WATERSHED MONITORING GROUP PROGRAMS: IMPACT AND ASSESSMENT OF OIL AND SEWAGE SPILLS IN HUNNICUTT CREEK; ATHENS, GEORGIA

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REFERENCE: *Proceedings of the 2005 Georgia Water Resources Conference* held April 25-27, 2005, at The University of Georgia. Kathryn J. Hatcher, editor, Institute of Ecology, The University of Georgia, Athens, Georgia.

Abstract. In August 2003, up to 14,000 gallons of used oil spilled into Hunnicutt creek, headwaters to the Middle Oconee River. This resulted in significant aquatic ecological damage documented by members of the Upper Oconee Watershed Network (UOWN). The biological score for Hunnicutt Creek determined after the spill was poor (<11). In February 2004, free oil phases were observed at various points on the water surface and sediments extending as far as the mouth of Hunnicutt, the entry point into the Middle Oconee River.

Initial chemical analysis of the creek water in September 2003 was high in hydrocarbon concentrations, particularly dibenzo (a,h) anthracene (>345 µg/L) and hexadecane (178.66 mg/L). This was consistent with the poor biological score obtained in our September 2003 and January 2004 quarterly sampling at Ben Burton Park. The latter event yielded a poor biological score (12). The scores obtained in July 2004 were poor (7) closer to the contamination source but had returned good (20) at the creek's mouth. A shallow depth (<15 cm) chemical analysis of the sediments did not detect any organic contaminants of concern and monitoring results for 2004 show signs of improvement. Hunnicutt may have attained a fair level of recovery through natural attenuation, which can only be confirmed through continual monitoring of the water, sediments, and the biological activity in the creek.

INTRODUCTION

Contamination of water bodies is a major risk to human health and the environment in which the pollution occurs. Often, as is the case of oil spills, and the resultant environmental impact to surface water bodies are not limited to the effected sites only. Contamination of streams and rivers will therefore impact a significant part of the watershed. The immediate vicinity surrounding the contaminant source and downstream of the impact site are important areas requiring continual monitoring as a means of long-term impact assessment. Particularly when natural attenuation is the method of remediation, the function of the surface water body and its surrounding environment need to be evaluated and monitored to minimize potential health risks.

Small creeks and streams are valuable resources and need to be protected due to their link to major rivers. Pollution in small surface water bodies, however, are rarely detected and do not receive appropriate remedial attention. This may be due to a number of factors including lack of public awareness, funding, or inappropriate application of remedial procedures. Regular monitoring of local watersheds will expose contaminations and alert the local community as well as environmental officials to potential health and environmental hazards for prompt action. Pollution awareness may be more easily achieved through regular monitoring by local watershed groups.

BACKGROUND

Hunnicutt creek is located to the west of Athens – Clarke County in Northeast Georgia (Fig.1). It flows for approximately 2.5 miles from northeast to southwest and is a tributary to the headwaters of the Middle Oconee River within the Upper Oconee Watershed. The city of Athens is the largest municipality within this watershed. On August 10, 2003 an estimated 6,000 – 14,000 gallons of petroleum products from David Oil Company on Jefferson Road (Figure 1) spilled into the Hunnicutt. This spill resulted in significant ecological damage evidenced by dead fish and salamanders along the creek's shore. Several micro-invertebrates were also affected. Significant amounts of free oil products were also visible in the creek water. This extended from the source site upstream to the confluence with the Middle Oconee River.

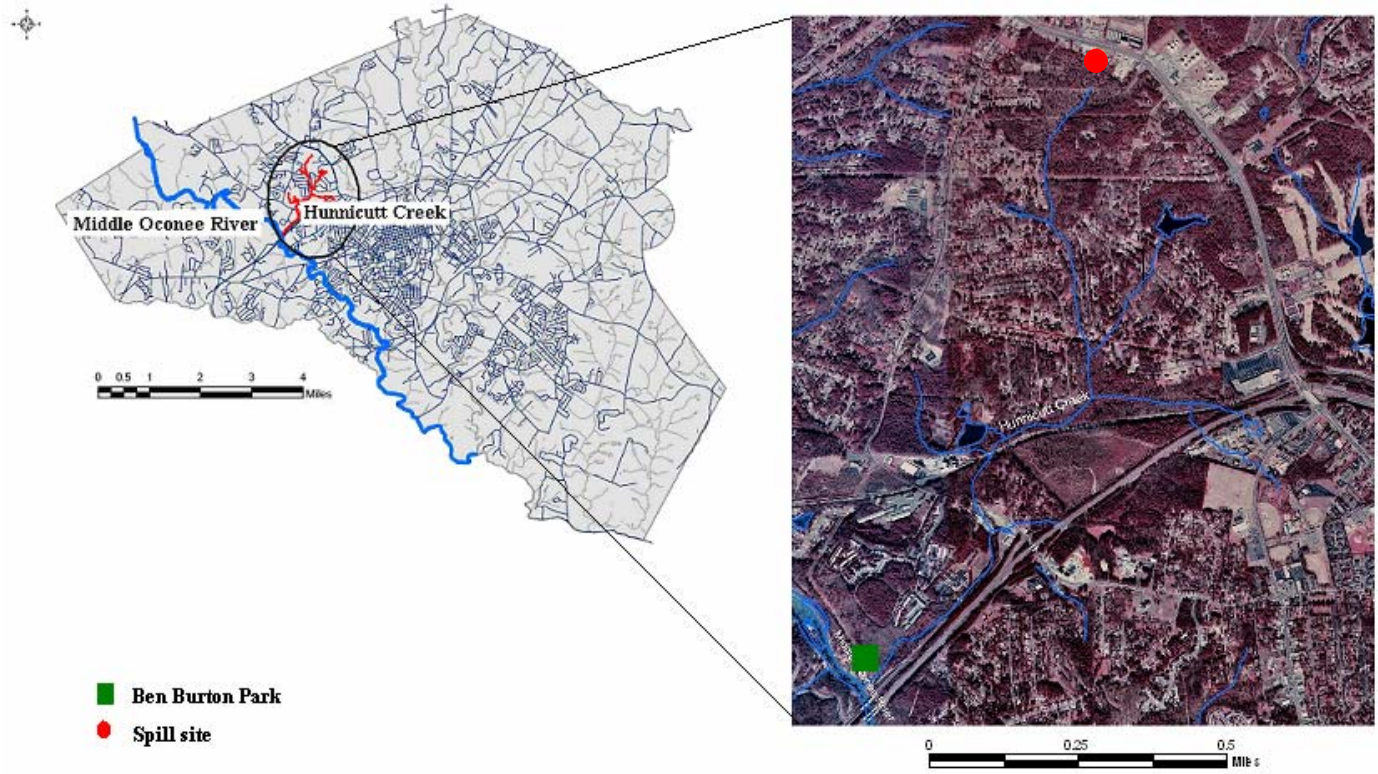

Figure 1. Location of Hunnicutt Creek in Athens-Clarke County. Maps developed by NEGRDC.

Following citizen alerts, the Georgia Environmental Protection Division (EPD) carried out immediate response activities to remove all free oil products from the water surface. Although a large amount of the oil was removed, significant amounts of the gasoline products still remained several months after the initial cleanup. A chemical analysis of the creek water conducted approximately a month after the spill, confirmed the nature and extent of the contamination. Several aliphatic and aromatic hydrocarbons were detected including Polycyclic Aromatic Hydrocarbons (PAHs), some of which are potentially carcinogenic at concentrations as low as 0.0002mg/L (ATSDR, 1995 and 1997). The aliphatic compounds included hexadecane and pentadecane, which are n-alkanes commonly associated with petroleum contamination (Sandmeyer, 1981). A summary result of this analysis is presented in Table 2. In February 2004, a field investigation of the site showed significant amounts of the free oil product at several locations along the entire length of the creek. Pockets of oil were to be found underneath leaf litter and there was evidence of oil penetrations into the stream sediments. Several spots had significant gasoline smells, particularly closer to the spill site. This visual assessment also revealed several petroleum rainbows present at the mouth of Hunnicutt and freely flowing into the Middle Oconee River.

The United States Environmental Protection Agency (E.P.A.) has prioritized watershed protection and restoration particularly for the surface waters and aquifers that supply water to community drinking water systems. The pollution into Hunnicutt Creek is therefore particularly sensitive due to the following reasons:

- A public drinking water intake point is less than 50 yards downstream from the confluence of the Middle Oconee and Hunnicutt Creek.
- Hunnicutt Creek runs through Ben Burton Park, which is used as a recreational space by members of the Athens community. There is therefore an increased potential for human receptor impact.
- A leak in a municipal sewer pipe that resulted in accidental discharge into the creek waters.

For the above reasons, it is important to monitor and treat contaminants in small surface water bodies such as Hunnicutt prior to its entry into a major river. Although most of the free oil was removed by sorbents and vacuuming activities carried out by the EPD, physical remedies have been shown to have very little effect on residual oil collected under leaf litter or sorbed into the sediments (Hoff et al., 1993). A long-term risk arises as the residual oil becomes recalcitrant over time. This is not uncommon in the presence of multi-ring hydrocarbons of high molecular weight, such as PAHs (Huesemann et al, 2004). These compounds have low water solubilities and become strongly bound to sediments or particulate matter thereby increasing their persistence in the environment (Walter et al., 2000).

The Upper Oconee Watershed Network (UOWN) is a local non-governmental environmental monitoring organization within the Upper Oconee Watershed. This group has been instrumental in monitoring Hunnicutt creek and has characterized it as a priority 1 site based on past reports of sewer contamination. Hunnicutt creek is an important resource within the watershed for the reasons outlined in the previous paragraph. It is regularly monitored during quarterly sampling events at Ben Burton Park, where it flows into the Oconee River. The monitoring effort by UOWN is to determine the health of surface water bodies such as Hunnicutt through long term monitoring of key environmental parameters. These monitored parameters, determined through biological and chemical monitoring, become the most efficient method for achieving impact assessment on the water resource and the surrounding environment. A snapshot of the health of the watershed can therefore be quickly assessed.

METHODS

Three sites: Ben Burton Park, Tallassee and Homewood Hills were biologically monitoring during the quarterly events. Biological monitoring to assess water quality involves the direct identification and counting of macroinvertebrates (Georgia Adopt-A-Stream, 2003). The abundance and diversity of macroinvertebrates found is an indication of overall stream quality. The water quality rating is then determined as a biological index score: >22 – Excellent, 17 to 22 – Good, 11 to 16 – Fair, and <11 – Poor. Water samples are also collected for measurements of E. coli and fecal coliform concentrations by using membrane filtrations (APHA et al. 1992). Fecal coliform is used as a primary indicator of contamination due to human waste (Stapp and Mitchell, 1995).

A Hewlett-Packard (HP) 5973 Gas Chromatograph (GC)/Mass Spectrometer (MS) was used for the chemical analysis of the creek water to determine the concentration of hydrocarbons present resulting from the August 2003 oil spill. The hydrocarbon concentrations were measured using integrated GC areas and converted to concentrations using standard calibration curves.

RESULTS AND DISCUSION

Our biological measurements for 2003 and 2004 (Table 1) show that Hunnicutt Creek at Ben Burton Park was generally fair prior to the August 10 oil spill. The biological score recorded for the same site only days after the spill, on August 15, was poor (4). By fall of 2003, the creek began to show signs of recovery indicated by a fair score of 12. The same trend is observed from our winter and spring quarterlies. Signs of positive recovery

Table1. Summary of Hunnicutt Quarterly Monitoring Data at Ben Burton Park (except where noted).

	Biological Index Score	Fecal coliform (CFU/100mL)	E. coli (MPN/100mL)
2003			
Winter	16	100	74
Spring	16	220	346
Summer	15	2400	583
August Spill	4	-	-
Fall	12	1500	275
2004			
Winter	12	190	175
Spring	11	180	175
Summer	20	1100	148
Tallassee Rd.	15	-	-
Homewood H.	7	-	-
Fall	21	-	327

- Not determined

(>17) were however observed during our summer and fall 2004 monitoring activities. Table 1 also shows that Hunnicutt creek at the Homewood Hills location, approximately 1 mile from the source site, is yet to achieve a fair level of recovery. The severity of the oil contamination is shown in the high concentrations of aliphatic hydrocarbons determined from the chemical analysis summarized below (Table 2). Although aliphatic hydrocarbons degrade relatively quickly and are moderately toxic (Sandmeyer, 1981), their high concentrations were of great concern. Aromatic benzo (a) pyrene is a suspected carcinogen with the maximum contaminant level for drinking water set at 0.0002mg/L (ATSDR, 1995). The concentration of indeno (1,2,3-cd) pyrene was also high enough to be of concern. Immediately following the oil spill, extensive ecological damage was evidenced by deaths of the macro-invertebrates observed during our first field survey. A second investigation carried out in February 2004 showed petroleum films at several locations along the creek. Our last survey of Hunnicutt creek, in August 2004, indicated that oil films were no longer present. Chemical analysis of the bottom sediments, up to 15cm, did not detect any contaminants of concern.

The results indicate a marked improvement in biological scores at Ben Burton Park since after the spill. This may be as a result of decrease in hydrocarbon concentrations through natural attenuation involving several processes such as biodegradation (microbial action), dilution, sorption (absorption, adsorption), and evaporation.

Table 2. Summary of high concentration hydrocarbons detected in creek water (9/11/2003).

Compound	Hydrocarbon type	Concentration (mg/L)
pentadecane	Aliphatic	143.60
hexadecane	Aliphatic	178.66
tetramethylhexadecane	Aliphatic	124.31
chrysene	Aromatic	0.079
benzo (a) pyrene	Aromatic	0.151
indeno (1,2,3 – cd) pyrene	Aromatic	0.345

Elevated E. coli levels (Table 1) may have been as a result of the accidental sewer discharge in 2003. The 2004 E. coli and fecal coliform indicate an improvement from the previous year's observations. Hunnicutt creek may have been impacted by a sewer spill besides the oil spill in August 2003. The creek's recovery by natural attenuation can only be assessed through monitoring.

RECOMMENDATIONS

Hunnicutt creek was impacted by a major oil spill and accidental sewer discharge in 2003. Long term monitoring activities by a community based watershed monitoring groups such as Upper Oconee Watershed Network have been very instrumental in assessing the extent of initial contamination and the natural recovery achieved over time. Regular monitoring will have the obvious benefit of providing early warning of ecotoxicological impacts to sensitive receptors within the watershed. Although Hunnicutt creek appears to have achieved a fair level of recovery as determined by the improved biological scores it is important to continue monitoring to assess its recovery over time.

ACKNOWLEDGEMENTS

We wish to thank all volunteers who have tirelessly support all the monitoring efforts of the Upper Oconee Watershed Network (UOWN). We also applaud the vigilance of the Athens community in alerting UOWN and the environmental agencies on environmental issues of concern within our watershed. The hydrocarbon data were obtained with help from Dr. Sayed Hassan of the Environmental Analysis Lab; University of Georgia. Base maps (Figure 1) were developed by the North East Georgia Regional Development Center (NEGRDC).

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