IDENTIFYING SEWAGE LEAKS IN URBAN ENVIRONMENTS: EXAMPLES FROM ATHENS, GA

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Abstract. Sewer line failures are a major cause of stream impairment in urban areas. While many sewer line failures can be readily identified and corrected, other failures may be more difficult to remedy. This paper examines the general problem of sewer line failures. Specifically, we discuss 1) the observed causes of sewer line failures, 2) methods for determining which streams are being affected by sewer line failures, and 3) strategies for pinpointing the exact location of these failures so that they can be repaired. Examples of sewer line failures within Athens, Georgia, are used to illustrate the problems with identifying these failures.

INTRODUCTION

Wastewater disposal infrastructures in many cities suffers routine damage and obstructions that result in the release of untreated sewage into neighborhood streams. Athens, Georgia, is a typical community that relies on centralized treatment of wastewater. Conveyance structures (e.g., sewer lines) are an important component of the wastewater system that connects the wastewater sources – such as homes, offices, and businesses – with the wastewater treatment facility.

This paper examines two cases where urban streams were adversely affected by sewer line failures in Athens. The first is Stinky Creek, located next to the University of Georgia campus. Residents who live next to the stream have long complained about the noxious smell associated with the stream. A second case focuses on Trail Creek, located downstream from a mixed residential and industrial zone in town. While the individual failures were eventually mitigated, institutional problems can limit the effectiveness of urban water quality protection efforts.

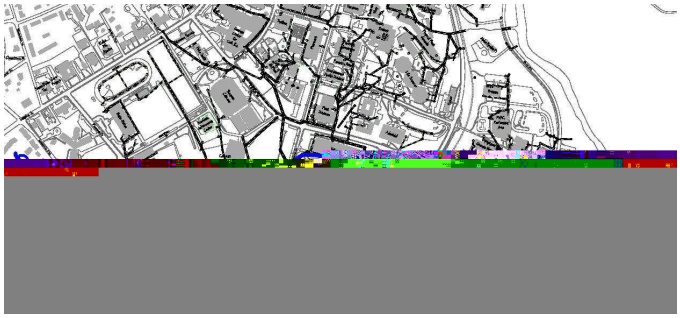

Figure 1: Map of storm drainage system for the east campus of The University of Georgia, showing the location of four sampling sites along Stinky Creek.

STINKY CREEK

In 2002, a group of University of Georgia students began monitoring Stinky Creek, a small urban stream in Athens Georgia, in order to address local residents' concerns about the water quality in the stream. Stinky Creek is a tributary of the North Oconee River, and is located in Athens, Georgia. The creek's watershed is fully developed and typical of most urban areas, with an extensive amount of impervious surface and limited riparian zone. Its headwaters are located in a residential area behind Lumpkin Square Apartments on Lumpkin Street. Approximately, two-thirds of Stinky Creek flows through drainage pipes under the University of Georgia (UGA) baseball field and College of Veterinary Medicine. Several storm drains empty into the creek as it flows under the UGA campus (Figure 1).

Four sites along Stinky Creek (Figure 1) were sampled weekly between September 14 and November 9, 2004, for water quality parameters, such as pH, dissolved oxygen, turbidity, and conductivity. We also collected grab samples to determine total suspended solids, ammonium N, and fecal coliform units (CFU) per 100 mL. Additional samples were

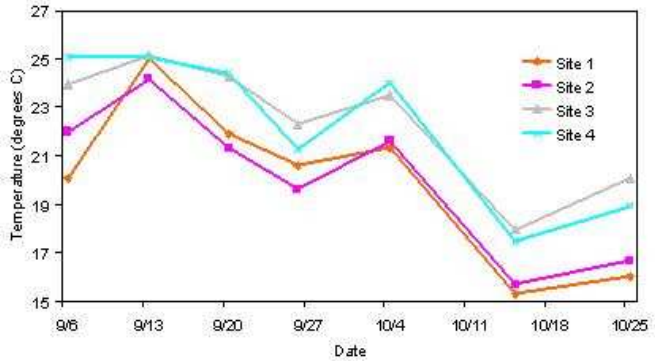

Figure 2: **Stream water temperature for each sampling date at all study site locations along Stinky Creek in Athens, Georgia.**

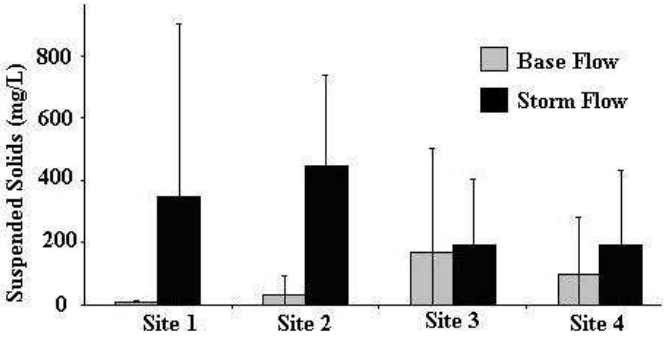

Figure 3: **Average total suspended solids from water samples collected during stormflow and baseflow events for each site along Stinky Creek.**

collected from Orange Trail Creek within the University of Georgia Botanical Gardens for use as a reference site. The Orange Trail Creek was selected because of its proximity to Stinky Creek, its intact riparian zone, and its known biological condition

Most of the data was typical of that associated with urban stream systems; temperature increased between upstream and downstream sites (Figure 2), baseflow turbidity and TSS concentrations were lower than stormflow (Figure 3), and DO showed no apparent trends. Baseflow ammonium N concentrations decreased at downstream sites, the opposite pattern of pH and DO values. Almost no fluctuation occurred in stormflow ammonium N concentrations between sites. For all sites and flow types ammonium N in Stinky Creek was greater than the concentration of the reference site. Fecal coliform counts showed high variation between sites at Stinky Creek and with the Reference.

Fecal coliform counts for Site 2, 5000 CFU / 100 mL, was above state limits of 4000 CFU / 100 mL

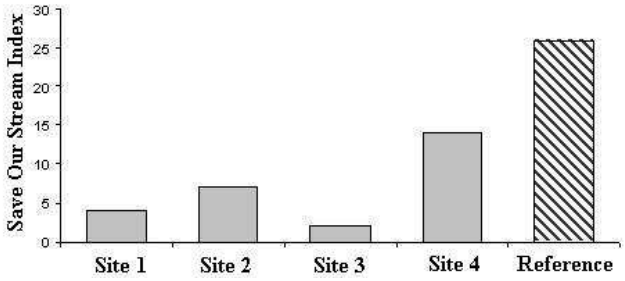

Figure 4: ***Save Our Stream*** **scores for Stinky Creek and the reference site, Orange Trail Creek. Assessments conducted on 10/28/02.**

for a single sample during the months of November to April. Macroinvertebrate abundance and diversity was greater in the Reference than for any of the Stinky Creek sites, as indicated by the biotic indices (Figure 4). Even though numerically more individuals were collected at Stinky Creek Sites 2 and 3, than at the Reference site, all of the Stinky Creek sites were dominated by Chironomidae larvae, a pollution tolerant taxon (Hilsenhoff 1988).

Due to the high fecal coliform counts and low macroinvertebrate abundance in conjunction with poor habitat conditions we chose to conduct a stream clean-up. Between 11-14 bags of trash were removed plus a large pile of objects that could not be placed in trash bags. Most notably, we found two bikes, a hibachi grill, three chairs, remnants of a toilet, a large metal mailbox, old metal pipes, bricks, and large pieces of glass. Left behind were construction debris, pieces of tubing, PVC pipes, and a lead-acid car battery. The most disturbing finds were two small sewer leaks and an unpermitted discharge.

The water quality data were forwarded to the Athens-Clarke County (ACC) Health Department, but they indicated that they were not responsible for resolving health problems due to sewage leaks unless they were associated with septic system failures. To their credit, the ACC Public Utilities Department inspected the county sewer lines for leaks, but were unable to find the source of the problem.

After repeated efforts to resolve the problem, Dick Field, the ACC Environmental Coordinator, inspected Stinky Creek and found failed pump stations for two separate apartment complexes, plus a sewer leak. The ACC Building Inspector was identified as the county unit responsible for addressing the problem, and the private sewer line was immediately connected to the ACC sewer system.

Some stream restoration actions were undertaken, including the construction of small check

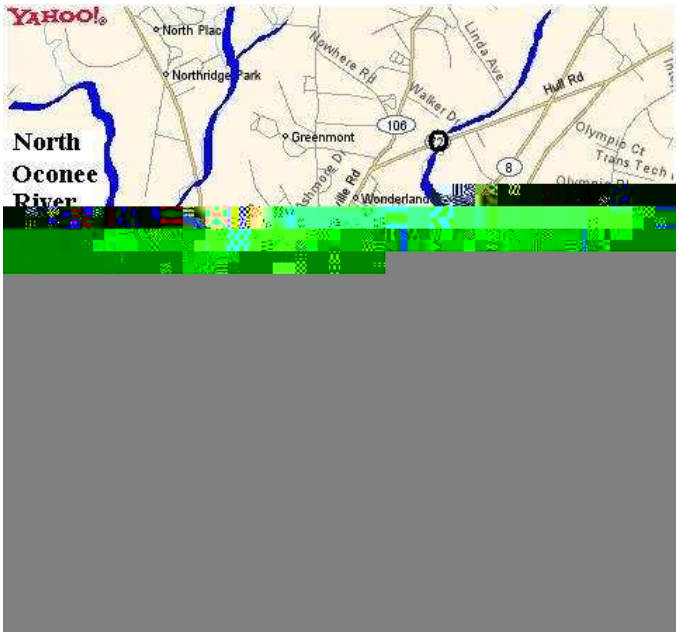

Figure 5: Map of Trail Creek Watershed and general area of leak location

dams in the stream channel and the addition of a fence to prevent trash from being dumped into the creek. Yet, no effort has been made toward mitigating the substantial quantities of organic sludge residual left in the stream channel.

TRAIL CREEK

Data collected during the 2004 River Rendezvous - sponsored by the Upper Oconee River Network (UOWN) on Saturday, April 3 - showed extremely high levels of pathogenic *E. Coli* bacteria in Trail Creek as it flows past the Greenway at Dudley Park. *E. Coli* is an indicator of sewage contamination.

Additional testing of Trail Creek at Dudley Park on the Wednesday and Thursday (April 7-8) following the River Rendezvous confirmed very high E. Coli contamination, as well as elevated *specific conductance* - a measure of dissolved solids that are high near leaking sewer lines (Table 1). Dead fish, foul odors, and a black sewage scum covering the streambed were also indicators that something wasn't right with this normally beautiful stream.

Because retesting confirmed the high levels of contamination, the Athens Clarke-County Public Utilities Department was contacted on the morning of Friday, April 9. County personnel were quickly dispatched to locate the leak. Unfortunately, county personnel were not initially able to find the source of the contamination.

At the request of the county, UOWN immediately established nine sites within the Trail Creek Watershed. Water quality measurements obtained from these sites indicated the approximate location of the major leak, which was forwarded to the county on Saturday, April 10. With this information in hand, the ACC Public Utilities Department were able to locate the cause of the failure on Monday, April 12, and the sewage leak was fixed by noon.

The failure most likely started sometime the previous December. Measurements collected by Professors Rhett Jackson (UGA - Forest Resources) and Bill Miller (UGA - Crop and Soil Sciences) in late November showed Trail Creek to be healthy, while a subsequent UOWN quarterly sampling on January 4, 2004, indicated high fecal contamination.

UOWN estimated that over one million gallons per day (1 mgd) of raw, untreated sewage were being discharged directly into Trail Creek. It is probable that this flow had been occurring for some time - at least since January 4 - which means that over one hundred million (100,000,000) gallons of untreated sewage was discharged into Trail Creek. This foul mix flowed through East Athens, and then into the North Oconee River at Dudley Park.

DISCUSSION

These cases indicate that persistent contamination of urban streams with untreated sewage can and does happen. The Stinky Creek contamination was estimated to have been occurring for twenty years, while the much-larger Trail Creek leak went unreported for months. Even when notified of the leaks, however, the local sewer utility was unable to immediately respond to the problem due to difficulties associated with identifying the failure location.

There are three management challenges for this problem; 1) Monitoring resources are needed to identify streams where sewage line failures are occurring, 2) Sufficient technical expertise must be available to identify the leak location once a stream has been identified as polluted, and 3) Institutional mechanisms must be put in place to resolve identified leaks.

A simple method for determining which streams are affected by sewer line failures would be to routinely monitor for fecal coliform concentrations during low flow periods. Elevated fecal concentrations not associated with stormflows are a likely indicator of sewer line or septic failure. An additional monitoring tool takes advantage of the higher specific conductivities associated with wastewater. Watershed monitoring of specific conductance is a low-cost

Table 1: Water quality data for Trail Creek

Site	NORO	Description	Date	Sp. Cond	Total Coliform	E. Coli
1	503	Dudley Park	4/3/04	54.5	> 24,192	3,255
			4/7/04	140	> 24,192	24,192
			4/7/04	140	> 24,192	> 24,192
			4/7/04	139	> 24,192	15,531
			4/7/04	139	> 24,192	14,136
			4/8/04	140	> 24,192	24,192
			4/8/04	140	> 24,192	17,329
			4/10/04	118	129,965	3,090
2	-	MLK Jr Dr	4/10/04	111	111,985	3,970
3	515	Vine St.	4/10/04	112	> 241,917	6,630
4	-	Moreland Ave	4/10/04	111	> 241,917	3,970
5	-	Bypass	4/10/04	254	106,624	9,330
6	514	Old Hull Road	4/10/04	60	1,046	187
7	501	Athena Drive	4/10/04	60		
8	505	Olympic Dr	4/10/04	68		
9	-	Olympic Way	4/10/04	69	1,723	97
-	510	N. Oconee at Dudley	4/8/04	77	1723	41
-	512	Olympic Dr	4/3/04	58.7	2359	624
-	513	Hull Rd	4/3/04	58.8		

alternative for fecal coliform monitoring.

Once a contaminated stream has been identified, then locating the source of the contamination should utilize a suite of techniques, including stream-walking as well as iterative sampling to narrow the zone of likely contamination. Causes of sewer line failures include - but are not limited to - clogging of sewer lines with trash, roots, and debris, leaking of damaged sewer lines, catastrophic failure of sewer lines during floods, as well as the failure of private and utility lift-stations. Locating these failures can be time consuming. For subsurface leaks, groundwater flow paths may need to be identified.

Institutional failures occur when the appropriate agency or unit for problem resolution is not readily identifiable. The County Health Department may be responsible for some types of failures, the County Public Works Department for others, and the County Building Inspector for yet others. Having *a priori* knowledge of the appropriate institutional responsibility is an important prerequisite for solving wastewater failure problems.

SUMMARY

Stream water quality data collected by University of Georgia students on Stinky Creek provided evidence of sewage contamination on this urban stream. Subsequent inspection by Athens Clarke County Environmental Coordinator identified the cause of the failure – non-functioning sewage lift stations at two small apartment complexes plus a sewer leak. These releases of untreated sewage had probably been occurring for twenty years.

The 2004 River Rendezvous successfully identified a major sewage leak on Trail Creek - a large tributary to the North Oconee River that drains most of Northeastern Athens-Clarke County. A bucket was found lodged within the main sewer line upstream of the Athens Loop - just behind the main Post Office on Athena Drive. This sewer line collects wastewater from the Trail Creek watershed. The obstruction caused massive amounts of raw sewage to overflow into Trail Creek.

Methods to identify and resolve sewer leaks of this kind include: 1) Watershed-scale surveys to identify streams affected by sewage contamination; 2) Scientific methods to identify the source and cause of the sewage discharge to streams; and 3) Identification of the appropriate institution for resolving the specific failure.

REFERENCES

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