

Interpretation of Water Quality Testing Results of Newtown Creek

Conducted by Newtown Creek Coalition Members & Bucks County
Community College STEM students on May 14, 2016



Most physical and chemical tests are within acceptable levels for good-excellent water quality. Exceptions involve tests for Electrical Conductivity, Nitrate & Phosphate, which are a measure of NUTRIENTS available to algae in the stream. The test results indicate levels above what is acceptable, which may lead to excessive algal growth and oxygen depletion in the stream, as the temperatures increase during the summer months. Also, the stream shows a significant increase in nutrient levels from the Upper Site at the Hidden Lake Dam to the Lower Site at the George School. Finally, the ORP test results are below the ideal level for stream ecosystems. This indicates something is potentially wrong with the normal metabolic processes within the stream. This is most likely related to the issues of excessive nutrients. ORP also increases significantly from the Upper to the Lower Sites.

The macroinvertebrate survey results (4.647 at Upper Site / 4.255 at Lower Site) support the results of the physical & chemical tests. The calculated Hilsenhoff Biotic Index, which is a scale from 0.00 (Excellent Water Quality) to 10.00 (Very Poor Water Quality), indicates GOOD Quality Water at the Upper Site, to slightly VERY GOOD water at the Lower Site. Both designations include the “potential” for organic pollution.

In conclusion, the stream is fairly stable for now, but organic pollution problems may surface during the summer season. The source of the excess organic nutrients is in the headwaters of the Creek, that drain into the Hidden Lake dam area.

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Newtown Creek Coalition
Water Quality Monitoring Program Coordinator



NEWTOWN CREEK COALITION
Newtown Borough Newtown Twp.
Bucks Co. Community College
STEM Dept. / CORE Club

Newtown Creek



WATER QUALITY MONITORING PROGRAM

FIELD DATA

DATE of TESTING: 5-14-2016

PARAMETERS	SITE #1	SITE #2
	Below Hidden Lake Dam Newtown Pa	George School Campus Langhorne Pa
Time.....	10-11:30am	12:30-2:00pm
Latitude...(decimal deg).....	40.24438	40.21213
Longitude.(decimal deg).....	-74.93323	-74.94113
Elevation (m).....	60.0	23.0
Average Width (m).....	5.0	5.0
Average Depth (m).....	0.12	0.197
Average Velocity (m/sec).....	0.220	0.132
Volume of Flow (m ³ /sec).....	0.132	0.130
Air Temperature (°C).....	20.4	25.8
Water Temperature (°C).....	17.7	19.4
Turbidity (JTU).....	20.0	0.0
Dissolved Oxygen (mg/l).....	9.9	10.1
Oxygen Saturation (%).....	104.0	106.0
Carbon Dioxide (mg/l).....	18.0	14.0
pH.....	8.0	8.1
Total Alkalinity (mg/l CaCO ₃).....	100.0	80.0
Total Ca/Mg Hardness (mg/lCaCO ₃)..	200.0	200.0
Electrical Conductivity (µS/cm).....	490.0	600.0
Oxidation Reduction Potential (mV).	114.0	130.0
Nitrate (mg/l NO ₃).....	2.20	2.00
Phosphate (mg/l PO ₄).....	0.10	0.19

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Biotic Community of a Freshwater Stream

MACROINVERTEBRATES

Hilsenhoff Biotic Index Calculation



Date: 5-14-2016 Time: 10-12am

Name of Stream: Newtown Creek - UPPER SITE

Observer: Newtown Creek Coalition Location: 300 yds below Hidden Lake Dam / Newtown, PA 18940

A-adult L-larva P-pupa N-nymph

TAXA		# of	Tolerance	
Common Name	Scientific Name	Individuals (n)	x Value (a)	= Product (n x a)
1. Aquatic Earthworm (A)	Oligochaeta		8	
2. Leech (A)	Hirudinea		10	
4. Pouch Snail (A)	Physidae	4	8	32
3. Flatworm (A)	Turbellaria	28	4	112
5. Orb Snail (A)	Planorbidae		6	
6. Gilled Snail (A)	Ampullariidae	3	4	12
7. Fingernail Clam (A)	Veneroida	7	8	56
8. Freshwater Mussel (A)	Unionoida		8	
9. Crayfish/Freshwater Shrimp (A)	Decapoda	2	6	12
10. Aquatic Sowbug (A)	Isopoda	3	8	24
11. Scud (Gammarid) (A)	Amphipoda	9	4	36
12. Dragonfly (N)	Anisoptera	1	3	3
13. Damselfly (N)	Zygoptera	3	7	21
14. Water Penny Beetle (L)	Psephenidae	2	4	8
15. Riffle Beetle (A/N)	Elmidae		4	
16. Crawling Water Beetle (A/L)	Halipidae		7	
17. Water Scavenger Beetle (A/L)	Hydrophilidae		5	
18. Predaceous Diving Beetle (A/L)	Dytiscidae	14	5	70
19. Whirligig Beetle (A/L)	Gyrinidae		4	
20. Long-toed Beetle (A/L)	Dryopidae		5	
21. Other Beetles (A/L)	Coleoptera fam.		5	
22. Dobsonfly/Fishfly (L)	Corydalidae		0	
23. Alderfly (L)	Sialidae		4	
24. Spongilla Fly (L)	Sysyridae		5	
25. Watersnipe Fly (L)	Anthericidae		2	
26. Blackfly (L)	Simuliidae	8	6	48
27. Crane fly (L)	Tipulidae		3	
28. Horsefly (L)	Tabanidae		6	
29. Soldierfly (L)	Stratiomyidae		7	
30. Midgefly (red/non-red) (L)	Chironomonidae		7	
31. Hoverfly (rat-tailed maggot) (L)	Syrphidae		10	
32. Long-legged Fly (L)	Dolichopodidae		4	
33. Net-winged Midge (L)	Blephariceridae		0	
34. Mosquito (L/P)	Cilicidae		9	
35. Backswimmer (A/N)	Notonectidae		6	
36. Water Boatman (A/N)	Coraxidae		5	
37. Water Scorpion (A/N)	Nepidae		8	
38. Water Strider (A/N)	Gerridae		6	
39. Caddisfly (L)	Trichoptera	14	2	28
40. Stonefly (N)	Plecoptera		1	
41. Mayfly (N)	Ephemeroptera	4	3	12

N = 102

$\sum n_i a_i = 474$

$\sum n_i a_i / N = 474 / 102 = 4.647$ HBI [GOOD Water Quality/some organic pollution possible]

Biotic Community of a Freshwater Stream

MACROINVERTEBRATES

Hilsenhoff Biotic Index Calculation



Date: 5-14-2016 Time: 2:30-2:00pm

Name of Stream: Newtown Creek – LOWER SITE

Observer: Newtown Creek Coalition

Location: Back of George School / Langhorne PA 19047

		A-adult	L-larva	P-pupa	N-nymph			
TAXA		# of				Tolerance		
Common Name	Scientific Name	Individuals (n)				x Value (a)	=	Product (n x a)
1. Aquatic Earthworm (A)	Oligochaeta	1				8		8
2. Leech (A)	Hirudinea	2				10		20
4. Pouch Snail (A)	Physidae					8		
3. Flatworm (A)	Turbellaria					4		
5. Orb Snail (A)	Planorbidae					6		
6. Gilled Snail (A)	Ampullariidae					4		
7. Fingernail Clam (A)	Veneroida					8		
8. Freshwater Mussel (A)	Unionoida					8		
9. Crayfish/Freshwater Shrimp (A)	Decapoda	4				6		24
10. Aquatic Sowbug (A)	Isopoda	3				8		24
11. Scud (Gammarid) (A)	Amphipoda	20				4		80
12. Dragonfly (N)	Anisoptera					3		
13. Damselfly (N)	Zygoptera					7		
14. Water Penny Beetle (L)	Psephenidae					4		
15. Riffle Beetle (A/N)	Elmidae	5				4		20
16. Crawling Water Beetle (A/L)	Halipidae					7		
17. Water Scavenger Beetle (A/L)	Hydrophilidae					5		
18. Predaceous Diving Beetle (A/L)	Dytiscidae	4				5		20
19. Whirligig Beetle (A/L)	Gyrinidae					4		
20. Long-toed Beetle (A/L)	Dryopidae					5		
21. Other Beetles (A/L)	Coleoptera fam.					5		
22. Dobsonfly/Fishfly (L)	Corydalidae					0		
23. Alderfly (L)	Sialidae					4		
24. Spongilla Fly (L)	Sysyridae					5		
25. Watersnipe Fly (L)	Anthericidae					2		
26. Blackfly (L)	Simuliidae	17				6		102
27. Crane fly (L)	Tipulidae					3		
28. Horsefly (L)	Tabanidae					6		
29. Soldierfly (L)	Stratiomyidae					7		
30. Midgefly (red/non-red) (L)	Chironomonidae	3				7		21
31. Hoverfly (rat-tailed maggot) (L)	Syrphidae					10		
32. Long-legged Fly (L)	Dolichopodidae					4		
33. Net-winged Midge (L)	Blephariceridae					0		
34. Mosquito (L/P)	Cilicidae					9		
35. Backswimmer (A/N)	Notonectidae					6		
36. Water Boatman (A/N)	Coraxidae					5		
37. Water Scorpion (A/N)	Nepidae					8		
38. Water Strider (A/N)	Gerridae	1				6		6
39. Caddisfly (L)	Trichoptera	1				2		2
40. Stonefly (N)	Plecoptera	13				1		13
41. Mayfly (N)	Ephemeroptera	20				3		60

N = 94

$\sum n_i a_i = 400$

$\sum n_i a_i / N = 400/94 = 4.255$ HBI [VERY GOOD-GOOD possible/slight organic pollution]

WATER QUALITY CRITERIA



EPA/Penna. DEP Standards
Freshwater Lakes & Streams



WATER QUALITY PARAMETER

ACCEPTABLE/RECOMMENDED VALUES

WATER TEMP (°C).....	Apr 8-14 ^o	Sep 24-28 ^o
(NOTE: Temps above the ranges are of more concern than those below the ranges.)	May 14-21 ^o	Oct 19-23 ^o
	Jun 21-23 ^o	Nov 10-18 ^o

FISH	SHORT-TERM MAX		OPTIMUM FOR SPAWNING	
Bluegill	35°C	95°F	25°C	77°F
Trout	24°C	75°F	9°C	48°F

TURBIDITY(JTU = Jackson Turbidity Units)..... 30.0 JTU or less

DISSOLVED OXYGEN..... 5.0 mg/l or greater during 24-hr period

mg/l	Effect on Aquatic Organisms
0.0-2.0	Too low to support most aquatic organisms.
2.0-4.0	Tolerated by only a few fish & aquatic insects.
4.0-7.0	OK for most aquatic organisms/too low for cold water fish.
7.0-11.0	Supports healthy populations of aquatic organisms.

OXYGEN SATURATION..... 80 – 120%

(NOTE: Values may vary from 50 – 140%)

CARBONDIOXIDE..... 10.0 mg/l or less

PH..... 6.0 – 8.5 (range for surface waters: 5.0-9.5)

TOTAL ALKALINITY..... 80 – 120 mg/l CaCO₃

TOTAL Ca/Mg HARDNESS..... 60 – 180 mg/l CaCO₃
(greater than 500 mg/l toxic to aquatic life)

Soft Water	0-60
Moderately Hard water	61-120
Hard Water	121-180
Very hard Water	> 180

[NOTE: Carbon Dioxide, pH, Alkalinity, Hardness & Limestone Geology all interrelated]

TOTAL DISSOLVED SOLIDS (TDS)	<50 mg/l	Nutrient Poor
[NOTE: $E_c = TDS/0.64$]	50-100 mg/l	Low Nutrients (OLIGOTROPHIC)
	100-200 mg/l	Nutrient-rich (EUTROPHIC)
	>200 mg/l	Excess Nutrients(ADVANCED EUTROPHIC)

ELECTRICAL CONDUCTIVITY (E_c)	<78 microS/cm	Nutrient Poor
[NOTE: $TDS = 0.64 \times E_c$]	78-156 microS/cm	Low Nutrients (OLIGOTROPHIC)
	156-313 microS/cm	Nutrient-rich (EUTROPHIC)
	>313 microS/cm	Excess Nutrients (ADVANCED EUTROPHIC)

NITRATE (NO_3)	Natural Levels usually	< 1.0 mg/l
> 0.5 algal blooms ??	Acceptable levels	< 10.0 mg/l
10.0 MAX for drinking water	Recommended for sensitive freshwater organisms.	< 0.06 mg/l

RANGE FOR NATURAL SURFACE WATERS

Nitrate-Nitrogen (NO_3-N)	0.10 - 4.0 mg/l
[4.4 multiplier]	
Total Nitrate(NO_3^{2-})	0.44 - 17.0 mg/l

PHOSPHATE (PO_4) orthophosphate	< 0.1 mg/l	(streams not entering into lakes)
(Major LIMITING FACTOR in Aquatic Systems)	< 0.05 mg/l	(streams entering into lakes)
	< 0.025 mg/l	(in lakes)

RANGE FOR MOST NATURAL WATERS

Orthophosphate (PO_4^{3-})	0.90 - 3.15 mg/l	[IDEAL RATIO of <u>16</u> NO_3 : <u>1</u> PO_4]
Uncontaminated Lakes/Streams	0.01-0.03 mg/l	
Stimulates Aquatic Plant/Algae Growth	0.025-0.10 mg/l	
MAX level before eutrophication	0.10 mg/l	
Accelerated Aquatic Plant/Algal Growth (eutrophication/oxygen depletion)	>0.10 mg/l	

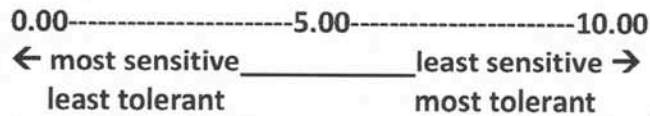
ORP (Oxidation Reduction Potential):	+300 - 340 mV	(Ideal for most active/efficient system)
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Macroinvertebrate Survey



Hilsenhoff Biotic Index a biological assessment water quality

The **Hilsenhoff Biotic Index (HBI)** estimates the overall tolerance of a macroinvertebrate community in a freshwater stream. The Index is weighted by the relative abundance of each organism **TAXA** (Order/Family/Genus/etc.), that are found in collected samples using kick seines, D-frame nets, etc. Each different type of invertebrate organism is assigned a **TOLERANCE VALUE** on a **0 – 10 scale**. The values are based on an organism's sensitivity to organic pollution.



The statistical equation for the index is: $HBI = \sum n_i a_i / N$

- Σ = sum of
- n = number of individuals in taxa i
- a = tolerance value of taxa i
- N = total number of individuals for all taxa in the sample

Hilsenhoff Biotic Index Scale

Biotic Index Value	Water Quality	Degree of Organic Pollution
0.00 - 3.75	Excellent	Organic Pollution Unlikely
3.76 - 4.25	Very Good	Possible Slight Organic Pollution
4.26 - 5.00	Good	Some organic pollution probable
5.01 - 5.75	Fair	Fairly substantial pollution likely
5.76 - 6.50	Fairly Poor	Substantial pollution likely
6.51 - 7.25	Poor	Very substantial pollution likely
7.26 - 10.00	Very Poor	Severe organic pollution likely

EXAMPLE:

TAXA (i)	# of Individuals (n)	Tolerance Value (a)	Product (n x a)
Stone flies Plecoptera	7	1	7
Water Pennies Psephenidae	17	4	68
Blackfly Simuliidae	20	6	120
Watersnipe Fly Anthericidae	3	2	6
	$N = 47$		$\sum n_i a_i = 201$

$$\sum n_i a_i / N = 201/47 = 4.28 \text{ Water Quality – GOOD / Some organic pollution possible}$$