# Black Lake Watershed Nutrients Analysis

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## Introduction

### Nutrients in Waterways

Nutrient loading is an issue that effects many U.S waterways both ecologically and economically. From 1994-2004 the U.S. Geological Survey did an assessment of nutrients in the nation's streams and groundwater[1]. Multiple nutrients were addressed in this report including nitrate, ammonia, total nitrogen, orthophosphate, and total phosphorus. Levels of all five nutrients exceeded (acceptable) background levels at more than 90% of streams that drained agricultural and urban watersheds due to the excessive use of fertilizers. Concentrations of total nitrogen in agricultural streams were about 4 mg/L, roughly 6 times greater than background levels compared to streams draining urban, mixed land use, or developed areas . The concentrations of total phosphorus were found to be the highest in both agricultural and urbans areas . Geographic patterns, when it relates to the occurrence and distribution of nutrients, tend to vary with seasonal change, and human factors like the use of fertilizer.

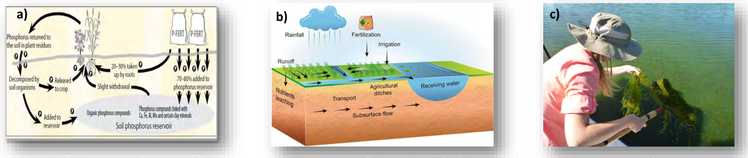


Figure 1 a) Nutrient utilization, b) Pathways to water bodies, c) Impact on Black Lake, NY – algal blooms and milfoil.

### Black Lake Water Quality Issues

Black Lake is a 7,855-acre lake that averages 8 ft in depth and spans 19.5 miles in length[2]. This lake runs through the Towns of Hammond, Morristown, Oswegatchie, Macomb, Rossie, and DePeyster in the St. Lawrence River region of New York and it part of the Indian River Watershed. At its northeast end the lake feeds into the Oswegatchie River. The popularity of Black Lake for recreational fishing has increased the human population has increased along the lakeshore. In 1972, the US EPA began studying the lake and found it to be highly eutrophic with levels of phosphorus and nitrogen. The water quality is influenced by agricultural runoff into rivers and overland, as well as outdated septic systems along the lakeshore. Algal blooms and milfoil are a significant problem, decreasing some recreational and aesthetic value. There are many ongoing efforts to better manage lake nutrient levels

### Project Statement

Black Lake has a major nutrient loading problem that is causing significant water quality issues. The goal of this project is to evaluate the nutrients and water quality conditions of the tributaries leading into Black Lake because they may be a significant contributor to the amount of nutrients in the lake. In order to accomplish this goal, an extensive literature review on Black Lake and its tributaries was conducted, to better understand the extent of the problem and research already conducted on the water quality of the region. Field testing and sampling will evaluate basic water quality conditions; and laboratory analysis will determine nutrient levels for nitrate, nitrite, total phosphorus, orthophosphate, and sulfate.

## Methods & Approach

### Field Testing and Sampling

The following parameters were tested for in the field:

- pH
- Temperature
- Dissolved Oxygen (DO)
- Conductivity
- Total Dissolved Solids (TDS)
- Total Suspended Solids (TSS)
- Turbidity

### Lab Testing

The following parameters were tested for in the lab:

- Nitrate
- Nitrite
- True color
- Apparent color
- Orthophosphate
- Total phosphorus
- Sulfate

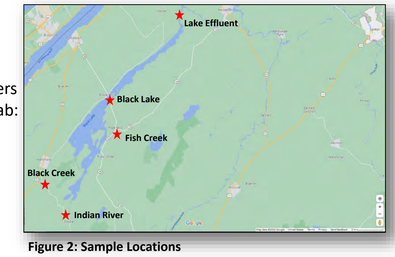


Figure 2: Sample Locations

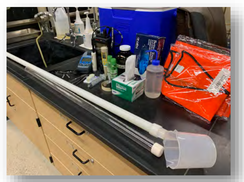

Figure 3: Materials

Figure 4: Testing tubes

## Overview Water Quality of Tributaries of Black Lake

### Indian River

| Basic Water Quality Parameters Indian River | | 30-Mar | 7-Apr |
|---|---|---|---|
| Parameter | Units | | |
| Conductivity | uS | 173.8 | 201 |
| Turbidity | NTU | 4.5 | 3.04 |
| pH | -- | 7.18 | 7.23 |
| Temperature | °C | 4.4 | 9.6 |
| Dissolved Oxygen | mg/L | 10.59 | 11.24 |
| TDS | ppm | 123 | 143 |

| Nutrient loading at Indian River | | 30-Mar | | 7-Apr | |
|---|---|---|---|---|---|
| Loading | Parameter | Units | | | |
| | | mg/L | ton/yr | mg/L | ton/yr |
| Nutrients | Orthophosphate ($PO_4^{3-}$) | 0.06 | 27.71 | 0.07 | 32.33 |
| | Nitrate ($NO_3^-$) | 0.02 | 9.24 | 0.01 | 4.62 |
| | Nitrite ($NO_2^-$) | 5.00 | 2309.28 | 3.00 | 1385.57 |
| | Total phosphate ($PO_4^{3-}$) | 0.34 | 157.03 | 0.31 | 143.18 |
| | Sulfate ($SO_4^{2-}$) | 0.00 | 0.00 | 1.00 | 461.86 |
| Discharge (cfs) | | 1761.526 | | 1048.218 | |
| = Low Range | | | | | |


Figure 5 Indian River Upstream

Figure 6 Indian River Down Stream

### Black Creek

Figure 7 Black Creek Down Stream

| Basic Water Quality Parameters Black Creek | | 30-Mar | 7-Apr |
|---|---|---|---|
| Parameter | Units | | |
| Conductivity | uS | 159.9 | 165.3 |
| Turbidity | NTU | 1.28 | 1.7 |
| pH | -- | 7.16 | 6.98 |
| Temperature | °C | 2.8 | 10.9 |
| Dissolved Oxygen | mg/L | 10.98 | 8.1 |
| TDS | ppm | 113 | 118 |

| Nutrient loading at Black Creek | | 30-Mar | | 7-Apr | |
|---|---|---|---|---|---|
| Loading | Parameter | Units | | | |
| | | mg/L | ton/yr | mg/L | ton/yr |
| Nutrients | Orthophosphate ($PO_4^{3-}$) | 0.03 | 13.86 | 0.07 | 32.33 |
| | Nitrate ($NO_3^-$) | 0.01 | 4.62 | 0.01 | 4.62 |
| | Nitrite ($NO_2^-$) | 6.00 | 2771.13 | 4.00 | 1847.42 |
| | Total phosphate ($PO_4^{3-}$) | 0.39 | 180.12 | 0.57 | 263.26 |
| | Sulfate ($SO_4^{2-}$) | 2.00 | 923.71 | 0.00 | 0.00 |
| Discharge (cfs) | | 214.156 | | 127.975 | |
| = Low Range | | | | | |

Figure 8 Black Creek Upstream

### Fish Creek

Figure 9 Upstream of bridge

Figure 10 Upstream towards bridge

Figure 11 Down stream

| Nutrient loading at Fish Creek | | 30-Mar | | 7-Apr | |
|---|---|---|---|---|---|
| Loading | Parameter | Units | | | |
| | | mg/L | ton/yr | mg/L | ton/yr |
| Nutrients | Orthophosphate ($PO_4^{3-}$) | 0.06 | 27.71 | 0.04 | 18.47 |
| | Nitrate ($NO_3^-$) | 0.10 | 46.19 | 0.01 | 4.62 |
| | Nitrite ($NO_2^-$) | 6.00 | 2771.13 | 5.00 | 2309.28 |
| | Total phosphate ($PO_4^{3-}$) | 0.39 | 180.12 | 0.79 | 364.87 |
| | Sulfate ($SO_4^{2-}$) | 1.00 | 461.86 | 0.00 | 0.00 |
| Discharge (cfs) | | 260.887 | | | |
| = Low Range | | | | | |

| Basic Water Quality Parameters Fish Creek | | 30-Mar | 7-Apr |
|---|---|---|---|
| Parameter | Units | | |
| Conductivity | uS | 203 | 210 |
| Turbidity | NTU | 1.91 | 0.93 |
| pH | -- | 8.06 | 6.70 |
| Temperature | °C | 2.7 | 12.6 |
| Dissolved Oxygen | mg/L | 11.2 | 8.17 |
| TDS | ppm | 144 | 149 |

### Black Lake

| Nutrient loading at Black Lake | | 30-Mar | | 7-Apr | |
|---|---|---|---|---|---|
| Loading | Parameter | Units | | | |
| | | mg/L | ton/yr | mg/L | ton/yr |
| Nutrients | Orthophosphate ($PO_4^{3-}$) | 0.08 | 36.95 | 0.03 | 13.86 |
| | Nitrate ($NO_3^-$) | 0.02 | 9.24 | 0.01 | 4.62 |
| | Nitrite ($NO_2^-$) | 4.00 | 1847.42 | 5.00 | 2309.28 |
| | Total phosphate ($PO_4^{3-}$) | 0.09 | 41.57 | 0.62 | 286.35 |
| | Sulfate ($SO_4^{2-}$) | 0.00 | 0.00 | 0.00 | 0.00 |
| Discharge (cfs) | | -- | | | |
| = Low Range | | | | | |

| Basic Water Quality Parameters Black Lake | | 30-Mar | 7-Apr |
|---|---|---|---|
| Parameter | Units | | |
| Conductivity | uS | 185.7 | 167.2 |
| Turbidity | NTU | 3.16 | 3.84 |
| pH | -- | 8.14 | 6.71 |
| Temperature | °c | 2.6 | 5.4 |
| Dissolved Oxygen | mg/L | 10.09 | 11.12 |
| TDS | ppm | 132 | 119 |

Figure 12 Lake bridge

Figure 13 Western Black Lake view

Figure 14 Black Lake Effluent, facing northwest

### Lake Effluent

| Nutrient loading at Black Lake | | 30-Mar | | 7-Apr | |
|---|---|---|---|---|---|
| Loading | Parameter | Units | | | |
| | | mg/L | ton/yr | mg/L | ton/yr |
| Nutrients | Orthophosphate ($PO_4^{3-}$) | 0.04 | 18.47 | 0.10 | 46.19 |
| | Nitrate ($NO_3^-$) | 0.03 | 13.86 | 0.01 | 4.62 |
| | Nitrite ($NO_2^-$) | 4.00 | 1847.42 | 5.00 | 2309.28 |
| | Total phosphate ($PO_4^{3-}$) | 0.54 | 249.40 | 2.20 | 1016.08 |
| | Sulfate ($SO_4^{2-}$) | 0.00 | 0.00 | 0.00 | 0.00 |
| Discharge (cfs) | | -- | | | |
| = Low Range | | | | | |

| Basic Water Quality Parameters Lake Effluent | | 30-Mar | 7-Apr |
|---|---|---|---|
| Parameter | Units | | |
| Conductivity | uS | 187.6 | 163.8 |
| Turbidity | NTU | 4.61 | 3.88 |
| pH | -- | 7.20 | 6.45 |
| Temperature | °C | 2.5 | 10.9 |
| Dissolved Oxygen | mg/L | 11.33 | 9.68 |
| TDS | ppm | 134 | 116 |

## Evaluation of Black Lake Waterways

### Comparison to 1974 USEPA Study

| Sampling Locations | Sampling Parameters (Mean and Standard Deviation) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Combined Nitrite+ Nitrite (mg/L - N) | 1974 | Total Phosphorus (mg/L Po43-) | 1974 | Orthophoshate (mg/L PO43- | 1974 | Sulfate (mg/L) | 1974 |
| Indian River | 4.014 ± 1.005 | 0.117 ± 0.126 | 0.0325 ± 0.015 | 0.061 ± 0.031 | 0.065 ± 0.005 | 0.028 ± 0.020 | 0.05 ± 0.05 | - |
| Black Creek | 5.01 ± 1 | 0.074 ± 0.043 | 0.48 ± 0.09 | 0.060 ± 0.039 | 0.05 ± 0.02 | 0.030 ± 0.026 | 1 ± 1 | - |
| Fish Creek | 5.555 ± .545 | 0.106 ± 0.122 | 0.59 ± 0.2 | 0.101 ± 0.071 | 0.05 ± 0.01 | 0.051 ± 0.048 | 0.05 ± 0.05 | - |
| Causeway at Black Lake | 4.515 ± 0.495 | - | 0.355 ± 0.265 | - | 0.055 ± 0.025 | - | 0 | - |
| Lake Effluent | 4.52 ± 0.49 | 0.059 ± 0.062 | 1.37 ± 0.83 | 0.049 ± 0.016 | 0.07 ± 0.03 | 0.016 0.007 | 0 | - |

Nutrient levels were compared to results from a 1974 study of the same sample locations. Almost every nutrient examined has a higher value than before, as shown in the table. Agricultural runoff may be the primary cause of the rise in nutrients in the tributaries.

### Comparison to National Streams and Lakes

| National Median for Agriculturally Impacted Streams est by Dubrovsky Et Al[4] | Combined Nitrite+ Nitrite (mg/L - N) | Total Phosphorus (mg/L Po43-) | Orthophoshate (mg/L PO43-) |
|---|---|---|---|
| | 2.7 | 0.25 | 0.08 |
| Indian River | 4.014 | 0.325 | 0.065 |
| Black Creek | 5.01 | 0.48 | 0.05 |
| Fish Creek | 5.555 | 0.59 | 0.05 |
| Causeway at Black Lake | 4.515 | 0.355 | 0.055 |
| Lake Effluent | 4.52 | 1.37 | 0.07 |

Combined nitrite+nitrate and total phosphorous levels at all sites exceeded the national median values for agriculturally impacted streams. Dissolved orthophosphate levels were below the national median.

### Comparison to EPA Criteria

| Mean Values for Parameters Tested in Lab | | | |
|---|---|---|---|
| | Nitrate (mg/L - NO3-) | Nitrite (mg/L - NO2-) | Total Phosphorus (mg/L Po43-) |
| EPA Criteria | 10 | 1 | 0.01 |
| Sampling Locations | | | |
| Indian River | 0.015 | 4.014 | 0.325 |
| Black Creek | 0.01 | 5.01 | 0.48 |
| Fish Creek | 0.055 | 5.555 | 0.59 |
| Causeway at Black Lake | 0.015 | 4.515 | 0.355 |
| Lake Effluent | 0.02 | 4.52 | 1.37 |

The occurrence of stream nutrient concentrations exceeding USEPA-recommended nutrient standards is seen at all the tested sites for nitrite and total phosphorus . Excessive fertilizer and manure applications are linked to high phosphorus and nitrogen concentrations in agricultural contexts. Natural fluctuations in precipitation and streamflow also have an impact on nutrient concentrations.

## Conclusions

The amounts of nitrogen and phosphorus have changed dramatically since 1972. In upstream watersheds, nutrient concentrations in streams are directly tied to land use and accompanying fertilizer applications, as well as human and animal wastes. The Clean Water Act requires states and authorized tribes to establish designated uses for their waterways in consideration of these aims, and to adopt water quality criteria that safeguard those designated uses as part of state and tribal water quality standards.

## Reference

1. USGS. (2004). Nutrients in the Nation's Streams and Groundwater.
2. Quantitative Environmental Analysis, LLC Liverpool, NY. (2008, July 14). *Black Lake Eurasian Watermilfoil Management Plan*
3. US EPA. (1974). U.S Environmental Protection Agency National Eutrophication Survey
4. Dubrovsky, N.M., and Hamilton, P.A., 2010, Nutrients in the Nation's streams and groundwater: National Findings and Implications: U.S. Geological Survey Fact Sheet 2010-3078, 6 p.