RESULTS AND EVALUATIONS
"CITY OF GRIFFIN TEA-21 HIGHWAY CORRIDOR" GRIFFIN, GA

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ABSTRACT

The City of Griffin's Stormwater Utility engaged in the "City of Griffin TEA-21 Highway Corridor Non-Point Pollution Mitigation Study" in 2002, concluding in March 2004. The project was to assess the current status of the highway corridor in its respective watershed basin relative to water quality. The study evaluated the Best Management Practices (BMP's) (Proprietery) along Georgia Highway State Route 16. The study evaluated the engineering, construction, BMP costs and the maintenance costs in relationship to water quality management objectives, which would successfully, could be implemented to restore or maintain water quality in the receiving waters adjacent to the highway corridor. This research and presentation provides the practioner with empirical data and cost analyzes collected and produced for the decision makers responsible for the Best Management Practices used to eliminate stormwater runoff pollutants on a highway system.

INTRODUCTION

The City of Griffin, in anticipation of future growth and infrastructure development, has determined the need to assess water quality within its city limits. The EPD now requires that watershed assessments be performed on an area where new plants and sewer plants will be constructed or where existing plants will undergo expansion to acquire a National Pollutant Discharge Elimination System (NPDES) permit. In addition, Spalding County has developed a watershed management plan to protect their potable water reservoirs. This plan will require water quality assessments within the county watershed and its basins; including the City of Griffin.

Urban growth and development can adversely affect the water quality and biotic integrity of streams and water supply reservoirs. These affects are directly related to urban and agricultural stormwater runoff. According to the Environmental Protection Agency (EPA), nonpoint source pollution is the largest source of water quality problems facing the nation today. Nonpoint source pollution is the reason that 40% of the nations assessed water bodies are unsafe for basic uses. Understanding the sources and magnitudes of stream impairment is critical to the development of management strategies for achieving water quality improvements and the restoration or maintaining biotic integrity. In summary, the goals of the TEA-21 project were to:

- Assess the current status of the highway corridor sub-basin of Potato Creek with respect to water quality;
- Assess the effect of implemented BMP's along the Taylor Street corridor; and
- Evaluate and develop realistic, flexible water quality management alternatives that can be successfully implemented to restore or maintain water quality in receiving waters adjacent to highway corridors.

The ultimate goal of the study is to provide the City of Griffin with a technically sound and defensible basis for making informed watershed management decisions and balancing economic growth and the long-term health of the City's water resources. A secondary goal of the study is to utilize the assessment process to provide water quality data for the implementation of BMP's resulting in the removal of Potato Creek from the State of Georgia's 303(d) list of impaired water bodies.

The data derived in this assessment will be especially useful in:

- Determining realistic pollutant loadings for urban highway corridors in Georgia;
- Providing water quality data for the development of total maximum daily loads (TMDLs) for water quality parameters as appropriate and as required for the Ocmulgee and Flint River Basins; and

- Identifying realistic combinations of flexible and economical management alternatives for maintaining stream water quality in the future.

TECHNICAL APPROACH

Station Selection

Stormwater quality is directly related to pollutant input from surrounding sources, including atmospheric deposition and point sources, but in particular, watershed runoff (nonpoint sources) from various land uses. The effects of runoff or stressors from various land uses on aquatic integrity are documented in the literature. The nature and severity of aquatic integrity degradation is dependent on the type of land use and the imperviousness of the watershed (Schueler, 1994). "Imperviousness" refers to the sum of roads, sidewalks, rooftops, parking lots, and other developed surfaces that do not allow infiltration of rainfall into the soil. The sampling station location were critical to providing information about runoff effects, or stressors on water quality from the various land uses in the watershed. The approach used to differentiate between land uses and effects on water quality, involved isolating the major land use areas by dividing the watershed into basins. A comparison of the sampling results from each station was then be used to evaluate the various land use effects on water quality within the basin as well as the basin as a whole.

Water Quality Assessment

The water quality assessment involves a two-step approach. One includes a review of any existing water quality data for the study area. The second involves the collection of water samples for the analysis of specific sources or indicators of stream degradation or stress.

Watershed Assessment Proposed Sampling Program

The primary purpose of collecting water quality data is to establish existing water quality conditions. The approach to assess water quality is to compare the findings of wet weather sampling to the State standards. Sediment samples were taken to determine their role in pollutant loading.

The primary elements of water quality sampling included:

- Conducting literature reviews of existing data
- Establishing sampling stations
- Conducting insitu water quality measurements
- Collecting water samples for chemical and bacteriological analysis

Sediment Assessment

The technical approach to sediment assessment is based on the concept that sediment contamination can involve deposition of toxicants over long periods of time and are responsible for water quality impacts in some areas. Several pollutants such as pesticides, heavy metals, and several of the organic priority pollutants will accumulate in sediment. Sediment assessment is performed to analyze and assess the occurrence, abundance, and distribution of these chemical constituents in surface-water systems. Sediment assessment addresses a broad spectrum including surveillance monitoring, mass transport loading, remediation, effectiveness, presence or absence of contaminants, and spatial extent and temporal change of chemical constituents (Radtke, 1997). Sediment samples were collected at various locations in the project area, including the stormwater infrastructure, creek and streambeds. The sediment assessment consisted of analysis of the following constituents:

- Total Phosphorus
- Extractable Ortho Phosphate
- Oil & Grease
- Total Copper
- Total Cadmium
- Total Iron
- Total Mercury

Baseline sediment samples were collected from each station selected. Additionally, sediment samples were collected at specific points in the watershed to evaluate the watershed as a whole, before and after construction of the BMPs. One watershed sampling point was located at the Fifth and Wall Detention Pond and the second was located at Grape Creek, the most downstream point of this portion of the watershed. The purpose of the watershed sediment samples was to evaluate the effectiveness of the BMPs on the quality of the watershed as a whole.

BMP Selection

The project team selected each BMP based on the pollutants that were identified during the preconstruction water quality sampling as to compared to the various vendor claims.

Stormwater Management, Inc.'s StormFilter and StormScreen devices were selected for evaluation at LocationTwo located on Fifth Street. Baysaver Inc.'s 10K was selected for evaluation at Location Four located on Third Street. Practical Best Management, Inc.'s CrystalStream device was selected for Location Five on Taylor Street near Grape Creek.

Each vendors claims and pricing information are presented in the following sections. Please note the pricing information presented is the amount that was charged to the City of Griffin in May 2002 and may differ for private party sales.

Table 1. Percent Removal Efficiency Summary Table

Constituent	StormFilter	BaySaver	PBM	NGRDP Without Wetlands	NGRDP With Wetlands
Total Suspended Solids	45.2%	-42.7%	14.3%	33.4%	86.0%
Total Dissolved Solids	-10.1%	-13.9%	-77.2%	-11.9%	67.3%
Nitrate Nitrogen	-44.7%	42.0%	48.2%	61.6%	68.9%
Nitrite Nitrogen	0.0%	66.7%	66.7%	-114.3%	58.8%
Biochemical Oxygen Demand	61.0%	20.7%	30.6%	-88.5%	71.4%
Total Phosphorus	45.0%	33.3%	50.0%	55.6%	70.3%
Total Kjeldahl Nitrogen	6.9%	-24.0%	38.0%	59.7%	72.1%
Chemical Oxygen Demand	44.7%	32.0%	64.6%	30.5%	67.2%
Oil & Grease	55.2%	51.9%	62.5%	Not Measured	72.9%

Table 2. Percent Removal Efficiency in Dollars per Pounds

Constituent	StormFilter	BaySaver	PBM	NGRDP Without Wetlands	NGRDP With Wetlands
Total Suspended Solids	$483.93	-$35.28	$31,29	$16.41	$1.81
Total Dissolved Solids	-$1,938.08	-$104.56	-$46.12	-$80.58	$4.31
Nitrate Nitrogen	-$56,942.58	$1,936.86	$2,372.52	$1,425.36	$990.99
Nitrite Nitrogen	-	$20,337.07	$32,029.05	$12,784.56	$12,718.31
Biochemical Oxygen Demand	$1,074.39	$280.51	$261.46	-$37.88	$25.25
Total Phosphorus	$132,866.02	$8,134.83	$6,405.81	$3,041.68	$1,565.46
Total Kjeldahl Nitrogen	$108,708.57	-$1,694.76	$842.87	$201.20	$109.64
Chemical Oxygen Demand	$356.95	$25.94	$10.56	$21.82	$5.87
Oil & Grease	$1,077.75	$71.28	$64.06	Not Measured	$23.38
Total Zinc	$132,866.02	$20,337.07	$-64,058.09	$4,583.82	$2,237.30

Maintenance Summary

During the course of the study, it became apparent that all three units need to be maintained on a regular schedule. Most of the vendors claim removal using a time basis. The units should be inspected regularly following rain events and maintained as needed. Without maintenance, re-suspension occurs; thus increasing the pollutant loading downstream.

The StormFilter was cleaned once during the testing period which is in accordance with the manufacturer's recommendation. BaySaver was cleaned once during the testing period which was in accordance with the manufacturer's recommendation. The Crystal Stream unit was cleaned three times, approximately once every two months.

Insects

During dry periods with no regular rain, mosquitoes were present in both the StormFilter and BaySaver devices. It may be beneficial to monitor the devices during dry periods for mosquito infestations.

Water Quality Summary

StormFilter

Based on the baseline and post construction water quality results, it appears that the StormFilter unit improved the water quality at least slightly with respect to the following constituents:

- Oil & Grease
- Total Suspended Solids
- Total Phosphorus
- Total Kjeldahl Nitrogen
- Biochemical Oxygen Demand
- Chemical Oxygen Demand
- Ortho Phosphates
- Ammonia Nitrogen
- Total Copper
- Total Lead
- Total Magnesium
- Total Zinc

The StormFilter unit seemed to have increased the downstream pollutant loading for the following constituents as compared to the baseline water quality results:

- Total Petroleum Hydrocarbons
- Total Dissolved Solids
- Nitrate Nitrogen
- Total Iron

There was no decrease or increase in the concentrations of the remaining constituents.

BaySaver

Based on the baseline and post construction water quality results, it appears that the BaySaver unit improved the water quality at least slightly with respect to the following constituents:

- Oil & Grease
- Total Petroleum Hydrocarbons
- Total Phosphorus
- Biochemical Oxygen Demand
- Chemical Oxygen Demand
- Ortho Phosphates
- Ammonia Nitrogen
- Nitrate Nitrogen
- Nitrite Nitrogen
- Total Calcium
- Total Copper
- Total Magnesium
- Total Zinc

The BaySaver unit seemed to have increased the downstream pollutant loading for the following constituents as compared to the baseline water quality results:

- Total Suspended Solids
- Total Dissolved Solids
- Total Kjeldahl Nitrogen
- Total Iron
- Total Lead

There was no decrease or increase in the concentrations of the remaining constituents.

PBM Crystal Stream

Based on the baseline and post construction water quality results, it appears that the PBM Crystal Stream unit improved the water quality at least slightly with respect to the following constituents:

- Oil & Grease
- Total Petroleum Hydrocarbons
- Total Suspended Solids
- Total Phosphorus
- Total Kjeldahl Nitrogen
- Biochemical Oxygen Demand
- Chemical Oxygen Demand
- Ortho Phosphates
- Ammonia Nitrogen
- Nitrate Nitrogen
- Nitrite Nitrogen
- Total Calcium
- Total Copper
- Total Iron
- Total Magnesium

The PBM CrystalStream unit seemed to have increased the downstream pollutant loading for the following constituents as compared to the baseline water quality results:

- Total Dissolved Solids
- Total Lead
- Total Zinc

There was no decrease or increase in the concentrations of the remaining constituents.

Removal Efficiency Summary

As compared to the pollutant removal efficiency of the NGRDP, the BMPs tested as part of this project exceeded the performance of the NGRDP in Nitrite Nitrogen removal where the forested wetlands were included as part of the water quality analyses. The StormFilter unit exceed pollutant removal efficiency for Total Suspended Solids and Biochemical Oxygen Demand as compared to the removal efficiency of solely the NGRDP not including the forested wetlands. The PBM Crystal Stream unit exceeded the performance of the NGRDP in Nitrate Nitrogen, Total Phosphorus, Total Kjeldahl Nitrogen, and Total Zinc when the NGRDP is functioning independently of the forested wetland area.

As compared to the pollutant removal efficiency of the NGRDP based on dollars per pound of pollutant removal, the NGRDP appears to be more cost effective when analyzed with the forested wetlands. Additionally, the NGRDP appears to be more cost effective when analyzed independently of the forested wetlands for all constituents except Chemical Oxygen Demand and

Biochemical Oxygen Demand, where the PBM Crystal Stream unit appeared to be more cost efficient.

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