or its borders. (See photo at right.) Because equestrians use that trail, any attempt to prevent disturbance of the streambed would need to have a non-slip texture. A geo-textile secured across the stream - as farmers do for cattle - would address that concern in a cost-effective way. A wood-decked bridge over Little Pine Creek would be a more expensive solution but might be more aligned with the aesthetic goals of the park.

Upslope Buffer

4) Establishing buffers of shrubs and tree upslope from stream channels can be a valuable strategy in preventing/reducing erosion downslope. Both the speed and volume of water traveling to and along a stream contribute to degraded streambanks. Establishing an expanded forested buffer along the bottom of the "sledding hill" in the park's southwest corner would help catch any surface flow coming from that slope that eventually enters Little Pine Creek.

Harrison Hills Park



The generally favorable physical condition of the streams in Harrison Hills Park, the good water condition and the good aquatic biological community are a reflection of the intact forest of the park. The only large areas that are unforested are by the environmental center and the ball fields. This park is more extensively forested than Hartwood Acres or White Oak.

1) The history of part of the park's land as a dumping ground for various materials has left a legacy of debris that makes access to at least one stream channel hazardous and might be causing erosion. The stream valley directly east of the parking lot for the ball fields contains both glass which had been dumped there historically as well as slag and extensive fallen timber, possibly due to slag contamination of the soil. The photo (right) shows a hidden area of erosion in that area. As a legacy situation, any attempt to remediate the area would be expensive and could prove counterproductive by disturbing unconsolidated materials that are at least partially covered by vegetation. The historical pattern of using swales or valleys as dumping grounds should end. Asphalt millings, tree debris, or any other materials placed in

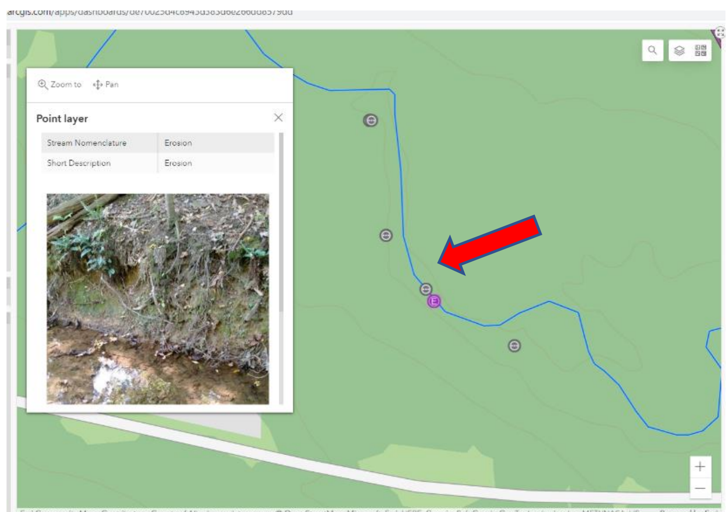
or near a swale – regardless of how shallow – can contribute to erosion and downstream impacts during storm events when water uses those otherwise dry depressions.

Tree Debris

2) Whether due to age or insect damage or other factors, there are a lot of trees that have fallen in the park. While fallen trees across a stream are not inherently problematic in many cases – and often provide valuable habitat - if they are causing erosion because water is trying to circumvent them, selective removal of sections of trees can help to reduce erosion. A review of fallen timber in the park with that in mind is merited.

Erosion Remediation

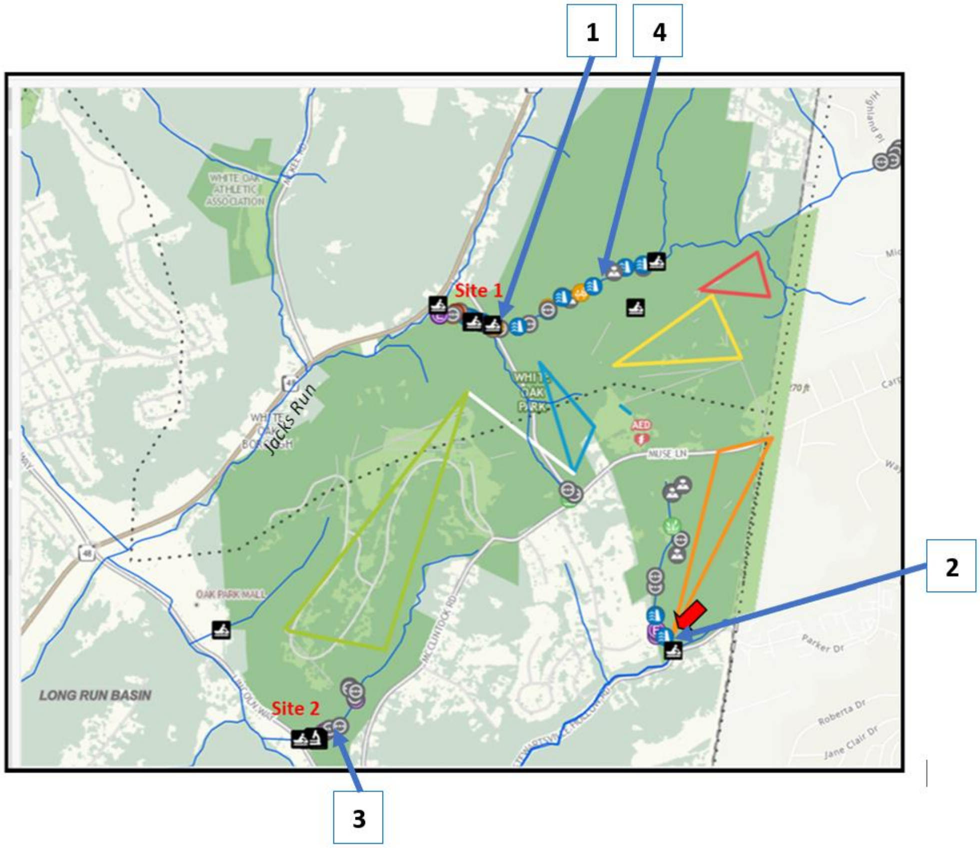
3) A section of Rachel Carson Run between Cottontail Drive and the Purple Trail has severe erosion and should be targeted for investigation into the causes of the erosion. Until then, recommendations for remediation are premature.



Old Structures

4) Several old bridges are resting in stream channels and can be promoting the accumulation of debris that prevents free flow of water along the channel or diverting the flow and causing erosion. Each of the structures should be studied and removed in a manner that enhances the channel's stability and function.

White Oak Park



Erosion Remediation

1) Of the three parks studied in Year 1, White Oak Park has the most mowed area at the top of the terrain the park occupies. Between the mowed areas and roadways, considerable surface flow and culverted stormwater is directed to the streams, resulting in extensive erosion. This is especially evident along the main stream downstream of the culvert under McClintock Road uphill from the playground which receives water from two streams traveling down steep gradients. (See photo to right and two at top of next page.)

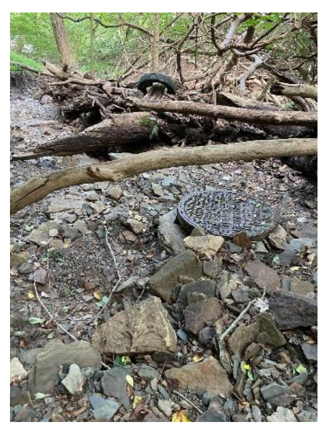
2) Similar scouring is seen at the base of the stream along the purple trail near where it meets the tributary running parallel to Stewartsville Hollow Road (photos below.) Live stake plantings in eroded slopes like these might slow erosion but are inadequate in strong scouring environments.

Restoration of any site with severe erosion at the scale of those above requires an engineering assessment to determine the causes and best restoration technique. Bioengineering could be appropriate but should be applied with a holistic understanding of the source and consequences of the erosion. References about live-staking and bioengineering are provided at the end of the report. Bioengineering is likely to be compatible with the management objectives of the park but does require permitting from the Allegheny County Conservation District or Department of Environmental Protection.

White Oak Park is surrounded by residential or commercial property on all sides which is probably contributing to the stormwater capture by the streams within the park. Pressure on understory plants by deer browse combined with the park's high relief topography makes any mitigation of these conditions challenging. Live stake plantings in eroded slopes like these might slow erosion but would have limited success if soil is not moist enough to prompt root growth.

Sewer Line Impacts

3) Lastly, the historical practice of installing sewer lines down stream valleys is visible at White Oak Park. The manholes below are in the valley behind White Oak animal shelter. The construction of sewer lines in valleys destabilizes the channel material with this kind of erosion and makes debris accumulation nearly inevitable. A review of the debris and options for judicious removal and planting of small shrubs that will not disrupt the sewer could be explored.



Promote Infiltration / Reduce Force

4) As with Hartwood Acres Park, any opportunity to convert mowed lawn that is not used for recreation is strongly encouraged at White Oak Park. Another universal consideration is to

reduce the force of water from storm drain outfalls with extensive splash pads. An array of well-secured timbers salvaged from the park set beneath a pipe can also reduce the force of the water as it drops to a hillside or enters a stream.

SUMMARY

The first three parks included in the stream assessment were the smallest of the nine parks in the County Parks system. This provided time for Master Watershed Steward to develop proficiency on the protocols and resolve any issues with equipment or techniques.

Hartwood Acres, Harrison Hills, and White Oak Parks each have distinct topography and land use patterns that impact the streams within their boundaries in different ways. Issues related to stream conditions and health reflect those differences. Erosion and sediment deposition are concerns in all three parks, but to varying degrees of severity. While stormwater management is the primary source of erosion, vegetation impacts from deer and invasive species play a significant role. Any effort to promote healthy forests or promote infiltration with conversion of lawn to meadow are valuable in combating the sources of erosion. Other strategies can be as minimal as debris removal or extensive as bioengineered restoration projects. While localized areas require attention, the results of this study indicate that most of the streams in the parks studied support pollution-sensitive insects and are fairly stable, structurally.

RESOURCES

Live Staking for Stream Restoration, Penn State Extension 2019

Yochum, Steven E. 2018. **Guidance for Stream Restoration.** U.S. Department of Agriculture, Forest Service, National Stream & Aquatic Ecology Center, Technical Note TN-102.4. Fort Collins, CO.

Bioengineering Materials, Planting Guide. Ernst Seeds
https://www.ernstseed.com/products/bioengineering-materials/