

Water testing near the Town of Tuxedo's mulching facility

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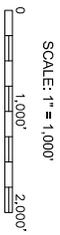
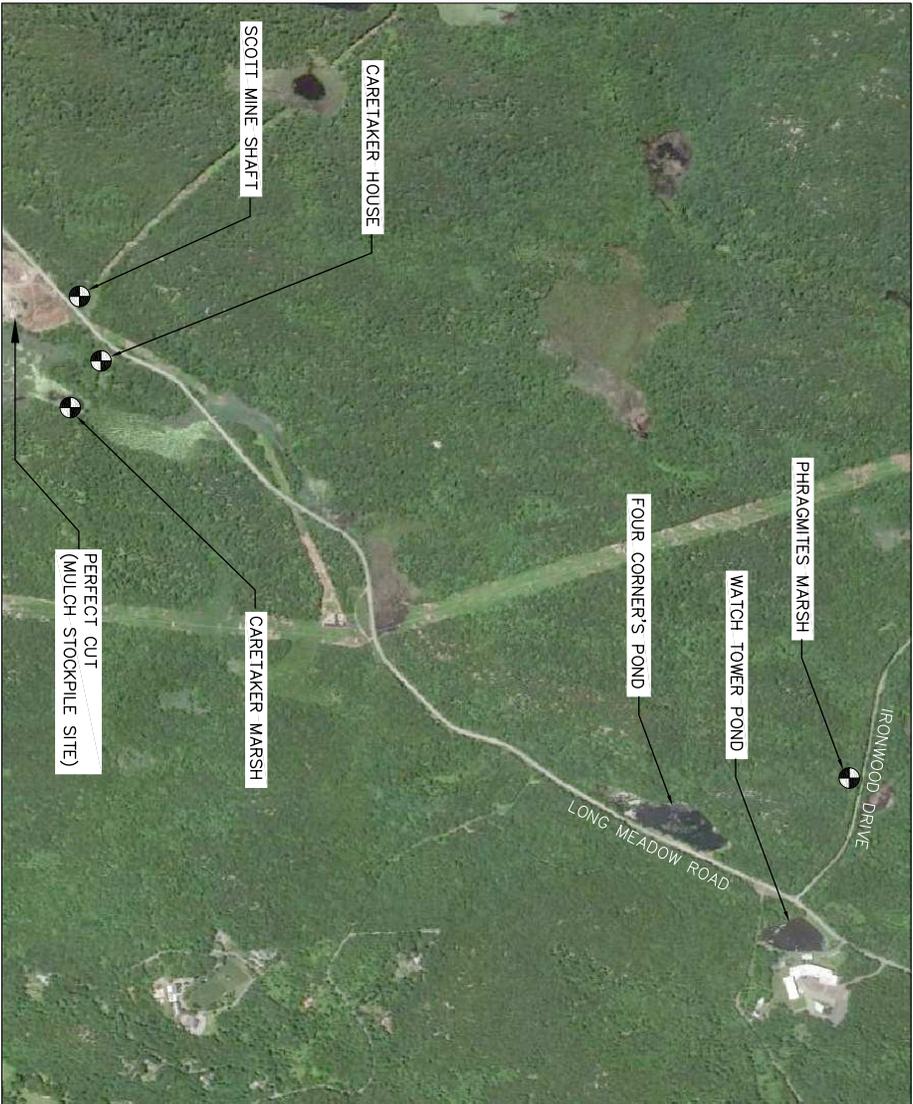
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Introduction

A fish kill in Four Corners Pond on or about March 12, 2012 and a subsequent fish kill a few days later in Watch Tower Pond have raised concerns about the environmental health of Warwick Brook. This stream runs northeast from the Caretaker Marsh along Long Meadow Road to Four Corners Pond and Watch Tower Pond then east eventually emptying into Wee Wah Lake (Figure 1). On March 13th and 20th, the New York DEC measured pH, dissolved oxygen, conductivity and alkalinity along the course of Warwick Brook, between Wee Wah Lake and the Caretaker Marsh and at various locations in streams flowing into Caretaker marsh. While oxygen and pH levels were near normal (Ph. 7 to 8, DO 7 mg/l to 10 mg/l) in streams flowing into the Caretaker Marsh, they were both below normal within that marsh (Ph 5 to 5.5, DO 1mg/l to <1 mg/l) (*i.e.* more acidic and oxygen starved), as well as at some locations in Warwick Brook, downstream from the marsh, including Four Corners pond. On March 25th, Watershed Assessment Associates identified impoverished macro invertebrates faunas (mostly insect larvae visible to the naked eye) in Warwick Brook with impoverishment increasing from Wee Wah Lake to upstream of Four Corners Pond.

The cause of this surface water degradation was unknown, however, the Town of Tuxedo's mulching facility, operated by Perfect Cut Inc., could be supplying organic matter to the adjacent Caretaker Marsh contributing to its low oxygen levels and that of waters downstream from it.

By tracing drainage patterns between the Caretaker Marsh and Tuxedo Lake, Donald Bayne, John Moon and others raised the possibility of a hydraulic connection between the Caretaker Marsh and Tuxedo Lake. Therefore the environmental degradation of the Caretaker Marsh not only threatens the surface waters of Sterling Forest State Park, the recreational uses of Wee Wah Lake and possibly threatens the drinking water of the Village of Tuxedo Park and the Hamlet of Tuxedo.



LEGEND
 APPROXIMATE SAMPLE LOCATION

FIGURE 1
 TUXEDO PARK, NY
 GROUNDWATER AND SURFACE WATER
 SAMPLE LOCATION PLAN
 AUGUST 2012 SCALE: AS SHOWN

Weston&Sampson

Sampling strategy:

The chemistry of the Caretaker Marsh may provide clues to the source of its degradation and at the same time provide a chemical signature that can be used to trace pollutants into neighboring water bodies within Sterling Forest State Park and beyond. Accordingly a sampling strategy was designed to identify differences between the chemistry of the Caretaker Marsh and that of a comparable marsh, designated here as the Phragmites Marsh (Fig. 1), 1.5 miles from the Caretaker Marsh and with no known connection to it. To explore the possibility that pollutants may enter the ground water near Caretaker Marsh, two subsurface water bodies were sampled, Scott Mine Shaft #2 and a well at the Sterling Forest caretaker’s house near the mulching facility (Table 1, (fig 1). Specific measurements include the concentrations of calcium (Ca), iron (Fe), potassium (K), magnesium (Mg), arsenic (As), phosphorous (P) as well as total organic carbon (TOC), dissolved organic carbon (DOC) and biochemical oxygen demand (BOD)¹.

	Scott Mine shaft #2	Caretaker house well	Caretaker Marsh	Phragmites Marsh
GPS coordinates	41° 12.3637'N 74° 14.5098 W	41° 12.3894' N 74° 14.3649' W	41° 12.3480' N 74° 14.2547' W	41° 13.8213' N 74° 13.9264' W
Water Temp. C°	17.93	19.30	25.79	25.04

Laura Yellen, an employee of the engineering firm of Weston and Sampson, gathered the samples on July 16, 2012 accompanied by James Hays who had selected the sampling sites. The work was supported through a gift from TARGET Tuxedo to the Sterling Forest Partnership. We are grateful to Mr. Jeffrey Hutchinson, Sterling Forest State Park Manager, for his cooperation and encouragement during the sampling process and to the Sterling Forest State Park organization for granting us permission to sample. Weston and Sampson’s report is included as Appendix I and Test America’s report of chemical analyses as Appendix II.

¹ BOD is the amount of [dissolved oxygen](http://en.wikipedia.org/wiki/Biochemical_oxygen_demand) needed by aerobic organisms to break down organic material present in a given water sample at a certain temperature over a specific time period. Pristine natural waters have BOD of less than 1 mg/l, raw sewage in the US as little as 200 mg/l (http://en.wikipedia.org/wiki/Biochemical_oxygen_demand).

Results of surface water testing

Surface waters underlain by granite gneiss, as are the surface waters of Sterling Forest State Park, are usually “soft” (i.e. have low concentrations of dissolved elements and compounds). This is true of Phragmites Marsh, far from the mulch pile (Table 1). Not so for the Caretaker Marsh, adjacent to the mulch pile, where concentrations of all measured elements are many times those of the Phragmites Marsh (Table 1). The Caretaker Marsh’s excess total organic carbon (TOC), dissolved organic carbon (DOC), biochemical oxygen demand (BOD) and phosphorous (P) over their concentrations in the Phragmites Marsh require a source of organic carbon and phosphorous outside the Caretaker Marsh. Carbon and phosphorous leached from wood within the adjacent mulch pile is the likely source. The amounts of TOC in the Caretaker Marsh are indeed remarkable. For example, pristine waters have about 5mg/l of TOC (Maybec, 1982) similar to that measured in Phragmites Marsh. A highly polluted river such as the European Zenne river near Brussels, Belgium receives untreated sewage from a basin with a population density of 300 people per square kilometer has TOC of 74.8 mg/l (Abril et al., 2002) well below the 139mg/l measured in the Caretaker Marsh.

The excess calcium, iron, potassium, magnesium, and arsenic in the Caretaker Marsh, relative to the Phragmites Marsh, probably have other sources than uncontaminated wood within the mulch pile. Scott mine water,

Table I

Surface water	TOC mg/l	DOC mg/l	BOD mg/l	Ca µg/l	Fe µg/l	K µg/l	Mg µg/l	As µg/l	Al µg/l	P mg/l
Phragmites Marsh	6.55	5.39	<6.00	5140	998	<5000	<5000	<2.5	<200	0.17
Caretaker Marsh	139	101	101	75100	12500	80900	37200	15.9	223	6.01
Subsurface water										
Scott Mine	12.3	10.8	12.4	86600	27600	15300	22200	<2.5	<200	0.19
Caretaker House well	<1.0	<1.0	<6.0	81300	410	5630	18300	<2.5	< 200	0.03

used to frequently wet the mulch pile, is a possible source of some of these elements for the mine water contains high concentrations of calcium, iron,

potassium and magnesium compared with the Phragmites Marsh but only calcium and iron concentrations are higher in the mine water than Caretaker Marsh water. Other sources than the mine water should be sought to account for the higher concentrations of potassium, magnesium, aluminum and arsenic in the Caretaker Marsh. Arsenic is of special interest for its concentration in the Caretaker marsh is above the international standard for drinking water of 10 µg/l (Meybec, 1982). The Caretaker Marsh concentration is also much higher than the arsenic concentration in the mine water. The marsh arsenic could be coming from sources within the mulch pile, or the low oxygen values of the marsh water could contribute to mobilizing (extracting) arsenic from the sediments.

The pH of the Scott Mine water is 3.26 (acidic) compared with near neutral (7.03 to 7.46) readings for the other three sites. DEC recorded more acidic pH readings in the Caretaker Marsh (5 to 5.5) during their March sampling. Weston and Sampson's report (Appendix A) recommends against the application of acidic mine water to mulch piles.

“The acidic mine water passing through the mulch pile and the exposure of the mine water to the atmosphere can result in complex reactions that may contribute to production of materials that may be detrimental to the aquatic environment.”

Results subsurface water testing

Low levels of organic matter in the well of the Caretaker's House suggests that neither water from the Caretaker Marsh nor from the Mulch Pile reaches the ground water at this site. This is consistent with this well's lack of response to lowered water levels in Scott mine during testing by the Sterling Forest Corporation (Lawler, Matusky and Skelly, 2001). Higher levels of total and dissolved organic carbon in the Scott Mine water than the Caretaker Cottage well water may indicate mulch pile effluent reaches the mine water.

Discussion

Marshes can develop low oxygen levels through natural processes; however, the high levels of organic carbon and other elements in the Caretaker Marsh, relative to the Phragmites Marsh, require sources external

to the Caretaker Marsh. The data presented here are consistent with massive amounts of organic carbon being released to Caretaker Marsh from the adjacent mulching facility. Such carbon pollutants have a negative environmental effect because as microorganisms oxidize carbon, oxygen levels in the water are reduced limiting and probably exterminating all oxygen breathing life within the marsh. The resulting complex organic “soup” can also generate other toxins that are beyond the scope of this study. The organic carbon released to Caretaker Marsh in late winter was apparently sufficient to cause low oxygen levels and fish kills as far away as Watch Tower Pond in mid March.

Scott Mine water, used to wet the mulch pile, is also adding elements it contains to the Caretaker Marsh. Mine water from the Cook Mine shaft also reaches the Caretaker Marsh via pipes under the Town’s DPW facility. Either way the addition of polluting mine water to the marsh is the Town of Tuxedo’s responsibility. Although the mine water has low dissolved oxygen concentrations (0.15 to 0.54 mg/l) (Lawler, Matusky and Skelly, 2001) it is not a source of much organic carbon to Caretaker Marsh. The greater potassium, magnesium aluminum and arsenic concentrations in Caretaker Marsh than either Phragmites Marsh or Scott mine water probably requires sources other than the mine water or the organic material in the mulch pile.

Conclusion

This study concludes that activities of the Town of Tuxedo are introducing pollutants into Caretaker Marsh. These pollutants include large amounts of organic carbon and a suite of other elements.

Recommendations

The pollution of Caretaker Marsh and waters downstream from it, within the Sterling Forest State Park, must cease. To this end the application of acidic mine water to the wood in the mulching facility should stop without delay. The mulching facility should be moved to another location; such a large mulching facility (some two hundred thousand cubic yards of woody material) should never have been placed in close proximity to a marsh within a State Park with possible connections to the sole source of drinking water of two communities. The drainage of mine water from Cook

Mine shaft to the Caretaker Marsh should also cease as acidic mine waters are known to have negative environmental consequences (Akcil and Soner 2006).

References cited

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