THE CITY OF KNOXVILLE
TENNESSEE

NPDES Permit Annual Report

CITY OF KNOXVILLE
BILL HASLAM, MAYOR

National Pollutant Discharge Elimination System
Stormwater Discharge Permit TNS068055
July 1, 2008 - June 30, 2009

CITY OF KNOXVILLE

BILL HASLAM, MAYOR

Stephen J. King, P.E.
Director of Public Works
Brently J. Johnson, P.E., R.L.S.
Deputy Director of Engineering

December 30, 2009

Mr. Jim McAdoo
Tennessee Department of Environmental and Conservation
Division of Water Pollution Control
Attention: Compliance Review
401 Church Street
L & C Annex, 6th Floor
Nashville, TN 37243-1534

RE: City of Knoxville, NPDES MS4 Permit # TNS068055
2008 – 2009 Annual Report

Dear Mr. McAdoo:

The City of Knoxville is pleased to submit the fifth annual report for the NPDES permit issued July 1, 2004. This annual report summarizes the NPDES activities during the twelve-month period of July 1, 2008 through June 30, 2009. The annual report was coordinated and prepared by the Engineering Division in conformance with the reporting requirements in the City's NPDES Permit Part VI.

If you have any questions or wish to discuss any of the NPDES Permit programs, please contact me by email at dhagerman@cityofknoxville.org or by phone at (865) 215-3251.

Sincerely,

David Hagerman, P.E., Stormwater Management

400 MAIN STREET, SUITE 480, KNOXVILLE, TENNESSEE 37902
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BILL HASLAM, MAYOR

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Deputy Director of Engineering

December 30, 2009

Ms. Natalie Ransone Harris
Tennessee Department of Environmental and Conservation
Division of Water Pollution Control
3711 Middlebrook Pike
Knoxville, TN 37921

RE: City of Knoxville, NPDES MS4 Permit # TNS068055
2008 – 2009 Annual Report

Dear Ms. Harris:

The City of Knoxville is pleased to submit the fifth annual report for the NPDES permit issued July 1, 2004. This annual report summarizes the NPDES activities during the twelve-month period of July 1, 2008 through June 30, 2009. The annual report was coordinated and prepared by the Engineering Division in conformance with the reporting requirements in the City's NPDES Permit Part VI.

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Signature and Certification

NPDES STORMWATER PERMIT TNS068055
2008/2009 MUNICIPAL ANNUAL REPORT

FOR: City of Knoxville, Tennessee

Federal regulations, 40 CFR 122.22 (a) (3) and 122.22 (d), require the application and reports for the NPDES permit to be signed and certified as follows:

> *For a municipality, State, Federal, or other public facility, by either a principal executive officer or ranking elected official.*
>
> *"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."*

Bill Haslam
Mayor

12-22-09
Date

Stephen J. King, P.E.
Public Works Director

12.22.2009
Date

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1.0 INTRODUCTION

The Tennessee Department of Environment and Conservation, Division of Water Pollution Control issued the City of Knoxville a National Pollutant Discharge Elimination System (NPDES) Permit (TNS068055) for the discharge of stormwater from the municipal separate storm drain system (MS4). Stormwater from the City of Knoxville discharges directly to the Tennessee River and to major creeks that drain to the Tennessee River. Only a small portion of the MS4 runoff will drain to sinkholes, ponds, and lakes throughout the area. In December 2008, the City submitted a reapplication as part of the Year Four annual report. The current permit was approved and made effective July 1, 2004 and expired June 30, 2009.

The NPDES Permit requires an annual progress report for the Stormwater Management Program outlined in the Part I and Part II applications. This annual report was completed in accordance with the reporting requirements of Part VI of the permit and will complete the requirements for the permit year from July 1, 2008 through June 30, 2009.

The Stormwater Quality Section of the City of Knoxville Engineering Department coordinated preparation and submittal of the system-wide annual report. Information for the annual report has been provided by the Engineering Department, Public Service Department, Solid Waste Management office, and Knoxville/Knox County Emergency Management Agency (KEMA). The Engineering Department has compiled the available information into the format outlined in Part VI of the current NPDES Permit.

2.0 CONTACTS LIST

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Stephen J. King, P.E., Director
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P.O. Box 1631, Suite 480
400 Main Street
Knoxville, TN 37901

3.0 STORMWATER MANAGEMENT PROGRAM (SWMP) EVALUATION

The objective of the City of Knoxville's SWMP is to protect the taxpayer's health, safety, and welfare through an economically viable comprehensive stormwater quality and quantity program. Although it would be impossible to list all of the City's water quality related accomplishments in this report, the City is proud to report some of the major accomplishments related to the SWMP that occurred during the fifth year of the new NPDES permit term.

- The City partnered with the Water Quality Forum and sold close too 600 rain barrels at the 2009 Earthfest at Pellissippi State Community College. Over 10,000 people attended the event, which had over 100 exhibitors from the environmental community.

- The City of Knoxville continued to expand the greenways/buffers zones along the major waterways. The City currently maintains over 41 miles of trail distributed over 31 greenways. These linear parks help protect the adjacent waterways with natural buffers and provide opportunities for stream enhancements. The City has extensive plans to connect the Greenways from Fountain City Park down to the mouth of First Creek.

- The year 2009 was the 20th year for the River Rescue, which is coordinated by Ijams Nature Center and the Water Quality Forum partners. The spring 2009 River Rescue attracted 814 volunteers who collected 18 tons of trash and 47 tires from the shores of the Tennessee River.

- A total of 5,895.08 tons of recyclables was collected at the City's eleven solid waste drop-off recycling centers in 2008. The volume has increased by 186 tons more than the recyclables from 2005 to 2007. The City maintains updated information on the web at http://www.cityofknoxville.org/solidwaste/recycle.asp.

- The City of Knoxville has been awarded a Green Development Grant for its new downtown dog park. The City was selected as one of the first four Tennessee cities to receive the state's new Green Development Grants. The City will use its grant to help protect the water quality of First Creek by installing features designed to better control the flow of stormwater runoff at the new park. A low-impact infiltration trench along the border of the park will reduce runoff volume and additional trees and vegetation between the park and the creek will help prevent bacteria, pollutants and excessive nutrients from reaching the creek.

- The City broke ground on the new Knoxville Station Transit Station in June 2008. The building will use LEED standards to use less energy than conventional buildings and will be built with sustainable building practices. Large water quality units will treat all of the impervious surface areas.

- During 2008, the City partnered with the Water Quality Forum and featured a rain barrel workshop. Over 150 people attended the event in which the participants learned about water quality education/conservation, and built a 55 gallon functioning rain barrel.

- The final phase in the planning of the First Creek Drainage Improvement Project was completed during this permit year. The scope of the work includes widening a 1,853-foot-long section of the First Creek channel to establish additional 40-feet of grass-lined floodplain; the replacement of the existing bridge at Fairmont Boulevard and construction of a new bridge at Emoriland Boulevard designed to provide a high-flow bypass for the First Creek Channel.

- In 2008, the City along with the Water Quality Forum partners held the second annual Rain Day Brush-off. Local artists, business, and schools painted thirty-one 55-gallon rain barrels as part of the event. The event was designed to bring awareness to water conservation and water quality by promoting the use of rainbarrels throughout the community.

Since the stormwater quality program officially started in 1996, the City has defined a baseline to compare future surface water improvements and/or degradations. Although the continuing improvements are incremental and difficult to measure quantitatively, many programs initiated since the inception of this program have undeniably improved quality of surface waters throughout the city. The long-term results should become apparent in future years. The City implemented many of the SWMP tasks beyond the minimum permit requirements and will continue to advance the water quality programs beyond the minimum requirements as economically feasible.

4.0 STORMWATER MANAGEMENT PROGRAM SUMMARY TABLE

SWMP activity summary tables for the last year of the NPDES permit program were compiled in accordance with the reporting requirements specified in Part VI(A)(2)(c) of the permit and included on the next few pages. Although the summary tables concisely document many program activities, some activities could not be quantified and have therefore been omitted.

4.0 Stormwater Management Program Summary Table

MONITORING TASKS WET/DRY WEATHER	SCHEDULE OF ACTIVITIES	SCHEDULE FOLLOWED	ACTIVITIES ACCOMPLISHED	COMMENTS
Repeat High Parameter Sites	20 Outfalls repeated	Yes	9	Each outfall tested at least four times this year
Field Screening Industrial Outfalls	Visits to Industrial outfalls	Yes	62	Continued retesting outfalls from Industrial areas (four times)
Total Field Screening Outfalls	High Parameter repeats + 30 to 40	Yes	252	All field data sheets available for inspection. Outfalls tested four times this year.
Full Suite Stormwater Analysis (one station per year)	One Station / year	Yes	2 samples	Full Suite sample obtained at 1st and 3rd Creek Monitoring Stations.
Storms Sampled at 5 monitoring stations	1 storm / quarter / 5 sites	Yes	20 storms	Summer: 5 storms, Fall: 5 storms, Winter: 5 storms, Spring: 5 storms
Ambient Samples at 5 monitoring stations	1 sample / quarter / 5 sites	Yes	20 samples	Summer: 5 samples, Fall: 5 samples, Winter: 5 samples, Spring: 5 samples
Storm Drain Televised	As Needed	Yes	11,856 feet	Pipes are defined as sections between inlets, catch basins, junction boxes, or outlets.

STORMWATER MANAGEMENT & INDUSTRIAL PROGRAM TASKS	SCHEDULE OF ACTIVITIES	SCHEDULE FOLLOWED	ACTIVITIES ACCOMPLISHED	COMMENTS
Stormwater Quantity Requests for Service (Received / Resolved)	As Needed	Yes	475/477	Complaints are investigated as received and resolved as solutions or resources are available
Stormwater Quality Requests for Service (Received / Resolved)	As Needed	Yes	122/112	Complaints are investigated as received and resolved as solutions or resources are available
Site Development Workshop/Professional Training	Annually	Yes	86	Included Engineers, contractors, developers, & surveyors involved in land disturbing activities.
Stormwater GIS Field Investigations for Annexations	As Required	Yes	1	Newly annexed areas are investigated within 60 days for all storm drain features and possible pollution sources.

4.0 Stormwater Management Program Summary Table

STRUCTURAL CONTROLS	SCHEDULE OF ACTIVITIES	SCHEDULE FOLLOWED	ACTIVITIES ACCOMPLISHED	COMMENTS
Street Cleaning	Daily/Bi-Weekly	Yes	24,672 Miles	Daily for downtown streets. Frequency varies for other streets.
Litter Pick-up, Hand	As Needed	Yes	56,882 Bags	Routine Schedule
Catch Basin Cleaning and Repair	As Needed	Yes	10,924 Jobs	Per work order and requests
Ditching: Hand, Truck, & Track/Gradall	As Needed	Yes	17,957 Feet	Per work order and requests
Storm Drain Installation & Repair	As Needed	Yes	45 Jobs	Per work order and requests
Brush & Leaf Pick-up	Bi-Weekly	Yes	14,918 Loads	Bi-Weekly curb pick-up
Seed/Sod, ROW	As Needed	Yes	51 Jobs	Per work order and requests
Storm Drain Cleaning	As Needed	Yes	36,667 Feet	Per work order and requests
Grate Replacement	As Needed	Yes	101 Jobs	As Needed
Field Inventory & Inspection of On-Site Detention Facilities	Within 60 Months	Yes	As needed	All new facilities are mapped after construction is complete. Existing facility's inventory is complete.
Creek Cleaning by Creek Restoration Crew	As Needed	Yes	207 Jobs	Creeks are inspected and cleaned on a routine schedule
Tree and Plant Planting	When Applicable	Yes	272 trees	Trees were planted by the City's Service Department
Total Waste Recycled	As Brought In	Yes	43,331 tons	5,895 tons of paper, metal, plastic, glass, etc. and over 36,683 tons of yard wastes

4.0 Stormwater Management Program Summary Table

EDUCATIONAL PROGRAM TASKS	SCHEDULE OF ACTIVITIES	SCHEDULE FOLLOWED	ACTIVITIES ACCOMPLISHED	COMMENTS
Publicize Hotline Number	Within 24 Months	Yes	Undetermined	Hotline number has been published in phone book, on road signs, pamphlets, magnets, radio PSA's, etc.
River Rescue	Annual Event	Yes	1 day event	18 tons of trash and 47 tires removed by 814 volunteers from 44 sites.
Water Quality Forum	Meets Monthly and Quarterly	Yes	Undetermined	Three committees meet monthly to plan projects focused on urban water quality.
Storm Drain Marking	As Needed or by volunteers	Yes	Approx.	Catch Basins marked with decals labeled "Dump No Waste-Drains to Waterway"
Volunteer Creek Cleanups	Volunteers	Yes	Several sites on several creeks	A citizen based program that periodically hosts several creek cleanups in the spring and fall
Waterfest	Annual Event	Yes	1 Day Educational Event	A unique community event dedicated to educating citizens about water quality. Over 830 youths, 200 teachers & parents, and 100 volunteers participated.
Pooper Scoopers	As Needed or by volunteers	Yes	18,000	Disposable dog waste containers were distributed to 9 different pooper scooper stations.

NEW DEVELOPMENT PROGRAM TASKS	SCHEDULE OF ACTIVITIES	SCHEDULE FOLLOWED	ACTIVITIES ACCOMPLISHED	COMMENTS
Residential/Commercial Inspections	As Required	Yes	852	As Required
Final Inspections	As Required	Yes	178	As Required
Site Development Permits Reviewed	As Required	Yes	980	As Required
Right of Way Permits Issued	As Required	Yes	203	As Required
As-Built Certificications Reviewed	As Required	Yes	241	As Required

5.0 NARRATIVE REPORT

The following narrative report is divided into the five main programs of the SWMP plus an additional section for specific TMDL activities. The SWMP is described in the program element schedules listed in Part II of the permit application and Part III of the permit. The main programs are listed as follows:

5.1 Residential and Commercial Program (RC).
5.2 Illicit Discharges and Improper Disposal Program (ILL).
5.3 Industrial and Related Facilities Program (IN).
5.4 Construction Site Runoff Program (CS).
5.5 Comprehensive Monitoring Program (MN).
5.6 TMDL Implementation and Activities.

Each of the above programs are further divided into separate program elements and related tasks that correspond to the Implementation Schedules listed in Part IV of the Permit and to the requirements listed in 40 CFR 122.26(d)(2)(iv). Each specific task is briefly discussed in accordance with the reporting guidelines outlined in Part VI of the NPDES Permit. Some sections of this report may be an abbreviated version of earlier reports when the particular task elements are ongoing.

5.1 RESIDENTIAL AND COMMERCIAL PROGRAM (RC)

Program of Structural and Source Controls for Reducing Pollutants to the Municipal Separate Storm Sewer System, 40 CFR 122.26(d)(2)(iv)(A).

RC-1 Maintenance Activities for Structural Controls

SWMP Task: Continue Existing Maintenance Activities from Part 2 application, pp. 5-5 to 5-9.

Status: Ongoing

The City's Public Service Department (PSD) currently performs maintenance of the municipal stormwater system. The PSD has developed and maintained an extensive database to track work tasks performed during the year. The database not only tracks labor category (e.g., Equipment Operator) and labor hours devoted to each task, but also includes equipment type and costs. The PSD database produces summary reports for monthly and annual work production and costs. The database includes more than 80 task activities of which 18 were identified as relating directly or indirectly to stormwater management. Only a small portion of the stormwater conveyance system is located on public rights-of-way and city-held easements. The City generally assumes no responsibility for maintenance or improvements on private property even though crews may work in some of those areas to remove blockages, spills, and trash with permission or in emergencies.

Maintenance by the City within rights-of-way and easements is normally performed on an as-needed basis by the PSD. Approximately 75 percent of the storm drainage system maintenance work performed by the PSD is in response to direct calls from property owners and requests from the Engineering department. The remainder of the storm drainage system maintenance work is in

response to maintenance needs detected by the PSD, such as repairing collapsed pipes. Under normal conditions, the PSD can respond to all complaints that are the responsibility of the City as defined by the City's stormwater policy.

Under the current system, the PSD has divided the City into six geographic maintenance zones, for routine work. Duties performed in each zone relating to stormwater are brush collection, leaf collection, street sweeping, and the cleaning of curb inlets. Catch basins are inspected annually. Cleaning and maintenance of catch basins are performed "as-needed". Most drainage facility maintenance is performed in response to complaints or known problems. The PSD logs all complaints by address and by category into the computerized database. The Construction Division of the PSD performs non-routine storm drain maintenance and installation.

The City has several multipurpose construction crews that perform storm drain installation. One of their primary responsibilities includes installing various sizes of corrugated metal pipe and reinforced concrete pipe, major repair to existing storm drains, and building catch basins. Each of the crews has seven employees, a backhoe, two single-axle dump trucks, and one 3/4-ton pickup truck. A 12-ton tool truck services all crews. These crews also provide emergency response in the event of flooding. The Storm Drain Maintenance Crew has five employees. They perform such tasks as: clearing culverts of debris, flushing storm drains, hand and mechanical ditching, and performing minor catch basin repair. A Storm Drain Vacuum Machine, a ditching machine, and a 3/4-ton pickup truck with a small crane are used to perform these tasks.

SWMP Task: Continue Improved Stream Restoration and Channel Maintenance Program.

Status: Ongoing

Stream restoration and channel maintenance have improved since the first permit cycle. These programs included stream bank stabilization projects to reduce erosion and sediment and a creek restoration crew to remove litter, debris, and flow blockages. The City has improved this program by providing an annual grant to the Fort Loudon Lake Association (FLLA) for removing debris and blockages on the major urban creeks. The summary report for the FLLA's efforts is included in appendix of this report. Removal of the dams helps prevent streambank erosion and reduce large destructive pools of silt and trash. The FLLA primarily used chain saws and hand tools to restore flow and remove the unnatural dams. Large or heavy objects require assistance by heavy equipment. The City properly disposes all of the trash and debris.

With the addition of the FLLA's work in the creeks, the 4-person Creek Restoration Crew that was added to the Public Service Department will now be able to focus their attention on maintaining the stormdrain system as the Stormwater Maintenance Crew. Obviously, the crew will still respond on a work order basis for work in the creek when needed. The crew still has access to a knuckle boom and a single-axle dump truck for performing their work. The crew has been trained and is used to assist with illicit discharge investigations in the MS4.

Since the City's NPDES permit program began in 1996, several bank stabilization projects have been completed with the help of TSMP, TDEC, TVA, USCOE, UTK, and CAC Americorps along urban creeks throughout the city.

Since sediment, hydromodification, and habitat alteration are the most common impairments in our urban creeks, the City will continue to focus on stream restoration projects where possible. Although these projects will certainly vary in scope, biostabilization techniques will be used instead of concrete or riprap. Whenever possible, the adjacent riparian zone will be enhanced with trees and

native vegetation to provide cooling effects and help restore habitat. The City will work with TDEC to obtain the appropriate ARAP permits before work begins.

SWMP Task: Implement Improved Stream Restoration and Channel Maintenance Program.

Status: Ongoing

The City has completed some initial flood control projects in the upper portion of First Creek. These projects focus on improving flow capacity but include the benefit of stabilized creek banks and improved high-flow bench. The design for the lower sections of the First Creek project will include the same concept for stabilizing the low-flow channel and creating access to the floodplain. Stream improvements and watershed modeling in First Creek will continue to be a priority in the next year. The 2008/2009 budget included $1,204,214 to continue improvements in First Creek.

The 2003 ordinance revisions added a significant improvement to the stream restoration program. The City began requiring private development to stabilize eroding creek banks on their project sites before completing their development. The ordinance specifically prohibits the use of hard armor unless no better alternative exists. TDEC can exempt the work if they determine that stabilization efforts would do more harm than good.

The City initiated a major improvement project on Third Creek in 2005 to restore over 7,600 feet of degraded and channelized stream. The goals of the restoration projects are to reduce sediment, hydro-modification and flooding while improving habitat, riparian zones and water quality. Opportunities to implement large-scale restoration projects such as the First Creek and Third Creek projects may not be feasible every year. However, the City will continue to focus when feasible on large projects, which may produce significant and measurable impacts.

During this permit year, significant improvements were made to the Acker Place regional pond to reduce sediment off loading from the stream banks erosion, establishment of the flood plain, re-meandering of the channel, and re-vegetation restoration.

SWMP Task: Implement Structural Controls To Prevent Floating Discharges To The TN River.

Status: Ongoing

Since the summer of 1999, the City has coordinated with TVA, UTK, TDEC, USACOE, the Isaac Walton League (IWL), Keep Knoxville Beautiful (KKB), Fort Loudon Lake Association (FLLA), and area businesses to reduce the amount of floating pollution entering the river from the urban creeks. The City has studied and identified several possible solutions. Short-term solutions have included increasing the frequency of the maintenance at the mouths of the major creeks, adding more trash receptacles at bus stops, increasing public awareness, installing temporary skimmers, etc.

During the first permit term, the City donated a new boat and hundreds of feet of trash skimmers to help then IWL and now the FLLA collect litter and debris along the riverfront in the downtown area. The City will continue to fund replacement of the skimmers (left) as long as they remain effective. The City has contracted with the FLLA to maintain a "Litter Free Zone" from the South Knoxville Bridge to the Alcoa Highway Bridge. Although the focus of this initiative has largely been to reduce unsightly trash from entering the river, the floating trash skimmers at the mouths of the creeks have also effectively detained oil spills until remediation personnel could respond. According to the FLLA, the booms have successfully prevented tons of floating material that would otherwise have been discharged from the creeks into the river. All of the trash skimmers have been purchased with penalty funds collected from polluters. Due to the age of the skimmers, the City will likely replace major portions in the future.

SWMP Task: Require Standard Maintenance Agreement for On-site Facilities.

Status: Ongoing

Since 1997, permanent maintenance agreements and/or covenants have been required for all new stormwater detention facilities and special pollution abatement devices (i.e. oil/water separators, catch basin inserts, etc.). To speed up the permit review process the original "Agreement" referred to in the Part II application and Part IV of the permit has been replaced with a "Covenants", which does not require the Mayor's signature or council approval. The end result for water quality protection and flood control is the same. The Stormwater and Street Ordinance section 22.5-34 now requires the owner of the property to execute a legal document entitled "Covenants for Permanent Maintenance of Stormwater Facilities" and record it in the office of the Knox County Register of Deeds before a site development permit is issued.

In the case of a lessee, the Stormwater and Street Ordinance Section 22.5-5 allows the City to require a Performance and Indemnity Agreement along with a surety bond or letter of credit to assure the stormwater facilities will be maintained and removed, if necessary, at the end of the lease. This is a new provision to allow some property owners the ability to share the responsibility of maintenance with the lessee who will use the land and create the need for the stormwater facility. The lessee must also pay the City no less than $5,000 to compensate for any perpetual maintenance that may be required after the expiration of their lease.

The City will retain the right to inspect to insure that the stormwater facilities are properly maintained, however, the responsibility for the maintenance of stormwater facilities will remain with the property owner unless legally transferred to another person or entity by a properly

recorded legal agreement. If the property owner does not maintain the facility properly, the City may authorize the maintenance to be completed and place a lien against the property for double the cost. To ensure access to the facility, a traversable access easement is recorded on the plat.

SWMP Task: Require Routine / Major maintenance of BMP facilities. Status: Ongoing

All stormwater facilities constructed since 1997 are required to be maintained according to the detailed agreement or covenant, which was recorded before the site development permit was issued. These agreements and covenants are discussed in the previous section above and also in the Stormwater and Street Ordinance sections 22.5-5 and 22.5-34. At a minimum, woody vegetation must be cut annually and sediment must be removed as necessary from detention ponds to maintain proper function of the facility. The standard maintenance requirements for large underground facilities (i.e. detention or oil/water separators) include a minimum of quarterly visual inspections and annual maintenance. Smaller BMPs, such as catch basin inserts, must be inspected at least monthly and maintained quarterly.

Sediment from the maintenance of detention/water quality ponds, treatment devices, or from stream restoration activities must be removed from the stormwater facility and disposed properly in a landfill classified for such material or used as fill outside the stormwater drainage system. The City does not propose to duplicate TDEC's efforts to regulate contaminated sediments from any stormwater management sources.

RC-2 Planning for New Development

SWMP Task: Review Stormwater & Streets Ordinance to evaluate possible improvements to existing water quality and quantity requirements for new development. Status: Complete

The City of Knoxville revised the Stormwater and Street Ordinance in 2005. The ordinance may be accessed on the Internet at www.cityofknoxville.org/engineering/stormwater. A brief summary of the current development requirements for stormwater detention and water quality control is included in the following paragraphs.

Stormwater detention is required for the following categories of development:

(1) All road construction exceeding one-half (1/2) acre of impervious area;

(2) All commercial, industrial, educational, institutional and recreational developments of one (1) acre or more of disturbed area;

(3) Large single-family or duplex residential developments of five (5) acres or more of disturbed area or five (5) lots or more;

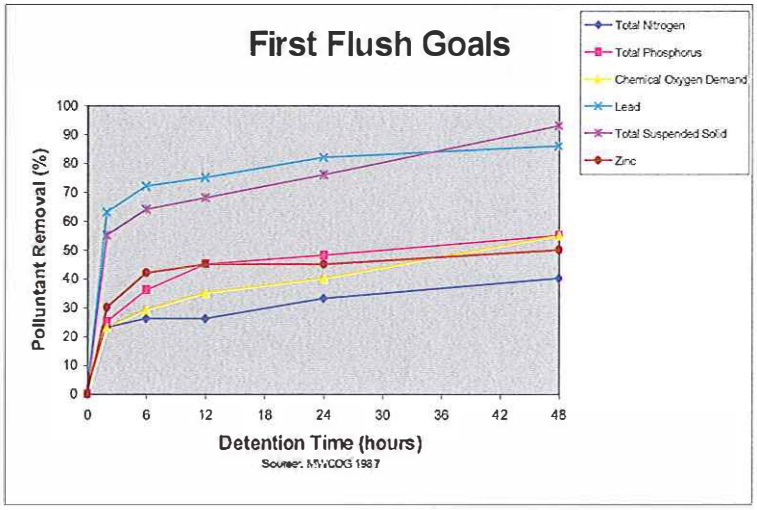
(4) Any site development which contains one-half (1/2) acre or more of additional impervious area.

(5) Any redevelopment that meets any of the four criteria above.

When a stormwater quantity detention pond is required, the engineer must design the pond to control the runoff from the 1-year, 2-year, 5-year, 10-year, 25-year and 100-year return frequency 24-hour storm events. The design Engineer must submit calculations to show that the detention facility will control the post development as required and that the downstream system is adequate

to convey the flow from a 10-year storm. Detention may be waived for some developments discharging directly into a main stream (i.e. TN River) or if the developer submits supporting hydrologic and hydraulic computations to show that detention is unnecessary. For areas of redevelopment, detention requirements may be waived if the downstream stormwater system is adequate to convey the 2-year and 10-year 24-hour storms. The ordinance clearly states that a waiver of detention requirements "does not exempt the developer from providing the first flush and/or water quality requirements."

The standard management method for water quality control from new development and redevelopment includes first flush control outlets in the quantity pond or in a separate quality pond. The quality pond must be designed to collect the first one-half inch of direct runoff from the contributing drainage basin or the first 4500 cubic feet of stormwater runoff, whichever is greater, and attenuate that runoff for a minimum 24-hour period. Alternate treatment methods are accepted if they provide equivalent or better pollutant removal efficiencies than the standard first flush detention ponds.



The target removal efficiencies for the first flush treatment were estimated from the research and chart provided by the Metropolitan Washington Council of Governments' 1987 report titled "Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs." The target removal efficiencies for a 24-hour detention are estimated as follows: Total Suspended Solids – 76%, Lead – 81%, Zinc – 47%, Total Phosphorus – 44%, COD – 40%, and Total Nitrogen – 33%. The City chose 24-hour attenuation of the first flush since the pollutant removal rates for detention longer than 24 hours did not increase significantly. This may be reevaluated before the next ordinance update.

In addition to first flush treatment, Section 22.5-37 of the ordinance requires a Special Pollution Abatement Permit (SPAP) for certain land uses that are known to either contribute a disproportionate amount of stormwater pollution (a.k.a. hotspots) or contribute pollutants which would not be effectively removed by the standard first flush control. The SPAP requires the operator to submit the management and structural controls necessary to address the expected pollutants and sources of pollution from the site after development. The typical special pollution abatement requirement has been a minimum of an oil/water separator for large parking lots of 400 spaces or 120,000 square feet of area along with a management plan to keep the site free of illicit discharges and pollution sources. Other special land uses that need a SPAP include any type of vehicle maintenance, fueling, washing, and storage areas; scrap and recycling facilities; restaurants; grocery stores; animal housing facilities; and other areas with concentrated bacteria sources. Most of these land uses are expected to have a much higher potential for either floatable pollutants (e.g. oil, grease, hydrocarbons, trash) or soluble pollutants (e.g. bacteria, nutrients) that will not be collected in a standard first flush pond.

After implementing the illicit discharge program for a few years, some of these land uses were added in the 2003 ordinance update when they proved to be common hotspots for pollution. The pollution is typically caused by illicit dumping/discharges from employees and contractors or from an increased volume of vehicle traffic. The SPAP program has effectively reduced pollution in our waterways by requiring planning and education to prevent pollution before it occurs from these new sources. This is more economical for the operator and the City since it reduces the need for enforcement, penalties, structural retrofits, and downstream remediation. Some businesses have reported that the pollution control requirements have paid for themselves by reducing other normal costs.

As the City implements the requirements of the NPDES permit and as other TMDLs are issued, other land uses may be added to the SPAP program to control specific pollutants.

The ordinance also requires protective streamside buffer zone along blue-line creeks. The three-tier restricted buffer zone requirement varies from 100', to 70' to 30', centered on the centerline of the low-flow channel of the creek. The width required for the buffer depends on whether the creek is a FEMA studied named creek, unstudied named creek, or unnamed tributary respectively. The natural streamside buffer zone must be shown on the plat and maintained in a stable condition for the life of the development. The ordinance does not allow any vertical or actively eroding creek banks to remain after development is complete. This may require the stream bank to be stabilized as part of the construction project. If stabilization is necessary, hard armor may only be used when bioengineering alternatives are not technologically feasible.

SWMP Task: Require "No Dumping" message cast into all curb irons and solid stormwater catch basin covers installed on new developments. Status: Complete

In January 2000, the City set a new standard to require a "No Dumping" message to be cast in all new curb irons and solid stormwater catch basin covers. The following year, the City included covers for stormwater treatment devices in this requirement. The message is an attempt to educate the public that our stormdrain system is not a sewer for their waste. When polluters are caught discharging or dumping pollutants into the stormdrain, they often plead ignorance to the fact that the stormdrain is directly connected to the creeks. After using stencils and plastic curb markers for years, the City decided to halt the growing number of curb irons that needed the temporary markers by requiring the permanently cast message.

Before setting the standard, the City contacted the major foundries to be sure they could manufacture the new irons and remain competitive in Knoxville. East Jordon Iron Works, NEENAH, John Bouchard & Sons, Acheson, and Deeter are the primary foundries that provide irons in Tennessee. Each of the foundries could provide the new pattern without any additional cost to the development community. Since there was no additional cost for the messages and the message will never need to be replaced unlike the plastic markers or stencils, this new standard may be the most cost effective educational program in the City.

SWMP Task: Plan and site location for regional BMP facilities for areas of new development. Status: Ongoing

During the term of the permit, the City will target large development projects or strategically located smaller developments that are suitable for siting regional BMPs. Regional

BMPs would serve multiple upstream developments and typically have drainage areas ranging from 50 acres to several hundred acres. Since most development activity within the City is primarily "infill" that occurs on the limited number of remaining vacant parcels, there are limited opportunities for siting regional BMPs without impacting existing developments.

The City only owns and maintains three regional detention facilities. Those facilities include the detention pond at the Acker Place development, the detention pond located at the Northwest Crossing shopping center on Clinton Highway, and the retention pond at Victor Ashe Park. However, private developers continue to build regional ponds for developments that have drainage areas over 50 acres.

In 2005, the City partnered with Knox County to hire a consultant to review the stormwater ordinances for each agency and to develop a master plan and SWMM model for First and Whites Creek. Although the initial project focused on flooding, it creates a base model that can be expanded in the future to include water quality parameters and analysis for the watershed. One benefit of the watershed model will be to help identify beneficial locations for regional detention. The full report was completed in year four and the executive summary did list three locations of regional detention that were evaluated. One is an existing on line pond South of Adair Drive on a tributary to First Creek that might be improved. The other two locations are located on White's Creek immediately upstream of I-640 and at McCampbell Road. The City has funded a full time hydrologist position to replicate the model in other watersheds.

SWMP Task: Review, update, and maintain guidance criteria for BMPs on City web page (www.cityofknoxville.org/engineering). Status: Ongoing

The City has successfully completed a comprehensive BMP manual during the first permit term. The manual may be accessed at www.cityofknoxville.org/engineering on the Engineering Division's web page. The guidance criteria describe acceptable types of BMPs, design standards, and maintenance requirements for BMPs to be used throughout the City to meet the requirements of the new Stormwater and Street Ordinance. The guidance criteria will be kept on file in the Engineering Division and distributed to developers as the official reference to ensure proper selection, design and maintenance criteria for BMPs.

Because maintenance of BMPs is critical to their long-term effectiveness in reducing pollutant loading from stormwater, the guidance criteria incorporates maintenance considerations with the design criteria to ensure that effective and maintainable BMPs are constructed in the City. The guidance criteria addresses the goals of the NPDES stormwater program by only allowing BMPs which are effective in reducing pollutants targeted by the NPDES stormwater regulations.

This manual is intended to be a live document that changes as new technology or future needs develop. Therefore, the website version is the preferred method of free distribution while CDs and paper copies may be made available for a fee at a local copy center. Free CD versions are typically distributed during the new development seminars each spring. The website and BMP content will continue to be updated at least annually as needed.

TDEC and the UT Water Resources Research Center have adopted the BMP manual as a basic model for use by Phase II NPDES communities. The City provided an electronic copy and has authorized modifications by the State for this purpose. Several other municipalities have obtained electronic copies of the Knoxville BMP manual for edit and adoption in their

community. The City intends to continue providing the editable version of the BMP manual to other MS4s to help develop some consistency in the region.

RC-3 Maintenance Activities for Public Streets, Roads, and Highways

SWMP Task: Continue street maintenance activities outlined in Part 2 application, p. 5-8.
Status: Ongoing

Street cleaning is performed daily for the downtown streets and less frequently for all other streets throughout the City. Large Vac-All trucks are used in most service areas while smaller Tymco vacuum sweepers are used in the downtown areas where maneuverability is key. The Vac-All trucks are also used to vacuum debris from catch basins and remove leaves in the fall. Mowing in City rights of way is typically performed on a two to four week schedule between the months of April and September.

SWMP Task: Evaluate current deicing program and study alternatives and improvements.
Status: Complete

Snow removal, anti-icing, and de-icing of roadways are performed by the PSD and are essential programs to ensure public safety. Sodium chloride, stored undercover at the Loraine Street facility, mixed with liquid calcium chloride is applied to highways and streets by spreaders as necessary. Application of de-icing/anti-icing materials targets highways and major arteries first, and residential streets next. Priorities follow the adopted Major Roads Plan of the City of Knoxville. Because of the importance of maintaining public safety and public commerce, the City aggressively pursues its road clearing operations.

The Public Service Division evaluated the snow removal activities and materials and revises the Snow Removal Plan on an annual basis. The City has been able to significantly reduce the quantity of deicing materials used by improved equipment, improved forecasting, chemicals, and operator training. The City will continue to look for opportunities to minimize the use of deicing materials to reduce costs and protect the environment.

RC-4 Evaluation of Flood Management Projects

SWMP Task: Evaluate regional BMP facilities for water quality retrofit. Status: Ongoing

The City only owns and maintains three regional detention facilities. Those facilities include the detention pond adjacent to Middlebrook Pike and Weisgarber Road at the Acker Place development, the detention pond located at the Northwest Crossing shopping center on Clinton Highway, and the regional retention pond at Victor Ashe Park. Although the regional basins were designed for flood control, the City found that it was possible to retrofit the sites to achieve additional water quality benefits as well. All ponds built since 1997 were required to comply with the water quality requirements for new development.

The City has assumed the responsibility of continued maintenance and water quality improvements at the large regional pond (Acker Place) in the Fourth Creek Watershed. The City

restored a large section of Fourth Creek downstream of the pond in the first year of the permit. In order to reduce the vast amount of sediment in the stormwater effluent and to prevent future accumulation of sediment downstream, two rock check dams and an 18-inch weir plate were placed in the pond's low flow channel. These velocity dissipaters allow the sediment time to settle out of the stormwater while still in the pond. The sediment is removed to prevent migration into Fourth Creek. In the first permit term, volunteers replanted riparian zone vegetation in the pond including red osier, silky dogwood, black willow, and willow oak in addition to the existing species of white pine, cedar, and red oak trees. Since this pond is a site of one of the permanent stormwater monitoring stations, the City will continue to monitor the water quality enhancements and improve the pond as needed in the future. The City is currently evaluating further water quality retrofits to this regional pond through a partnership with an adjacent property development. If this project is beneficial, it will be reported next year.

The regional pond at Northwest Crossing on Clinton Highway serves the Wal-Mart, Lowe's, and surrounding area. The City accepted the maintenance of this pond and immediately designed a water quality retrofit to reduce the pollution in the stormwater runoff. Three large Crystal Stream stormwater treatment devices (www.crystalstream.com) were installed. The units have effectively removed large amounts of trash, sediment, hydrocarbons and organic material from the runoff and prevented the discharge of those pollutants into the receiving stream.

The retention pond at Victor Ashe Park was designed and built with water quality in mind. Three Crystal Stream stormwater treatment vaults were installed to improve the quality of the stormwater runoff from the contributing parking lots, park, and subdivisions. Maintenance and inspection of the Crystal Stream units has been contracted out to Crystal Stream's service company to ensure proper function at both regional ponds.

SWMP Task: Maintain existing GIS inventory of on-site BMP facilities. Status: Ongoing

When the NPDES permit program first started, the City implemented a systematic method of inventorying the existing detention ponds by using a GIS grid of the city. Field crews inspected drainage features in each map grid and recorded the detention facilities in the GIS with a circled D. Since all new development must be certified to confirm that constructed facilities were built as planned, all new stormwater facilities will be properly recorded in the GIS after construction. During the year three reorganization of the stormwater section, the City dedicated one technician position to mapping and maintenance inspections. Due to staffing turnover, this position was not filled until year four.

Engineering staff will continue to maintain and update the existing inventory of ponds, pipes, water quality facilities and other drainage features as part of an ongoing GIS maintenance program. A GIS analyst inspects newly annexed areas in the field to verify the accuracy of the GIS stormwater features and edits the stormwater layers as necessary.

RC-5 Monitoring of Solid Waste Facilities

This program is described in the management section IN-3 for industrial facilities.

RC-6 Management Program for Pesticides, Herbicides, and Fertilizer

SWMP Task: Evaluate possible improvements to existing public education program as part of the illicit connection and improper disposal program. Educate City staff, public, etc.

Status: Ongoing

Public education programs for pesticides, herbicides, and fertilizer use have already been implemented in conjunction with City public education programs for collection and recycling of household hazardous waste. In addition to the solid waste and household hazardous waste informational programs, the City has developed a stormwater pollution program that includes helpful information regarding pesticide and fertilizer use. The City's online Best Management Practices manual located at www.cityofknoxville.org/engineering/bmp_manual/ offers two BMPs for proper pesticide, herbicide, and fertilizer use and disposal. The BMP AM-13 is targeted towards institutional and commercial applications while the BMP RH-05 is directed towards residential and homeowner uses.

The HHW collection program, which includes collection of pesticide, herbicide, and fertilizer waste material, was officially implemented when the facility opened on April 22, 1997. More information about the HHW facility is included in the Illicit Discharges and Improper Disposal Program section ILL-6.

SWMP Task: Reevaluate effect of fertilizers as part of the City's ongoing monitoring program.

Status: Ongoing

Pesticides, herbicides, and fertilizer used by the City are stored in a building at the Loraine Street Operations Center. This building is in compliance with all regulations regarding the storage of hazardous materials. The Horticulture and Grounds Maintenance section of the PSD is responsible for the application of pesticides, herbicides, and fertilizer. The herbicide "Roundup" is applied annually to City parks and rights-of-way to control unwanted weed growth. PSD personnel, who have been trained to apply the herbicide as needed. Fertilizer is only used for minor landscaping projects and stormwater runoff from these projects is not considered a threat to receiving water quality.

The City does not currently require registration by commercial applicators; however, commercial applicators must be licensed under State and Federal Regulations. There are no regulations restricting the use of these substances by individual landowners; however, a household hazardous waste collection facility has been opened to collect all types of hazardous wastes including pesticides, herbicides, and fertilizer.

For pesticide, herbicide, and fertilizer pollutants, the control program is difficult to define since the presence of pesticides, herbicides, and fertilizers in urban runoff is not always evident. Current problems with pesticide, herbicide, and fertilizer pollutants are not believed to be significant. As part of the ongoing stormwater-monitoring program, the City will continue to

monitor the significance of these pollutants. Pesticides, PCBs, and nutrients are tested as part of the ongoing monitoring program described in Sections 5.5 and 6.0 of this report. To date, no significant traces of pesticides have been detected in the annual full-suite grab sample.

5.2 ILLICIT DISCHARGES AND IMPROPER DISPOSAL PROGRAM

Program to Detect and Remove Illicit and Improper Discharges to the Municipal Storm Sewer System, 40 CFR 122.26(d)(2)(iv)(B).

ILL-1 Ordinances

SWMP Task: Evaluate the prohibitions and exemptions of non-stormwater discharges in the original Stormwater & Streets Ordinance. Maintain authority for $5,000 penalties.

Status: Complete

This task was completed in 1997. See description below.

SWMP Task: Implement any new revisions to the Stormwater and Street ordinance.

Status: Complete

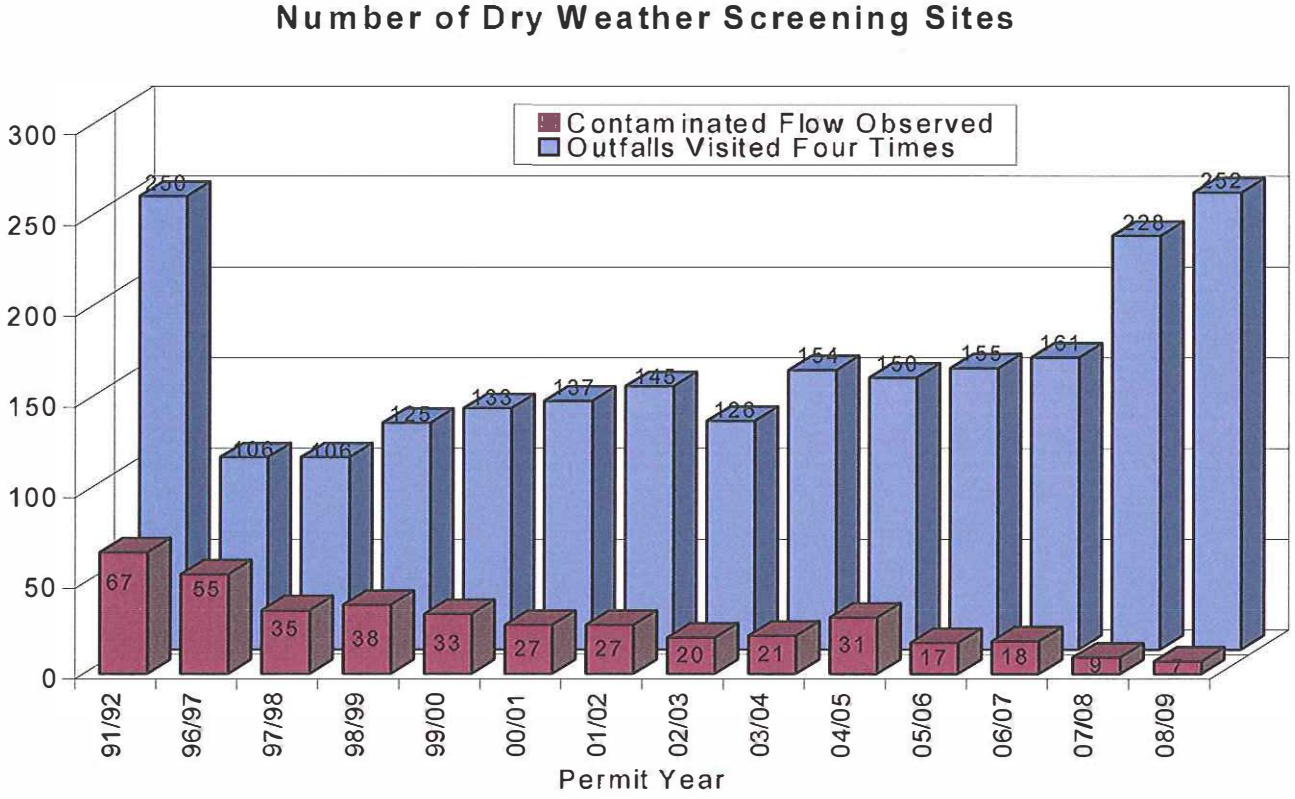
The Stormwater and Street Ordinance was developed to specifically prohibit non-stormwater discharges, increase penalties for illegal discharges, and to provide water quality regulations for new development. The first ordinance was effective June 20, 1997. The ordinance has been updated several times since then. The revised ordinance is available on the Internet at www.cityofknoxville.org/engineering/stormwater.

The ordinance section 22.5-52 specifically prohibits illicit discharges and illegal dumping to any portion of the MS4 or any area draining to the MS4. Illicit discharges were defined consistent with 40 CFR 122.26(b)(2) as any non-stormwater discharge to the MS4, which is not specifically exempted in the ordinance. This definition, along with the $5,000 penalty for violations, has formed the cornerstone of our successful enforcement program and will remain in place during this permit term.

Exemptions to the non-stormwater prohibition are listed in the ordinance in accordance with the list in 40 CFR 122.26(d)(2)(iv)(B)(1). The City added language to the exemption for individual car washing on residential property to include fund-raising washes by non-profit organizations for no more than two consecutive days in duration. During this permit term, the City did purchase two car washing kits which are available to chartable events at no charge.

ILL-2 Field Screening

SWMP Task: Perform follow-up analysis at all high-risk screening sites. Status: Ongoing



The Dry-Weather Screening Program was developed and implemented during the first permit term to evaluate both randomly chosen outfalls and high-risk outfalls, which were tested during the previous year. Each high-risk stormwater outfall was checked for flow after a period of dry weather. If flow was present, the discharge was tested with a Chemetrics colorimetric field test kit (shown) for the following parameters: phenols, ammonia, detergents, copper, chlorine, pH, turbidity, color, temperature, and flow rate. If ammonia is greater than one part per million, then a fecal coliform and E-coli sample is collected for laboratory testing. The outfall test was repeated again between four and forty-eight hours after the first test. After one month, this process was repeated for each outfall to complete a total of four tests each year.

Since this program has successfully identified many illegal dumps and illicit discharges during the first permit term, the City will continue to annually retest all sites that have high parameters or signs of illegal dumping. Once the outfall has tested clean or dry during four site visits in a single year, it will only be retested if randomly selected from the list of inventoried outfalls.

As illustrated by the bar graph, the percentage of high-risk outfalls decreased each year since 1991 except for 2004/2005. The number of high-risk outfalls that need to be retested each year will obviously vary depending on the tested results of the previous year.

As required by Part VI (A)(2)(f)(ii) of the NPDES permit, the results of the dry-weather

screening are included in the appendix of this report. Since the beginning of the program, 8489 outfall-screening visits have been conducted. The results from each of those visits are tabulated in the database by outfall identification number, testing date, and visit number. The testing results from the outfall screenings that occurred during the last permit year are included in the appendix of this report.

SWMP Task: Investigate 150 field-screening sites four times per year.

Status: Ongoing

To insure that all outfalls are eventually tested each permit cycle, the City will continue to monitor a minimum of 150 outfalls each year throughout the new permit term. Last year the City visited 252 outfalls four times each. The monitored outfalls consisted of the previous year's 9 high-risk outfall sites plus 243 randomly selected outfalls from the general outfall inventory. The randomly selected sites were selected from areas of primarily industrial use and from areas that had not been previously tested. The City also selected outfalls throughout the city with some preference given to the highly developed areas.

The Engineering Department has developed an outfall database to maintain the testing data and site information for each outfall in the inventory. This outfall database is linked to the GIS to allow data access geographically for a single point or by report/query functions for many outfalls at a time. By maintaining a history of each outfall, illicit discharge trends may become apparent and therefore may be resolved with education or enforcement.

The dry-weather-screening program has been one of the most successful programs during the last permit term and will continue to be a high priority throughout the next permit cycle.

ILL-3 Investigation of the Storm Drain System

SWMP Task: Implement procedures for mapping, field surveys and upstream source identification. Status: Ongoing

The procedures for mapping, field surveys and upstream source identification were developed and included in the Part II Application section 5.3.5. The City will continue to utilize these procedures to maintain the effectiveness of the Illicit Discharge and Illegal Dumping Program. Last year there were no updates to report for this procedure. If the procedure is updated, it will be included in the following annual report.

SWMP Task: Evaluate and update enforcement procedures, policies, monitoring and inspections.

Status: Complete

The schedule for this task appropriately coincided with the schedule for ordinance updates. The existing enforcement procedures and policies have been effective and were not amended when the ordinance was updated in 2005.

Depending on the violation, a first-time offender is usually educated and asked to remediate the damage or correct the violation if possible. This is usually followed up with a letter to inform the violator of the City's expectations and to provide helpful BMPs to prevent future problems. More severe or repeated violations will merit a Notice of Violation (NOV),

which is issued in the field directly to the violator if available on site. Copies of the NOV are distributed to the property owner or developer by certified mail, the City Law Department, and the Engineering Division's file. The NOV may order specific remedies and require the violator to submit reports and/or pollution prevention plans. Penalties, if any, are only issued after the NOV expires so the violation and remedies may be fully evaluated.

In the event that a penalty is assessed, a violator may appeal the penalty before a five-member Environmental Appeals Board. The five volunteer members of the Environmental Appeals Board are appointed by the Mayor and consists of individuals with an expertise as follows:

1) One licensed professional engineer with three (3) years of engineering experience as a Professional Engineer;
2) One architect, engineer, landscape architect or surveyor with three (3) years of experience;
3) One representative of the development or industrial community;
4) One neighborhood representative;
5) One member at large.

In addition to the above qualifications, one of the five members must have at least three years of civil engineering experience and a second member must have at least three years of civil or environmental engineering experience. Board members serve a 5-year term and may be re-appointed at the end of their term.

Some research has already begun to determine appropriate penalties for discharges that cannot be recovered but do not cause a fish kill or other quantifiable immediate damage. The City's current evaluation method does not account for incremental contributions to the overall pollutant loading or degradation of the waterway.

To help identify repeat violators, the City maintains an updated record of every NOV issued and a database for stormwater complaints. Follow-up monitoring and inspections will be a combination of City and self-inspections by industries. Enforcement actions resulting from the dry-weather screening program will be followed as defined within that program as a minimum. Any outfall that is tested for high parameters or identified as an illicit connection/ illegal dump source, will be tested four times a year, every year, until the outfall is dry or clean on all four visits. Sources of pollution identified by other means will be monitored as needed or specified for the individual situation. The ordinance Section 22.5-53 requires immediate reporting of spills and illicit discharges and Section 22.5-54 allows the City to require additional monitoring.

SWMP Task: Inspect stormdrain system and update features on GIS. Status: Ongoing

The City is dedicated to updating and maintaining reliable stormdrain data on the GIS. This task is implemented by a concerted effort within the Engineering Department. All employees are instructed to submit their completed stormwater work orders to a designated GIS analyst for the purpose of updating the GIS stormwater layer. That same analyst personally inspects all new annexations to insure that all existing stormdrain features are added to the system shortly after the parcel becomes part of the city. All new developments require a development certification submitted by a design professional upon completion. The analyst in the stormwater quality group records the stormdrain features from the development certifications into the GIS. Field personnel are instructed to log and report any discrepancies that are found

between the maps and actual system in the field. The GIS analyst is responsible for completing the proper updates.

During the first permit term, the GIS analyst and two engineering interns began to systematically inspect the entire stormdrain system by grid to find and correct the parts of the stormwater GIS layer that may be in error. Now that much of this work has been verified and the procedures for maintaining accurate data are in place, the grid-by-grid investigations will be conducted as needed or as part of specific updates for areas of significant development. Because maintaining the integrity of the GIS via field verification is extremely time-consuming, it is reasonable to believe this will be an ongoing task. The Stormwater program reorganized staff in year three to assign watersheds to specific technicians. A new Stormwater Technician position was dedicated to inspections for mapping accuracy and maintenance needs.

ILL-4 Spill Response Program

SWMP Task: Coordinate with Knoxville Emergency Response Team (KERT) and TDEC.

Status: Ongoing

The City of Knoxville Stormwater Quality Section of the Engineering Department continued to coordinate with both the KERT and TDEC during emergency situations. Each agency has specific roles to play during an emergency event. When discharges enter the MS4, the City's Stormwater Quality Section assists with information gathering, investigations, GIS support, containment, remediation, follow-up monitoring, and enforcement when necessary.

The Knoxville- Knox County Emergency Management Agency (KEMA) and Knoxville Fire Department (KFD) coordinate most major spills when they are called in to 911. KEMA also coordinates routine training and simulations for various situations throughout the year. Workshops are provided to simulate real scenarios and allow coordination of the field teams and the Emergency Operations Center (EOC). Engineering Division staff participates in the EOC while the KEMA, KFD, Police Department, and Rural Metro units perform the field exercises.

The KFD and Engineering Department coordinate to respond to small spills and possible hazards as they are reported. The two groups will continue to work closely together to contain and remediate discharges in the street, stormdrain system, creeks or wherever necessary. The KFD maintains a fireboat downtown on the waterfront and a Hazardous Materials truck in one fire hall to assist with spills and signification discharges into the river, creeks or stormdrains.

When a responsible party is identified for a spill or hazardous discharge, the Engineering Division staff will follow normal investigation and enforcement procedures to order the containment and remediation at the violator's expense. The HAZMAT team will work to contain the spill until the responsible party takes over. The City's HAZMAT team will then report back to the station to be ready for the next emergency while the Stormwater Section personnel monitor the remediation of site until the stormdrain and creek are restored.

Last year, the Stormwater staff responded to assist the Fire Department with a variety of spills including traffic accidents that lost fuel, illegal dumping, and discharges from permanent facilities. The small releases from accidents and illegal dumping were contained by the Fire Department and Stormwater management staff. Stormwater staff and/or Public Service Department will remove and dispose of the materials from the small spills. Larger spills are typically referred to a private remediation company.

Engineering staff will continue to closely coordinate with other emergency personnel by attending the monthly Local Emergency Planning Committee meetings and by maintaining a staff member on call after hours and on weekends to help respond to water quality emergencies.

ILL-5 Reporting of Illicit Discharges

SWMP Task: Maintain and monitor the "Water Quality Hotline" for public reporting.

Status: Ongoing

The Water Quality Hotline for public reporting of water quality concerns was established as planned during year one of the first permit term. The hotline was operational in November of 1996 but did not receive mass publicity until December 1996. The hotline phone number is a local Greater Knoxville Area number listed in the blue pages as follows:

WATER QUALITY HOTLINE-
To Report Illegal Dumping Into Ditches
Creeks Or Catch Basins 24-Hours/Day.....[865] 215-4147

The hotline has received a variety of calls including: industrial discharges, gray water discharges, broken laterals, commercial washing, and neighbors dumping, etc. The hotline has been a popular and convenient method for callers to anonymously report problems that they have witnessed or created. Common calls are from neighbors or dissatisfied employees of polluters. This program has been very successful and will be continued throughout the permit term.

The Water Quality Hotline is a dedicated phone line attached to a phone in the Stormwater Quality Section of the Engineering Department. Employees in the section also have the hotline linked as a second line on their individual office phones so anyone may answer the phone during the day. After hours and on weekends, the messages are recorded and routinely retrieved by the on-call supervisor. If the water quality concern is within the City limits, the Engineering Department investigates the problem. Otherwise, the problem is referred to the Knox County Health Department, TDEC Environmental Assistance Center, or other appropriate agency.

The objective of this task is to increase the public awareness of the City's role in water quality issues and to create a quick and anonymous method for citizens to report water quality concerns. The publicity of the hotline has already provided a consistent and convenient resource for concerned citizens.

The City includes the hotline number in thousands of mass produced stormwater pollution prevention educational handouts such as magnets, brochures, presentations, business cards, and routine correspondence with residents. The hotline is prominently displayed at the bottom of the Second Creek watershed boundary road signs to let travelers know where they may report water quality concerns.

Recently, the Hotline was advertised by placing the number on the plastic stormdrain markers, which are placed on curb iron inlets. Although the curb iron markers have been used for years, this custom design helps identify the markers specifically for Knoxville. The City will continue to seek out and develop innovative methods to advertise this successful program as a method for citizens to anonymously report complaints. Future opportunities to advertise may include: utility bills, public access TV, radio PSAs, signs on city buses, refrigerator magnets,

pamphlets, brochures, BMP manual CDs, permits, etc. The innovative methods of publicity will vary each year as opportunities are developed.

SWMP Task: Maintain public education program. Status: Ongoing

River Rescue

The year 2009 was the 20th year for the River Rescue. The spring 2009 River Rescue attracted 814 volunteers who collected 18 tons of trash and 47 tires from the shores of the Tennessee River. This annual event is coordinated through Ijams Nature Center in cooperation with the City of Knoxville and Sea Ray Boats and more than 20 other partners, including members of the business community, government agencies, private organizations, and individuals. There are over 44 sites or "zones" that stretch from the forks of the river above Knoxville to Fort Loudoun Dam. River Rescue is also held in partnership with Lake User groups on Watts Bar Lake, Melton Hill Lake, and the Clinch River. Ijams Water Quality Specialists plan for this event throughout the year by recruiting volunteers, surveying riverbank conditions, securing additional sponsors, and pinpointing areas in need of cleanup.

Operation Storm Drain Status: Ongoing

The Blue Thumb Coalition started this ongoing program in 1994 in an effort to educate the public that there is a difference between the stormdrain system and the sanitary sewer. Operation Storm Drain attempts to reduce the amount of pollutants dumped into our waterways through education instead of enforcement.

The message "DUMP NO WASTE, DRAINS TO STREAM" was stenciled on over ten thousand storm drains earlier in the permit term. In the last few years, the City replaced the stenciling program with DAS curb markers. These brightly colored plastic disks are affixed to the curb irons and carry the message "Dump no Wastes, Drains to Stream". Although the curb markers are a temporary retrofit for the existing storm drains, they are more economical and environmentally friendly since they do not wear off as quickly as the painted stencils. When the disks were first introduced, volunteers and City staff placed several thousands of markers on storm drains in the city. Currently, several hundred of the informational disks are purchased and distributed to volunteers each year to attach to curb irons. During year one the disks were revised to include the Water Quality Hotline phone number and some Spanish text.

In the City's new permit application, a permanent version of this educational program was proposed. The City has already adopted a new development standard for all new curb irons

and solid stormwater manhole covers. The new standard requires the iron to be cast with the educational message included on top of all new curb irons and solid manhole lids. In an effort to make the curb irons more eye-catching, several foundries have cast into the iron a graphic of a fish in addition to the environmental message. The foundries offer these designs to the surrounding communities to simplify their stock requirements. This program should offer long-term educational benefits as citizens become familiar with the message and it's meaning.

Water Quality Forum — Status: Ongoing

The WQF is a consortium of agencies, organizations, academic institutions, public utilities, and interested citizens working to protect and restore the waterways in Knox and the eight surrounding counties. It was initiated by the City of Knoxville in 1990. Currently it has twelve dues paying Partners; the City, TVA, Ijams Nature Center, Knox County, UTK-WRRC, the Town of Farragut, KGIS, the Knox County Soil Conservation District, KUB, the Sevier County Water Board, The League of Women Voters, and the Hallsdale –Powell Utility District. There are numerous other stakeholders, who attend the quarterly meetings ranging from concerned individuals to agencies from other counties seeking information and guidance. To learn more about the WQF, go to www.waterqualityforum.org.

Adopt-a-Watershed — Status: Ongoing

Currently, fifteen area high schools and middle schools are participating in the program. The Americorp volunteers coordinate the program with the individual schools. This program has helped implement the goals of the NPDES program and increased public awareness of water quality issues. The primary goals of the Adopt-a-Watershed program include:

- Characterizing the school's watershed using, at minimum, two AAW characterization tools (e.g., watershed inventory, watershed mapping, windshield survey, stream walk).
- Monitor the school's watershed stream(s), conducting, at minimum, chemical testing twice and a biological (i.e. macroinvertebrate and/or fish) assessment once.
- Conduct at least one water quality improvement activity (e.g., tree planting, storm drain stenciling, stream cleanup, stream bank restoration, presentations to school groups/community organizations on the "state of the watershed" as determined by the students' characterization/monitoring efforts).

The City will continue working with the schools and provide support such as information, solid waste support for cleanups, GIS maps, stencils, testing supplies, training, and grants.

Adopt-A-Stream — Status: Ongoing

The City of Knoxville, in conjunction with Knox County and The Town of Farragut is in the seventh year of administering the Adopt-A-Stream program. The City has provided the supervision and training in addition to gloves, trash bags, pitchforks, wheelbarrows, waders, and other tools for these activities.

Clean, Protect and Restore (CPR) Status: Ongoing

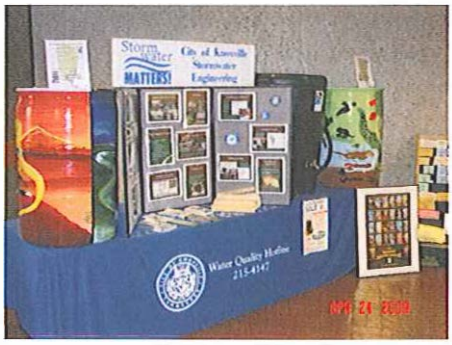
This annual project coordinated by the Americorps Volunteers with the assistance of the Water Quality Forum, coordinates creek cleanups at seven sites throughout the City of Knoxville and Knox County in October.

During this fiscal year, the CPR efforts were concentrated in the Williams Creek, First Creek, Goose Creek, Love Creek, Ten Mile, and two locations on Third Creek. The event had 164 volunteers and removed 8772 pounds of trash from a combination of all the sites.

Public Displays And Presentations Status: Ongoing

In cooperation with the COK Solid Waste Office staff presented displays and informational materials at several public events including the Dogwood Arts Festival, Home Show, and Earth Day Celebration.

Various environmental presentations were also made to citizens through groups such as the Fulton High School, rain barrel workshops, and University of Tennessee classes.



City Employee Training Status: Ongoing

The City purchased a stormwater pollution prevention video from Excal Visual to train City employees. The eighteen-minute long video outlines BMP's for stormwater pollution prevention and has been shown to various businesses. To learn more about the video, go to www.excalvisual.com. We also evaluated another video for erosion & sedimentation control.

WaterFest Status: Ongoing

WaterFest is an annual festival designed to educate youth about the many values of water. It was initiated in 1995 by the Water Quality Forum (WQF) and has grown into an event with hundreds of elementary and middle school children attending from across Knox County. Ijams Nature Center hosts and coordinates this springtime event that is planned by forum partners throughout the year. It is designed to be fast-paced, engaging, educational, entertaining and just plain fun for the students. On the day of this event, WQF partners come together to make WaterFest happen. The CAC AmeriCorps Team takes the lead in conducting games, arts and crafts and model-building activities with the students. Storytellers and musicians engage students in audience participation performances and forum partners run informational/demonstration booths. Local high school and university students provide great volunteer support.

ILL-6 Used Oil & Toxic Materials Program

SWMP Task: Continue coordination of Recycling Program. Status: Ongoing

The Solid Waste Division manages the City of Knoxville's recycling program. The entire annual report of these programs is included in the appendix of this report. This program is an important part of the City's solid waste reduction efforts and will continue throughout the next permit term.

SWMP Task: Maintain and Operate Household Hazardous Waste Facility. Status: Ongoing

The City continues to operate the Household Hazardous Waste (HHW) Collection Center, which first opened on April 22, 1997. When first opened, the City of Knoxville HHW Facility was the first permanent HHW Collection Center in the State of Tennessee. The HHW Facility is open five days a week. The center accepts HHW from both Knoxville and Knox County residents. Knox County shares the annual costs of operation. The capital expenditures associated with construction of this facility were paid for through a $500,000 grant from the State of Tennessee. Activities at the center include:

- Diverting reusable products;
- Collecting, reusing and solidifying latex paint;
- Collecting car batteries, oil and antifreeze;
- Diverting selected acid and bases to waste water treatment;
- Bulking flammable materials; and
- Packing miscellaneous HHW materials for safe shipment and disposal.

Upon entering the HHW Collection Center, customers pull into a covered drive-through unloading area, where technicians remove HHW from vehicles. Material that is collected and is still "good" is separated and made available for pickup by the public free of charge in a "reuse area". "Good" material includes containers that have never been opened or materials that have not yet exceeded their useful shelf life. The staff then processes materials that are not reusable. Diverting selected acids and bases to the wastewater treatment facility, bulking flammable materials, lab packing, and solidifying latex paint. Some limited amounts of latex paint are reconditioned at the facility and used by the City in its facility services operation. After materials are processed, they are packed into 55-gallon drums, which are placed in one of two prefabricated storage units. Each of these units has a special fire suppression system, and drainage/spill containment systems. The hazardous materials are then stored in the units and held until sufficient quantities are collected. The HHW is operated by two technicians trained to the 40-hour OSHA site worker level and managed by an on site foreman and manager.

5.3 THE INDUSTRIAL AND RELATED FACILITIES PROGRAM (IN)

Program to Monitor and Control Runoff from TSD and Industrial Facilities Subject to SARA Title III, Section 313, requirements, 40 CFR 122.26(d)(2)(iv)(C).

IN-1 Ordinances

SWMP Task: Evaluate and implement revisions to the prohibitions and exemptions of non-stormwater discharges in the existing Stormwater & Streets Ordinance. Status: Complete

The Stormwater and Street Ordinance was developed to specifically prohibit non-stormwater discharges, increase penalties for illegal discharges, and to provide water quality regulations for new and redevelopment. The latest revision of the ordinance was last revised in 2005. The current Stormwater and Street Ordinance may be accessed on the Engineering Department's web page at www.cityofknoxville.org/engineering/stormwater.

The ordinance section 22.5-52 specifically prohibits illicit discharges and illegal dumping to any portion of the MS4 or any area draining to the MS4. Illicit discharges were defined according to 40 CFR 122.26(b)(2) as any non-stormwater discharge to the MS4, which is not specifically exempted in the ordinance. This definition, along with the $5,000 penalty for violations, has formed the cornerstone of our successful enforcement program and will remain in place during the new permit term.

Exemptions to the non-stormwater prohibition are listed in the ordinance in accordance with the list in 40 CFR 122.26(d)(2)(iv)(B)(1). The City added language to the exemption for individual car washing on residential property to include fund-raising washes by non-profit organizations for no more than two consecutive days in duration.

IN-2 Inspection Element

SWMP Task: Continue inspection program for non-permitted commercial facilities (i.e. car lots, restaurants, service stations, grocery stores, etc.). Status: Ongoing

Over the course of the first permit term, the City has identified many common discharges from facilities that were not required to be permitted under the TDEC multi-sector general stormwater permit or individual NPDES permit program. Rather than spend limited resources attempting to duplicate the efforts of TDEC and EPA by monitoring existing permitted facilities, the City added a Special Pollution Abatement Permit (SPAP) program for those specific land-uses that have proven to cause polluted runoff problems. This program has been developed to fill in the gaps in the existing permit programs of those agencies with a local inspection program for otherwise non-permitted facilities.

In the current term, the City added a new Stormwater Technician position to perform additional education and inspections for industry and certain commercial areas. The technician performs most of the industrial and commercial facility inspections on sites that currently have a Special Pollution Abatement Permit (SPAP). Other technicians also perform inspections as needed. A complete list of the SPAP facilities that were inspected during this permit year can be found in the appendix.

Each of the SPAP facilities is required to have some type of structural stormwater treatment device (i.e. oil/water separators, catch basin insets, sand filters, grass swales, etc.) in addition to their pollution prevention management controls. During the SPAP inspection, the City normally reviews the facilities maintenance records, provides technical advice on proper maintenance scheduling, records the devices GPS coordinates if needed, and updates the City's industrial and commercial facilities database. Inspection of the SPAP permitted facilities will occur systematically to insure that the structural controls are maintained and the management controls are being followed.

In addition to inspections of sites that have SPAP's, the City will select for inspection some existing sites that were built before the SPAP program was implemented. These sites will be targeted for education rather than enforcement to bring the sites into compliance using proper BMPs from the City's manual. Other commercial site inspections will need to be performed in direct response to specific complaints from citizens or tips from the water quality hotline. The City will decide on a case-by-case basis whether this group of inspections will use education or enforcement to correct any problems found. In some cases, the old facility may be required to apply for a SPAP to correct violations.

The inspection program will focus on performing routine and/or random inspections on a variety of commercial sectors. The inspectors can work with the business to develop site-specific pollution prevention plans, employee training and structural modifications, if needed. The City's BMP manual has a wide assortment of information for a variety of businesses. Since these businesses are not regulated in a permit program now, many of the operators are not focused on how their actions impact water quality in the area streams.

Section 22.5-37 of the ordinance requires a Special Pollution Abatement Permit (SPAP) for certain land uses and Section RC-2 of this report provides more details on this program.

SWMP Task: Collect and analyze NOIs from Industrial Permit applicants. Status: Ongoing

When the NOIs are received from TDEC or directly from the private industry, the City reviews and evaluates the information for potential impacts to the municipal storm drain system. In the past, the NOIs have been instrumental in locating and removing discharges from local industries. During inspections or enforcement actions with an industry, the City may verify that an NOI has been filed. If an NOI has not been filed, the City will coordinate with TDEC to obtain the NOI. Future NOIs may be obtained annually from TDEC in bulk or electronically.

SWMP Task: Identify potential industrial discharges through Illicit Connection and Improper Disposal Program. (Both stormwater & non-stormwater discharges). Status: Ongoing

The illicit connection and improper disposal program defined in the City's Part II NPDES stormwater permit application and in the previous section of this report, primarily addresses runoff from industrial facilities. The majority of dry weather screening occurs from areas of industrial use or outfalls indicated by a "300" in the identification number. Illicit connections or improper disposal from industrial facilities that are discovered while inspecting the storm drain system under this program are recorded in the facilities' file in the database. The City contacts the industrial facility directly, along with TDEC if necessary, to identify the problem and work on an appropriate solution. If enforcement action is necessary, the City will track the situation

until the illicit connection is corrected, the illegal dumping stopped, or until the facility receives a valid NPDES permit for the discharge.

SWMP Task: Review and update inspection program as part of Pollution Prevention Plans for Municipal Industrial Facilities. Conduct annual inspections at MIFs. Status: Complete

During the first permit term, the City developed an inspection and pollution prevention program for municipal industrial facilities. This program will be reviewed and updated in the first year of the new permit and continued. Inspections will still occur annually of the new permit.

Currently only four municipal industrial facilities are operated in the City. These facilities include:

- the Solid Waste Management Facility (SWMF) on Elm Street,
- the fleet truck & heavy equipment garage on Loraine Street,
- the fleet and police garage at Prosser Road, and
- the Knoxville Area Transit (KAT bus station) on Magnolia Avenue.

Each facility is currently evaluated and inspected regularly by Engineering personnel and will continue to be inspected at least annually in the future. A new KAT facility is under construction now. Once completed, their SWPPP will be updated to include both facilities and reported at the following annual report. The new facility will be built using LEED standards and include stormwater quality treatment devices for the runoff.

The inspection and monitoring program has been productive at all of the MIF's in the past. Structural and management BMP's have been installed to control pollution and improve the runoff from each facility. All of the improvements were reported as they occurred. The SWMF is currently being retrofitted with structural controls to reduce the solids, sediment, hydrocarbons, and bacteria in the runoff from the paved areas.

IN-3 Monitoring Element

SWMP Task: Collect monitoring data from industrial stormwater dischargers and/or from TDEC. Assess impacts to the storm drain system. Status: Ongoing

As part of the NPDES Permit for stormwater discharges associated with industrial activity, applicants are required to monitor, at least bi-annually, representative stormwater outfalls identified on the facilities' Pollution Prevention Plans. Applicants must monitor in accordance with TDEC Rule 1200-4-10-.04. The City currently receives copies of the results of the industrial outfall self-monitoring from some of the regulated industries. The City will continue to work with TDEC or directly with the industrial discharger to obtain copies of the information, as it becomes available. The City will maintain this information in the City's industrial files, and will assess the impact of the monitored discharges on the water quality of the storm drain system as the City receives the data.

If the City determines that additional data needs to be provided in the monitoring program for an industry (reports on additional parameters, etc.), requirements for an expanded program for subsequent monitoring events will be coordinated with TDEC and/or the industrial discharger.

The Stormwater and Street Ordinance authorizes the City to require additional monitoring

from industries not covered under the TDEC programs whenever necessary. This will usually be required in conjunction with some enforcement action after a problem has been observed.

This program will be continued throughout the new permit term.

SWMP Task: Continue monitoring program at non-permitted commercial facilities using guidelines pursuant to 40 CFR 122.26(d)(2)(iv)(c)(2). Identify pollutants and sources.

Status: Ongoing

During the current permit term, the City developed a program to sample commercial "hotspots" sites that do not require TDEC or EPA permits. The land uses that require a City of Knoxville Special Pollution Abatement Permit (see section RC-2) are targeted for samples. The standard operating procedures for the City's wet-weather sampling program are used except grab samples are substituted for the automatic sampler stations.

The samples from the hotspot land uses are analyzed for a wide range of pollutants. These pollutants should vary from one land use to the other. For example, restaurants and grocery stores will likely have runoff containing a higher nutrient load from their dumpster/grease bin area than a new auto dealership. Both will likely have oil/grease, sediments, and metals from the vehicle traffic. This monitoring data may play an important role in determining the future direction of the SPAP program and to verify the suitability and effectiveness of the SPAP runoff controls.

In addition to the stormwater sampling above, all outfalls from industrial areas have been tested as part of the dry weather field-screening program to identify potential specific sources of the pollutants. Each year the City will continue to choose random outfalls from industrial areas as the primary dry weather screening locations. These outfalls are tested with field screening kits with additional laboratory tests as necessary.

Additional monitoring and reports from TSDs and industrial facilities subject to SARA Title III, Section 313 may be required when a problem has occurred, when the City has reason to believe a pollution problem exists, when TDEC or EPA do not already require sufficient testing, or if the City is mandated to test and report those facilities. The Stormwater & Streets ordinance Section 22.5-54 states, *"The Engineering Director may require any person engaging in any activity or owning any property, building or facility (including but not limited to a site of industrial activity) to undertake such reasonable monitoring of any discharge(s) to the stormwater system operated by the City and to furnish periodic reports of such discharges."* The City will maintain this legal authority to require monitoring from all facilities necessary as the Stormwater & Streets ordinance is updated throughout the permit term.

SWMP Task: Continue monitoring program at non-permitted commercial facilities and analyze the results from ongoing commercial monitoring program. Schedule: Ongoing

Beginning in year two, the City initiated an annual sampling program at the storage and maintenance areas at the City's Loraine Street facility, Solid Waste Management Facility, and the KAT bus station. Samples are also collected at non-permitted commercial facilities such as restaurants, gas stations, car lots, grocery stores and other known hotspots. The sampling locations will change each year to ensure a wide variety of sites within each commercial group.

SWMP Task: Maintain adequate legal authority to require monitoring and reports from TSDs and Industrial facilities subject to SARA Title III, Section 313. Schedule: Ongoing

The Stormwater & Streets ordinance Section 22A-54 states, *"The Director of Engineering may require any person engaging in any activity or owning any property, building or facility (including but not limited to a site of industrial activity) to undertake such reasonable monitoring of any discharge(s) to the stormwater system operated by the City and to furnish periodic reports of such discharges."* The City will maintain this legal authority to require monitoring from all facilities necessary if the Stormwater & Streets ordinance is updated in the next permit term. Additional monitoring may be required when a problem has occurred or still exists, when the City has reason to believe a pollution problem exists, when TDEC or EPA do not already require sufficient testing, or if the City is mandated to test and report those facilities.

SWMP Task: Evaluate and update the monitoring program for Municipal Industrial Facilities. Status: Ongoing

The City has implemented limited testing at these facilities including ambient monitoring, dry-weather screening, and industrial stormwater inspections conducted by the Engineering Department. Initial monitoring inspections resulted in some of the structural modifications mentioned above in section IN-2 as well as some management policies and procedures. The City evaluated the current monitoring at MIFs and updated the plan to include some laboratory analysis to help evaluate the effectiveness of the installed structural controls. For example, the large Stormceptors that were installed at the bus terminal may be monitored with a before and after treatment sample to determine the removal efficiency of that BMP.

The Loraine Street facility is the site for a full-scale side-by-side BMP investigation project. Inflow and effluent samples are collected from each of the structural devices to determine the efficiency of each unit. The City completed installation of the test site in year two and started sampling in year three.

Stormwater runoff from the SWMF is sampled annually as described in MN-2. BMP monitoring will begin after the structural retrofits are completed.

The dry-weather screening program will continue to monitor the outfalls from all MIFs to insure that management controls are sufficient.

SWMP Task: Manage and Conduct Monitoring Program at MIFs. Status: Ongoing

The monitoring program for the municipal industrial facilities was developed during the first permit term and included in the first annual report. The program specified that the only municipal industries included in the City's monitoring program will be limited to the Knoxville Area Transit station, the Prosser Road fleet and passenger vehicle garage, and the Loraine Street maintenance and storage facility. However, the City added additional monitoring and testing of the parking lot runoff from the Solid Waste Management Facility (SWMF) on Elm Street during the first permit term. This monitoring program was developed as a Best Management Practices test site to evaluate the usefulness and effectiveness of catch basin filters on ultra-urban land

uses. The City partnered with the University of Tennessee Civil & Environmental Engineering Department and with Aqua Shield to put two catch basin filters in place. One filter was installed at the SWMF and one was located on Phillip Fulmer Way outside Neyland Stadium.

A BMP sampling project began in 2007 at the Loraine Street as described earlier. Two vault type stormwater treatment units were installed side-by-side at the Loraine Street facility in 2006. The City began BMP testing at the SWMF in year four.

Each year, the MIF outfalls are inspected at least once for non-stormwater flow in dry weather. If flow is observed, the normal dry weather screening parameters are analyzed, recorded, and investigated. In addition to the dry-weather screening, grab samples are collected from storage/maintenance areas at the City's Loraine Street facility, the Solid Waste Management Facility and the KAT bus station.

5.4 CONSTRUCTION SITE RUNOFF PROGRAM (CS)

Program to Implement and Maintain BMP Plans to Reduce Construction Site Runoff to the Municipal Storm Sewer System, 40 CFR 122.26(d)(2)(iv)(D).

CS-1 Site Planning

SWMP Task: Requires construction sites greater than 10,000 sq. ft. to submit Erosion and Sediment (E&S) Control Plans. Status: Ongoing

The original Stormwater and Street Ordinance was passed in 1997 and specifically required construction sites greater than 10,000 square feet to provide erosion and sediment control plans. The ordinance was revised in 2005 but the requirement for erosion control plans was not removed. The current ordinance may be reviewed or downloaded on the Internet at www.cityofknoxville.org/engineering/stormwater. This requirement is satisfied in Section 22.5-27(j)(1) of the ordinance and will remain in place.

SWMP Task: Require Site Plans Submittals per the City of Knoxville BMP Manual.
Status: Ongoing

The Stormwater and Street Ordinance requires all erosion and sediment control plan submittals and all site development work to comply with the Erosion and Sediment Control Handbook produced by TDEC, dated March 2002, or as amended by TDEC or its successor, or the City of Knoxville's Best Management Practices Manual, whichever is more restrictive. The City proposes to maintain the requirement for compliance with the City's BMP manual or an equivalent BMP in the future.

SWMP Task: Review and update minimum criteria for plan review and checklists.
Status: Complete

Although the TDEC Erosion and Sediment Control Handbook does provide a checklist for review of Erosion and Sediment Control Plans, the City developed a list of minimum criteria

to supplement the State checklist for various categories of site plans (residential, commercial, etc.). The City plans review staff uses the minimum criteria and checklists to insure consistency in the plan review process. The checklist is available on the Stormwater section's web page at www.cityofknoxville.org/engineering/ldmanual as part of the Land Development manual.

SWMP Task: Require Pre-construction Assistance Meetings with Developers/Contractors for any project that requires a performance bond. Status: Ongoing

Since 1999, the City of Knoxville requires a Pre-construction Assistance Meeting with the Developer, contractors, design Engineers, and the City staff before a Site Development Permit is issued. This meeting is scheduled after the Site Development plans are ready for approval but before construction begins. The meeting insures that all parties involved with the construction project are equally aware of the City's expectations. Topics covered in the meeting may include:

- The Development Inspection Checklists,
- The Stormwater & Streets Ordinance,
- The Engineering Department Enforcement Policy,
- Construction Best Management Practices,
- Inspection Schedules,
- State of Tennessee Erosion & Sediment Control Handbook,
- The City of Knoxville BMP manual,
- TDEC's SWPPP and ARAP,
- Special notes and considerations for the particular site,
- Other important information relevant to the project, and
- The City inspector, which is assigned to the project.

The Pre-construction Assistance Meeting format will continue to be reviewed and updated throughout the permit term as new policies, procedures, BMPs, and other regulations necessitate. Since the assistance meetings have been successful at increasing compliance and reducing enforcement, they will be an ongoing policy.

CS-2 BMP Requirements

SWMP Task: Require Construction BMPs from the City BMP manual or equivalent.
Status: Ongoing

As outlined in the new Stormwater and Street Ordinance section 22.5-27, all erosion and sediment control plans must comply with either the Erosion and Sediment Control Handbook produced by TDEC, dated March 2002, or as amended by TDEC or its successor, or the City of Knoxville's Best Management Practices Manual, whichever is more restrictive. The requirement to use BMPs from the BMP manual or TDEC manual applies to Utility, Single Family Residential (>10,000 s.f), Large Residential and Commercial Developments. The City proposed to maintain the requirement for compliance with the City's BMP manual or an equivalent BMP in the reapplication.

SWMP Task: Evaluate additional BMP requirements and design modifications. Maintain the updated BMP requirements on the City's web page. Status: Ongoing

The Stormwater and Street Ordinance section 22.5-22 authorizes the Engineering Division to compose a development design manual as the standard for which the ordinance requirements will be met. The BMP manual may be accessed on the Stormwater Section's web site at www.cityofknoxville.org/engineering/stormwater.

The guidance criteria in the new manual describe acceptable types of BMPs, design standards, and maintenance requirements for BMPs to be used throughout the City to meet the requirements of the new Stormwater and Street Ordinance. The guidance criteria are maintained on the Internet and distributed to developers as the official reference to ensure proper selection, design and maintenance criteria for BMPs. To ensure that effective post-development BMPs are constructed and maintained in the City, a standard maintenance covenant is executed before site development plans are permitted. The guidance criteria address the goals of the NPDES stormwater program by allowing only BMPs, which are effective in reducing the targeted pollutants.

The BMP manual was intended to be a live manual with updates to add additional BMPs as necessary and to remove ineffective BMPs when appropriate. Maintaining the manual on the web is the easiest method to keep the manual current and available to the public.

SWMP Task: Continue to require construction site Good Housekeeping practices.
Status: Ongoing

To ensure that construction sites are kept clean and orderly, and to minimize pollutants in stormwater runoff as a result of other construction activities, the City will continue to require good housekeeping measures on all active construction sites. The good housekeeping regulations included in the new BMP manual address the following considerations:

- Designated areas for construction equipment maintenance and repair,
- Prohibition of discharges of oil and grease into the MS4 or receiving waters,
- Designated areas for construction equipment washing to ensure washwater is discharged to a maintained temporary holding basin or sediment trapping device,
- Designated construction site entrances, exits, and staging areas for all site traffic,
- Provision of storage areas for construction materials and receptacles for liquids (solvents, paints, acids) and solids in accordance with manufacturers recommendations,
- Provision of adequate waste storage areas and ensuring that the locations for collection of waste materials do not receive concentrated runoff, and
- Provision of adequate sanitary facilities on construction sites in accordance with Health Department Regulations.

Good Housekeeping issues are reviewed with the contractor, engineer, and developer during the pre-construction assistance meeting.

CS-3 Inspection / Enforcement

SWMP Task: Maintain expanded inspections to include smaller construction sites (single family). Status: Ongoing.

In the first permit term, the City of Knoxville expanded new development construction inspections to include single-family residential sites. The Engineering Department also created a new triage plans review position to focus primarily on small projects. Additional inspectors have been added in the current permit term to allow for inspections on these smaller sites. Although the small sites do not require the same type of frequency of inspections as the larger sites, all small sites should be inspected at some point in the construction process.

SWMP Task: Implement routine site inspections on commercial and large residential developments (e.g. rough grading, E&S control installation, final grading, and final stabilization.) Status: Ongoing

The Engineering Department continues to implement site inspections for large residential and commercial developments. These inspections are not a new program and have been occurring since at least 1994. Inspections are performed during rough grading, final grading, and at various other times during the construction process. Although the site inspections are not always scheduled with the contractor or developer, the City staff may visit the construction sites approximately every three weeks or sooner if necessary. The time frame for some project inspections will vary due to the specific project.

These inspections are performed to insure compliance with the approved erosion and sediment control plan, good housekeeping measures, and the design plan.

A significant improvement in this process was implemented after the 2003 ordinance revision. For bonded projects, the developer is now given a letter, which authorizes the installation of erosion and sediment controls after the submitted site development plan is approvable but before the permit is issued. After the e/s controls are in place, a licensed professional must certify that the installation has been completed according to the e/s control plan. The site development permit is issued after the Engineering Department receives the certification.

SWMP Task: Require post-construction Development Certifications from licensed design professionals, before bond release to insure the stormwater facilities are built as planned. Status: Ongoing

Since 1999, the City required all developments with a bond to submit to a post-construction Development Certification before the bond is released. A licensed professional Engineer and land surveyor must certify that the roads and stormwater features (quality & quantity) comply with the approved plans. Some deviation from the permitted plan may be allowed during construction as long as the final project still meets the City's minimum requirements. If the final certified project does not meet the minimum requirements, further adjustments must be made before the entire bond is released to the developer. This program does require a second plan review by the Engineering Department after construction has finished to

insure proper results in the field.

The Development Certification requires the following components when applicable:

- As-built drawings
- Complete detention calculations
- Roadway inspection reports
- Final site inspection in accordance with checklist
- Verification that all stormwater quantity and quality facilities are covered by a Covenants for Permanent Maintenance of Stormwater Facilities
- Engineering certification or soil retaining calculations for slopes or retaining walls steeper than 2:1.

This program has been successful and will be continued throughout the permit term.

SWMP Task: Maintain enforcement procedures, policies, and follow-up monitoring/ inspections.

Status: Ongoing

The schedule for this task appropriately coincided with the schedule for ordinance updates. The existing enforcement procedures and policies have been effective and were not amended when the ordinance was updated in 2005. During this permit year, 349 NOVs were written for construction site runoff violations, 32 of those resulted in civil penaltics totaling $54,835.

Depending on the violation, a first-time offender is usually educated and asked to remediate the damage or correct the violation if possible. This is usually followed up with a letter to inform the violator of the City's expectations and to provide helpful BMPs to prevent future problems. More severe or repeated violations will merit a Notice of Violation (NOV), which is issued in the field directly to the violator if available on site. Copies of the NOV are distributed to the property owner or developer by certified mail, the City Law Department, and the Engineering Department's file. The NOV may order specific remedies and require the violator to submit reports and/or pollution prevention plans. Penalties, if any, are only issued after the NOV expires so the violation and remedies may be fully evaluated.

In the event that a penalty is assessed, a violator may appeal the penalty before a five-member Environmental Appeals Board. The five volunteer members of the Environmental Appeals Board are appointed by the Mayor and consists of individuals with an expertise as follows:

1. One licensed professional engineer with three (3) years of engineering experience as a Professional Engineer;
2. One architect, engineer, landscape architect or surveyor with three (3) years of experience;
3. One representative of the development or industrial community;
4. One neighborhood representative;
5. One member at large.

In addition to the above qualifications, one of the five members must have at least three years of civil engineering experience and a second member must have at least three years of civil or environmental engineering experience. Board members serve a 5-year term and may be re-appointed at the end of their term.

Some research has already begun to determine appropriate penalties for discharges that

cannot be recovered but do not cause a fish kill or other quantifiable immediate damage. The City's current evaluation method does not account for incremental contributions to the overall pollutant loading or degradation of the waterway. The City is developing standard penalties for construction violations to be more consistent with TDEC's expedited enforcement procedures.

To help identify repeat violators, the City maintains an updated record of every NOV issued and a database for stormwater complaints.

CS-4 Training Programs

SWMP Task: Co-Sponsor E&S Control Practice Seminars for all participants.

Status: Annually

The City and other Water Quality Forum members developed and presented free erosion and sediment control workshops throughout the first five years of the first permit term. To maximize participation, the workshops were typically presented in the early spring or late fall while construction activities are least intense. The workshops were very successful.

Beginning in year six, the City assisted UT and TDEC with promotion and presentation of the new TDEC erosion control certification program. This new certification program effectively duplicates the information the City had been providing in our annual seminars. To reduce the amount of competition for the two programs, the City will continue to promote and support the TDEC certification program in place of a separate competing erosion control workshop. Each year, the City will send inspectors and supervisors to the training program as needed. Last year, all the new inspectors received this training and some were retrained.

SWMP Task: Provide training for City plans review staff. Status: Ongoing

In an effort to fully train the Stormwater Management staff, the City has participated in several stormwater seminars around the region. Most staff members at the Engineer level will attend at least one, but typically more, seminars or training workshops annually. Typical seminars attended each year include: stormwater modeling, NAFSMA conference, regulatory updates, erosion control certification, NPDES updates, ASCE seminars, software workshops, and others. All licensed engineers must complete at least twelve hours of professional development each year. In addition to the stormwater management seminars attended, the Engineering staff have sponsored, planned, and presented a series of annual workshops/seminars to better educate the staff and development community about the development and plans review processes. Some of the topics of the City sponsored development process training sessions include:

- ***Technical Requirements of the Stormwater & Streets Ordinance***
- ***Construction Site Erosion and Sediment Control design and implementation***
- ***Site Development Permit Review***
- ***Special Pollution Abatement Permit program***
- ***Performance and Indemnity Agreements, Permanent Maintenance Covenants for Stormwater Facilities***
- ***Plat Review Process and Procedures***
- ***Development Certifications***

The City will continue to provide training to the Engineering staff by participating in seminars locally and outside the city; in-house training by professional engineers; tuition reimbursement for university engineering classes; cooperating with TDOT, TDEC, TVA, UTK, and other agencies to provide professional training for the staff. Training of the plans review and inspections staff is an ongoing program within the Engineering Department.

5.5 COMPREHENSIVE MONITORING PROGRAM (MN)

Program to Collect Quantitative Data to Determine the Impacts of Urban Stormwater on the Natural Environment, pursuant to 40 CFR 122.26(d)(2)(iii)(A).

MN-1 Seasonal Storm Event Monitoring

SWMP Task: Review and update the Standard Operating Procedures (SOP) for the seasonal sampling program. Status: Complete

The original SOP was developed and submitted with the first annual report during the first permit cycle. Over time the SOP had become outdated and some parts obsolete. The City revised the SOP to make it current and valid for the equipment, software, site locations, and procedures that are currently used.

SWMP Task: Maintain at least five (5) automatic monitoring stations. Status: Ongoing

The five monitoring stations are currently located on First Creek, Love Creek, Williams Creek, Fourth Creek and Third Creek. The Third Creek monitoring station has replaced the one previously at Acker Place. The specific locations are noted on the large inventory map in the appendix of this report.

Each monitoring station consists of a tipping bucket rain gage, an automatic sampler with 24 individual bottles or bags, and a flow meter/data logger. The intake line and flow sensors are installed in the low flow path for constant monitoring. Modems and cell phones were initially installed to allow City staff to remotely monitor the conditions and station activity. Unfortunately, remote monitoring has not been available via phone since the City upgraded to Windows XP. The City plans to upgrade all the stations from analog to digital wireless dataloggers over the next three years.

After each rain event, a technician will interrogate the sampler in the field via laptop computer and calculate the appropriate flow-weighted composite sample. The information is then used to prepare the actual sample from the individual bottles. The composite sample is prepared; it is immediately transported to the laboratory for analysis.

SWMP Task: Collect twenty (20) - thirty (30) flow-weighted composite storm samples annually. Schedule: Ongoing

Each year, the automatic sampling stations should collect at least twenty (20) flow-

weighted composite storm samples. Each of the five monitoring stations should collect four (4) to six (6) storm samples each year with at least one storm sample per quarter to help distribute the sampling events seasonally. During dry weather, the stations may also collect ambient samples as described below in section MN-3 unless grab samples are taken manually.

Each of the flow-weighted storm samples will be analyzed for thirteen (13) routine parameters. Only pH will be recorded in the field. The remaining routine parameters will be analyzed and recorded in the laboratory in accordance with 40 CFR part 122.26 and 40 CFR part 136. The routine parameters to be tested in the laboratory are listed in the table below:

Routine Parameters for Laboratory Analysis		
Total Suspended Solids (TSS)	Nitrate + Nitrite Nitrogen (as N)	Total Recoverable Lead
Total Dissolved Solids (TDS)	Total Nitrogen	Total Recoverable Zinc
Total Ammonia Nitrogen (as N)	Biochemical Oxygen Demand (BOD_5)	Dissolved Phosphorus
Total Ammonia + Organic Nitrogen	Chemical Oxygen Demand (COD)	Total Phosphorus

SWMP Task: Collect five (5) wet weather bacteria samples. Schedule: Ongoing

Five bacteria samples will be collected each year. One grab sample will be collected manually at each monitoring station during a qualified storm event. Since the TMDL includes both fecal coliform and e-coli standards, both parameters will be analyzed in the laboratory.

SWMP Task: Collect five (5) full-suite grab samples (one/station/permit). Schedule: Ongoing

Each year, one monitoring station will be selected for a full-suite grab sample. The five stations will be rotated throughout the permit term to allow one sample from each location.

In addition to the 13 routine parameters, the full-suite grab sample includes analysis for oil & grease and all the pollutants listed in Tables II & III of 40 CFR Part 122 Appendix D including: volatiles, pesticides, acids, base/neutrals, toxic metals, total phenol, and cyanide.

SWMP Task: Analyze Results from Ongoing Monitoring Program. Schedule: Complete

Sampling data will continue to be collected, evaluated, and analyzed by City staff as part of the ongoing seasonal monitoring program. The updated seasonal pollutant loading and event mean concentration for the major watersheds within the MS4 may be estimated from the City monitoring data and/or from other regional data, which may include:

- NURP study,
- USGS Open-File Report 94-68 titled "Rainfall, Streamflow, and Water-Quality Data for Five Small Watersheds, Nashville, Tennessee, 1990-1992",
- USGS Water-Resources Investigations Report 95-4140,
- USGS Open-File Report 93-xxx titled "Stormwater Data for Knoxville, TN '91-'92.
- Any available data from TVA, EPA, and the State of Tennessee.

The estimates of the seasonal loading and event mean concentrations are included in the appendix. An estimate of the total annual runoff from each of the major watersheds within the City will be provided in each annual report (see Section 6.2.4 in this report). Due to ongoing annexations, watersheds or portions of watersheds may be added to this estimate as needed.

MN-2 Dry Weather Screening & Industrial/Commercial Site Monitoring

SWMP Task: Dry Weather Screening as described in ILL-2. Status: Annually

SWMP Task: Implement Commercial/Industrial Monitoring in IN-3. Status: Ongoing

The City began sampling runoff from commercial sites such as restaurants, automotive facilities, and large parking lots in the currant permit term. The purpose of this sampling is to determine the magnitude and variety of pollutants discharging from sites that have been targeted as pollution hotspots. The City began regulating some hotspots in 1997 through the Special Pollution Abatement Permit (SPAP) program. The list of SPAP land uses has expanded in the ordinance revisions. The current sampling program will help refine the SPAP requirements to better regulate the hotspots and reduce pollution in the streams.

MN-3 Ambient & Biological Monitoring

SWMP Task: Implement ongoing Ambient sampling program. Schedule: Ongoing

At least twenty (20) ambient samples will be collected each year at a rate of one sample per quarter from each of the five monitoring station locations. The City has implemented a quarterly ambient sampling program since the first permit and will continue in the next term.

The samples may be collected either by a single grab sample or by using the automatic samplers for a timed composite. Each ambient sample collected was analyzed for the 13 routine parameters listed in MN-1. This program was first implemented after the monitoring stations were moved to locations that have base flow in dry weather. Since all of the locations have some flow in ambient conditions, the samples can be retrieved at the same location as the storm event samples. This is an added convenience for direct comparison of storm event and ambient samples as well as allowing more options for collecting samples automatically.

SWMP Task: Collect five (5) wet weather bacteria samples. Schedule: Ongoing

Five bacteria samples will be collected each year. One grab sample will be collected manually at each monitoring station during a qualified storm event. Since the TMDL includes both fecal coliform and e-coli standards, both parameters will be analyzed in the laboratory.

SWMP Task: Collect five (20) ambient bacteria samples. Schedule: Ongoing

Twenty bacteria samples will be collected each year by one grab sample per station per quarter. Each of the monitoring stations will be sampled each quarter. The analysis of all 20 samples is summarized in section 6.2.2. of this report and will continue to be reported each year in the future permit. Both fecal coliform and e-coli parameters are analyzed as required in City's TMDL requirement.

SWMP Task: Continue the Biological-monitoring program(IBI, RBP III and stream surveys).
Status: Ongoing

During the current permit term, the City improved the Biological monitoring program by contracting with the Izaak Walton League and now the Fort Loudon Lake Association to complete Index of Biological Integrity (IBI) and Rapid Bioassessment Protocols (RBP III) studies. Multiple streams and sites are selected to provide data to supplement any available TDEC data and to assess overall stream health. In addition to the IBI and RBP III studies, the City has used staff and interns to perform stream walks and surveys. The results of this year's IBI and RBP III studies are included in the appendix of this report.

MN-4 Training Programs

SWMP Task: Implement Monitoring Training Program for staff and/or volunteers.
Status: Ongoing

Ongoing training is necessary for staff and volunteers as part of sampling programs, stream walks, and the Adopt-a-Stream program. All new staff, interns, and volunteers will receive the appropriate training for the monitoring project.

5.6 TMDL IMPLEMENTATION AND ACTIVITIES

A TMDL Implementation Plan was approved by EPA on January 15, 2003 for the Fort Loudoun Lake Watershed (HUC 06010201) for the following creek systems: First Creek, Second Creek, Third Creek, Fourth Creek, and Goose Creek.

The City of Knoxville addressed the following bacteria sources and activities as required by the TMDL and permit.

Farm Animals — Schedule: Complete

At the end of year two, the City contracted the CAC Americorps Water Quality Team (AWQT) to begin a study of the potential bacteria impact of farm animals on the 303(d) streams in Knoxville. Using agricultural zoning maps and GIS, the AWQT started to field verify potential livestock sites. During year two and three, they checked each site for signs of livestock access and runoff to the creek as well as erosion caused by access. Five properties in the Third Creek watershed contained a total of 94 head of livestock, including horses and cattle. Grab samples were collected from upstream and downstream of the study sites and delivered to the State of Tennessee's Laboratory for bacteria analysis. The data was compiled and analyzed during year three but did not indicate that the livestock create a significant impact on the bacteria in the stream. In fact, two of the sampled sites showed a decrease in both fecal coliform and E.

coli from the upstream sample to the downstream sample. A third property was sampled on three different dates with upstream and downstream samples. Only one of the downstream samples showed an increase in bacteria levels. The City may reevaluate the effect of livestock on urban streams in the future but at this time there is no evidence to indicate that livestock are a significant source of bacteria in Knoxville's streams. Due to codes and zoning, the properties that do contain livestock should shrink or be eliminated in the future.

Wild Birds — Schedule: Complete

During year one, the CAC Americorps Water Quality Team (AWQT) volunteered to study the biological impact that waterfowl populations have on our local waterways. The City identified 56 possible waterfowl locations that could be either a source or sink for bacteria. The AWQT visited those locations in the fall and spring, counted the number of birds, and selectively sampled for ammonia. Six sites that had a large number of waterfowl or high concentrations ammonia were analyzed for fecal Coliform and E. coli. Four sites were considered to be sources of bacterial pollution since they discharged to creeks and two were considered sinks since they had no outlet to waters. The results of the initial investigation were reported in year one.

The initial investigation reduced the original 56 possible locations down to only four sites that need to be analyzed for structural retrofit or some management control to reduce the bacteria levels entering the stream or river. Since two of those sites enter the Tennessee River directly, the City will concentrate on analyzing, designing and implementing some mitigation measure for the remaining two sites, which discharge directly into 303(d) streams listed in the bacteria TMDLs. The City has met with the property owners, a stormwater treatment unit manufacturer, and the Fort Loudon Lake Association to discuss retrofitting the outlet of the large duck pond on First Creek with a device to reduce bacteria. At TDEC's request, the project was put on hold until toxicity data could be collected on the media filter. Any future progress on the analysis or mitigation measures will be reported in the future annual reports.

Outside dumping of animal wastes — Status: Ongoing

In year one, the City investigated possible bacterial pollution sources from the Knoxville/Knox County Animal shelter. The City helped the shelter personnel setup a maintenance schedule for quarterly inspections and annual cleanout of their Nutrient Baffle Box.

Domestic Pets — Status: Ongoing

The City partnered with the Izaak Walton League and Prestige Cleaners to encourage the use of pooper-scoopers in City parks and the Central Business Improvement District. Four dispensers are located downtown and four are located in two City parks. Approximately 500 pooper-scoopers bags are restocked bi-weekly at the dispenser on Gay and Summit, which indicates a successful start to our pet waste challenge downtown. Additional dispensers may be added in other parks in the future. The City has distributed pooper-scoopers to vet clinics, pet stores, and during public functions such as Bark-in-the-Park and Earth Fest. An attention-grabbing poster was placed on display at these functions to help educate the pet owners of their responsibility to manage their pet's waste. In March 2003, the City passed a pet waste ordinance

(O-98-03) to require the owner or custodian of any pet to collect and remove all solid pet wastes from all areas within the CBID.

Fish/Bait Shops — Status: Ongoing

The City inspected Rea Springs Live Bait, Seymour Bait & Tackle, and Conservation Fisheries Inc. as possible sources of bacterial pollution. The effluent from Seymour Bait & Tackle and Conservation Fisheries Inc. discharged directly to a KUB sewer line. The effluent from Rea Springs Live Bait shop discharges to a constructed wetland and then into First Creek. Results of the bacterial sampling of the effluent entering First Creek were well below the threshold for human contact. TDEC was notified of the sampling and results.

Private Leaking Laterals — Status: Ongoing

The City has continued to coordinate with KUB to identify and correct sanitary sewer discharges as necessary. A standard procedure has been developed to insure that each possible contamination source is investigated after a problem is identified during dry weather screening. When high ammonia or fecal coliform levels are detected in the MS4, KUB and City personnel cooperate to identify the contamination source through dye testing or manhole by manhole testing. Once a source has been identified, KUB will be responsible for correcting problems in the main sanitary sewer system while the City will work with KUB and the private property owners to correct problems on private property. These coordinated inspections have identified private residences, industries, and businesses with plumbing or floor drains connected to the MS4 instead of the sanitary sewer system. This type of close coordination with all sewer utilities is essential for solving illicit discharges to the MS4 and will likely continue throughout the new permit term.

A Memorandum of Understanding has clarified the cooperative roles and responsibilities of both the City and KUB with respect to the City's stormwater management program and compliance with the MS4 NPDES permit. A copy of the MOU was included in the appendix of the 2003/2004 annual report.

Human wastes (Outdoor Elimination by Humans) — Schedule: Completed

In year two, the City implemented a survey and inventory of homeless populations in Knoxville. The Engineering Division was able to add a few questions to the survey to determine how transients use the creeks while living outdoors. The results of the survey indicate that there is likely some impact on stream water quality by homeless people.

Dr. Nooe issued the following statement regarding his homeless study for the City of Knoxville: *"In the February, 2006, survey of homelessness, we had planned to examine use of creeks and streams by those persons living in outside locations. However, finding a limited number of persons in the six camps visited, the data are incomplete. There are several observations based on visits to camps and conversations with outreach workers that I can share. Homeless camps are scattered throughout the county. Many are located in or near center city, but others can be found in various sections such as west in the Cedar Bluff and Lovell Road area. There appear to be approximately 18-20 camps along creeks and streams, with an average*

of 4-6 persons staying in each camp. Occasionally, someone will use the water for bathing, but the most frequent use seems to be cooling food and beverages (tying the food in a plastic bag and suspending it in the water). We did not observe directly using the water for disposal of waste, but the proximity suggests possible runoff."

Illicit connections to storm drain system — Status: Ongoing

The Illicit Connections and Illegal Dumping Program (ILL) is an ongoing program reported in section 5.2 of this report.

6.0 MONITORING REPORTS SUMMARY

6.1 Dry-Weather Screening Program - New Outfall Inventory.

During the past permit year, no outfalls were removed from the City's outfall inventory and 9 outfalls were added. Outfalls are typically added as a result of re-development or annexations and removed as a result of drainage alterations.

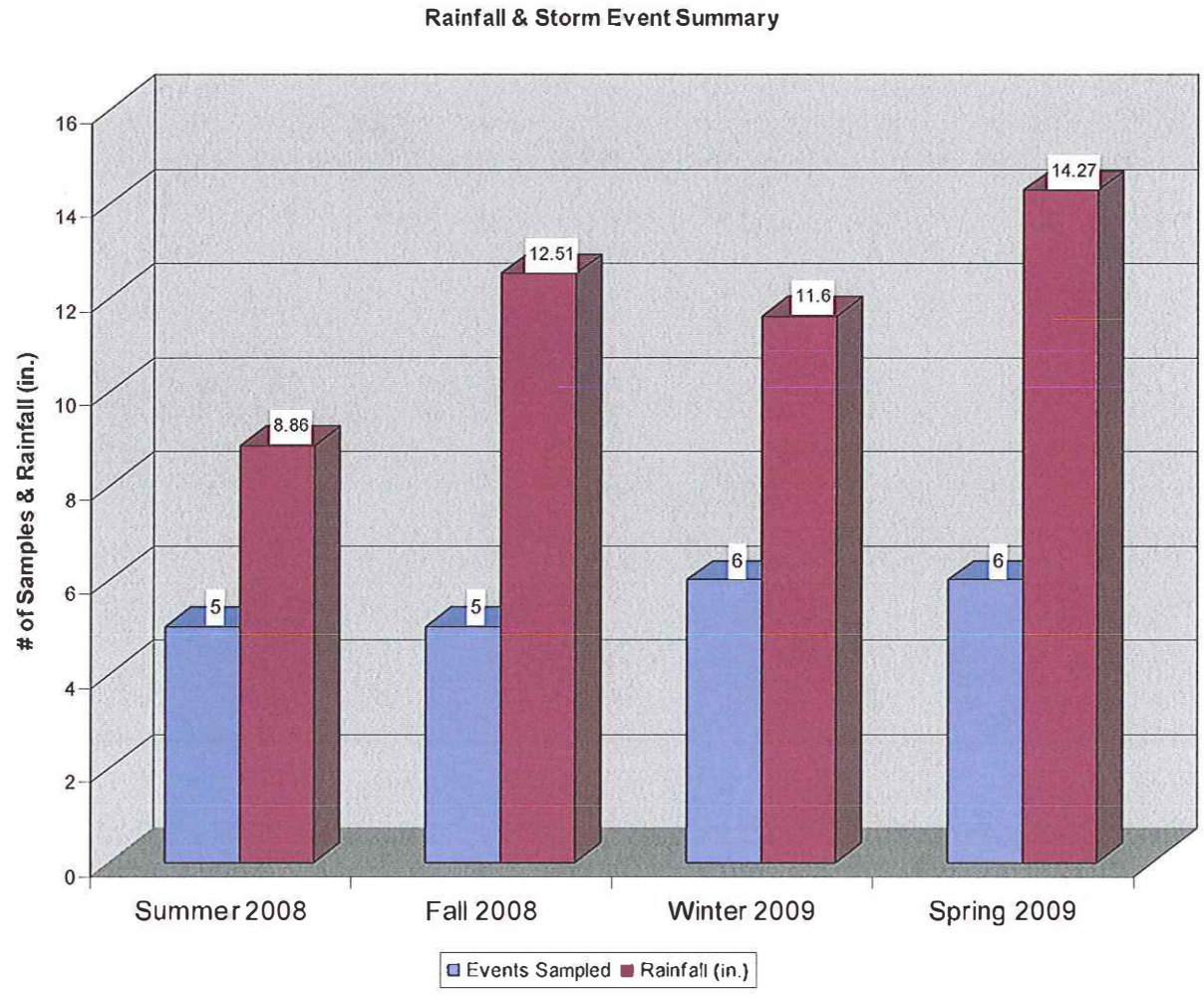
All updated outfalls are clearly marked on the inventory map located in the appendix but attached separately. The outfalls added to the inventory this year are listed below:

01-300-0144	02-200-0444	03-400-0411
01-400-0146	03-100-0408	04-300-0308
01-400-0148	03-200-0409	05-400-0013

6.2 Ongoing Stormwater Monitoring Program.

6.2.1 Area Rainfall Data & Storm Event Summary.

During the July 1, 2008 to June 30, 2009 monitoring period, an average of 47.24 inches of rainfall was recorded and 20 storm events were sampled from the City's five ISCO monitoring stations. Section V of the current NPDES Permit requires a sampling frequency for routine wet-weather samples of one storm event per season per station. This requirement was met. The graph below shows the relationship between the amounts of rainfall received and the number of storm events sampled per season. Monitoring data summaries for each of the sampling locations are included for TDEC's review on the following pages.



6.2.2 Laboratory Analysis Summary

Laboratory Analysis Summary - Seasonal Storm Sampling Program

July 1, 2008 thru June 30, 2009

Site	Quarter	pH	Average Sampled Volume	Rainfall per Event	BOD	COD	Total Suspended Solids (TSS)	Total Dissolved Solids (TDS)	Nitrate+ Nitrite nitrogen	Ammonia nitrogen	Total Kjeldahl nitrogen	Total organic nitrogen	Lead	Zinc	Total Phosphorus	Ortho Phosphate
Units			cu-ft	inches	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
KAT First Creek	Sum. '08	6.0	857,276	0.39	9.0	89.0	230.0	140	0.50	BDL	1.80	1.80	0.026	0.130	0.46	0.05
	Fall '08	7.0	643,319	0.79	5.4	BDL	82.0	160	0.51	BDL	BDL	BDL	0.009	0.077	BDL	0.22
	Wtr. '09	7.0	1,188,080	0.57	BDL	43.0	54.0	240	1.30	BDL	0.97	0.97	0.007	0.046	BDL	0.14
	Spr. '09	7.5	1,522,540	0.46	BDL	BDL	9.9	230	1.10	BDL	0.40	0.40	BDL	BDL	BDL	BDL
Average:		**6.9**	**1,052,804**	**0.55**	**3.6**	**33.0**	**94**	**193**	**0.85**	**BDL**	**0.79**	**0.79**	**0.010**	**0.063**	**0.12**	**0.103**
Love Creek	Sum. '08	7.0	761,388	0.84	6.4	43.0	95.0	210	0.77	0.81	1.30	BDL	0.011	0.220	0.120	BDL
	Fall '08	7.0	181,142	0.74	BDL	BDL	62.0	190	0.60	BDL	0.71	0.71	BDL	0.065	BDL	0.29
	Wtr. '09	7.0	20,757,000	0.65	BDL	32.0	56.0	230	1.10	BDL	1.10	1.10	0.0084	0.046	BDL	0.260
	Spr. '09	7.5	19,418,900	0.55	BDL	BDL	11.0	250	1.10	BDL	0.61	0.61	BDL	BDL	BDL	BDL
Average:		**7.1**	**10,279,608**	**0.70**	**1.6**	**18.8**	**56**	**220**	**0.89**	**0.20**	**0.93**	**0.61**	**0.005**	**0.083**	**0.03**	**0.138**
Third Creek	Sum. '08	6.0	5,653,350	0.88	9.6	130.0	440	130	0.48	BDL	1.90	1.90	0.037	0.19	0.44	BDL
	Fall '08	7.0	7,557,090	0.88	6.1	BDL	140	150	0.57	BDL	0.80	0.80	0.024	0.20	BDL	0.260
	Wtr.'09	5.5	3,210,090	0.56	5.0	39.0	57	340	1.10	0.13	1.10	1.00	0.011	0.12	BDL	0.210
	Spr. '09	7.5	4,497,210	0.52	10.0	28.0	48	190	0.90	BDL	0.74	0.74	0.0072	0.21	0.11	BDL
Average:		**6.5**	**5,229,435**	**0.71**	**7.7**	**49.3**	**171**	**203**	**0.76**	**0.03**	**1.14**	**1.11**	**0.02**	**0.18**	**0.47**	**0.118**
Walden Drive Fourth Creek	Sum. '08	6.0	515,284	0.16	BDL	66.0	270	150	0.60	0.38	1.40	1.40	0.015	0.200	0.25	BDL
	Fall '08	6.0	1,274,690	0.77	BDL	BDL	130	89	0.24	BDL	0.78	0.78	0.008	0.120	BDL	0.68
	Wtr.'09	5.5	795,073	0.51	BDL	30.0	160	200	0.82	0.19	1.30	1.10	0.017	0.140	0.10	0.22
	Spr. '09	6.5	684,766	0.47	10.0	91.0	240	120	0.58	0.15	2.20	2.00	0.015	0.210	0.38	BDL
Average:		**6.0**	**817,453**	**0.48**	**2.5**	**62.3**	**200**	**140**	**0.56**	**0.24**	**1.42**	**1.32**	**0.01**	**0.17**	**0.18**	**0.225**
Williams Creek	Sum. '08	6.0	548,875	0.24	15.0	48.0	120	160	0.53	BDL	1.80	1.80	0.0210	0.160	0.24	BDL
	Fall '08	6.5	530,999	0.89	BDL	BDL	51	140	0.59	BDL	0.70	0.70	0.0088	0.060	BDL	0.10
	Wtr. '09	6.0	1,344,170	0.54	BDL	33.0	48	150	1.00	0.15	3.40	3.20	0.0150	0.053	BDL	0.20
	Spr. '09	7.5	1,136,850	0.59	BDL	BDL	26	230	1.10	0.12	0.97	0.85	0.0067	0.100	0.14	BDL
Average:		**6.5**	**890,224**	**0.57**	**3.8**	**20.3**	**61**	**170**	**0.81**	**0.07**	**1.72**	**1.64**	**0.01**	**0.09**	**0.10**	**0.075**
National NURP Study Average					11.9	90.8	na	na	na	*****	2.35	3.31	0.18	0.176	0.16	
Characteristics of Urban Stormwater Range					1 - 700	5 - 3,100	2 - 11,300	200 - 14,600	na	0.1 - 2.5	0.01 - 4.5	na	0.0 - 1.9	na	0.1 - 125	

-The above chart is comprised of seasonal averages from the data collected from each individual storm event.

-Winter (Jan., Feb., and March); Spring (April, May, and June); Summer (July, Aug., and Sept.); Fall (Oct., Nov., and Dec.)

-The Characteristics of Urban Stormwater and National NURP Study Average data was taken from tables 4-1 and 4-2 of the Stormwater Management for Maine: BMPS

* Beaver dam resulted in inaccurate instrument reading

6.2.2 Laboratory Analysis Summary

Seasonal Ambient Grab Samples 2008-2009

Summer 2008	Date	pH	BOD	COD	Suspended Solids (TSS)	Dissolved Solids (TDS)	Nitrate + Nitrite Nitrogen	Ammonia Nitrogen	Total Kjeldahl Nitrogen	Total Organic Nitrogen	Lead	Zinc	Total Phosphorus	Ortho Phosphate	E. Coli	Fecal Colif.
First Creek	8/11/08	7.0	BDL	BDL	3.6	260	0.95	BDL	0.28	0.28	BDL	0.078	BDL	BDL	201	300
Love Creek	8/11/08	7.0	BDL	BDL	2.6	310	1.10	BDL	0.24	0.24	BDL	0.032	BDL	BDL	816	430
Third Creek	8/11/08	7.0	BDL	BDL	2.9	240	0.98	BDL	2.20	2.20	BDL	0.100	BDL	BDL	248	200
Walden Drive	8/11/08	7.0	BDL	BDL	2.6	250	1.10	BDL	0.22	0.22	BDL	0.056	BDL	BDL	276	260
Williams Creek	8/11/08	7.0	BDL	BDL	3.2	270	1.60	BDL	0.36	0.36	BDL	0.082	BDL	BDL	387	260
Average		**7.0**	**BDL**	**BDL**	**3.0**	**266**	**1.15**	**BDL**	**0.66**	**0.66**	**BDL**	**0.070**	**BDL**	**BDL**	**386**	**290**

Fall 2008	Date	pH	BOD	COD	Suspended Solids (TSS)	Dissolved Solids (TDS)	Nitrate + Nitrite Nitrogen	Ammonia Nitrogen	Total Kjeldahl Nitrogen	Total Organic Nitrogen	Lead	Zinc	Total Phosphorus	Ortho Phosphate	E. Coli	Fecal Colif.
First Creek	10/7/08	7.5	BDL	BDL	3.2	260	0.77	BDL	BDL	BDL	BDL	BDL	BDL	0.028	488	350
Love Creek	10/7/08	7.5	BDL	BDL	3.3	310	1.10	BDL	BDL	BDL	BDL	BDL	BDL	BDL	461	480
Third Creek	10/7/08	7.0	BDL	BDL	5.1	260	0.84	0.24	BDL	BDL	BDL	BDL	BDL	BDL	291	380
Walden Drive	10/7/08	7.0	BDL	BDL	1.0	270	1.50	BDL	BDL	BDL	BDL	BDL	BDL	BDL	387	360
Williams Creek	10/7/08	7.0	BDL	BDL	2.4	270	0.95	BDL	BDL	BDL	BDL	BDL	BDL	BDL	387	300
Average		**7.2**	**BDL**	**BDL**	**3.0**	**274**	**1.03**	**0.05**	**BDL**	**BDL**	**BDL**	**BDL**	**BDL**	**0.01**	**403**	**374**

Winter2009	Date	pH	BOD	COD	Suspended Solids (TSS)	Dissolved Solids (TDS)	Nitrate + Nitrite Nitrogen	Ammonia Nitrogen	Total Kjeldahl Nitrogen	Total Organic Nitrogen	Lead	Zinc	Total Phosphorus	Ortho Phosphate	E. Coli	Fecal Colif.
First Creek	2/25/09	7.0	BDL	BDL	8.6	220	1.60	BDL	0.71	0.71	BDL	BDL	BDL	0.19	211	160
Love Creek	2/25/09	7.0	BDL	BDL	1.5	290	1.80	BDL	0.72	0.72	BDL	BDL	BDL	BDL	130	82
Third Creek	2/25/09	7.0	BDL	BDL	2.3	230	1.50	BDL	0.52	0.54	BDL	BDL	BDL	BDL	80	28
Walden Drive	2/25/09	7.0	BDL	BDL	2.0	240	1.30	BDL	0.43	0.43	BDL	0.059	BDL	BDL	192	72
Williams Creek	2/25/09	7.0	BDL	BDL	6.4	280	1.50	BDL	0.89	0.89	BDL	0.13	BDL	BDL	435	250
Average		**7.0**	**BDL**	**BDL**	**4.2**	**252**	**1.54**	**BDL**	**0.65**	**0.66**	**BDL**	**0.04**	**BDL**	**0.04**	**210**	**118**

Spring 2009	Date	pH	BOD	COD	Suspended Solids (TSS)	Dissolved Solids (TDS)	Nitrate + Nitrite Nitrogen	Ammonia Nitrogen	Total Kjeldahl Nitrogen	Total Organic Nitrogen	Lead	Zinc	Total Phosphorus	Ortho Phosphate	E. Coli	Fecal Colif.
First Creek	4/27/09	7.0	BDL	BDL	5.0	250	1.00	BDL	1.20	1.20	BDL	BDL	BDL	BDL	488	240
Love Creek	4/27/09	7.0	BDL	24	3.7	300	1.20	BDL	0.62	0.62	BDL	BDL	BDL	BDL	326	320
Third Creek	4/27/09	7.0	BDL	BDL	11.0	270	1.30	BDL	0.86	0.86	BDL	BDL	BDL	0.038	260	120
Walden Drive	4/27/09	7.0	BDL	BDL	3.9	260	1.00	BDL	0.65	0.65	BDL	BDL	BDL	BDL	192	120
Williams Creek	4/27/09	7.0	BDL	BDL	14.0	280	1.50	BDL	0.70	0.70	BDL	BDL	BDL	BDL	108	149
Average		**7.0**	**BDL**	**4.8**	**7.5**	**272**	**1.20**	**BDL**	**0.81**	**0.81**	**BDL**	**BDL**	**BDL**	**0.01**	**275**	**190**

U = Analyte requested but not detected
BDL = Below Detection Limit

6.2.2 Laboratory Analysis Summary

Municipal Wet Weather Sampling Results

Point Source Sample Site		Date	Type	pH	BOD	COD	Suspended Solids (TSS)	Dissolved Solids (TDS)	Nitrate + Nitrite nitrogen	Ammonia	Total Kjeldahl Nitrogen	Total Organic Nitrogen	Lead	Zinc	Total Phosphorus	Ortho Phosphate	Oil/ Grease
					mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
KAT	Annual	7-Nov	Grab	6.0	110	270	66	130	0.44	0.67	2.70	2.00	BDL	0.28	0.56	0.470	330.0
Loraine St. Combined	Sum. '08	25-Aug	Grab	6.0	76	600	270	300	0.79	1.00	5.20	4.20	0.042	0.98	4.20	1.700	54.0
	Fall '08	7-Nov	Grab	6.0	320	770	190	260	1.60	0.60	6.40	5.80	0.039	0.83	1.60	0.860	40.0
	Wtr. '09	27-Feb	Grab	6.0	110	330	50	86	BDL	0.17	0.87	0.70	0.013	0.17	0.11	0.056	13.0
	Spr. '09	4-Jun	Grab	5.5	13	250	300	85	0.26	0.26	3.70	3.40	0.034	0.33	1.00	0.200	24.0
Average				**5.9**	**130**	**488**	**203**	**183**	**0.88**	**0.51**	**4.04**	**3.53**	**0.032**	**0.58**	**1.73**	**0.704**	**32.8**
Loraine St. East Unit	Sum. '08	25-Aug	Grab	6.0	63	430	120	320	0.62	1.50	5.60	4.10	0.021	0.60	3.40	1.100	20.0
	Fall '08	7-Nov	Grab	6.0	200	400	120	200	0.77	0.60	3.90	3.30	0.017	0.48	1.00	0.590	9.7
	Wtr. '09	27-Feb	Grab	6.0	160	440	43	56	0.10	0.11	0.65	0.54	0.011	0.18	0.15	0.044	8.6
	Spr. '09	4-Jun	Grab	5.5	15	230	220	120	0.25	0.17	3.00	2.80	0.028	0.33	0.96	0.280	13.0
Average				**5.9**	**110**	**375**	**126**	**174**	**0.44**	**0.60**	**3.29**	**2.69**	**0.019**	**0.40**	**1.38**	**0.504**	**12.8**
Loraine St. West Unit	Sum. '08	25-Aug	Grab	6.0	92	590	150	490	0.82	2.20	6.90	4.70	0.029	0.81	21.00	8.100	30.0
	Fall '08	7-Nov	Grab	6.0	46	310	56	270	0.55	1.00	4.00	3.00	0.014	0.47	1.40	1.100	15.0
	Wtr. '09	27-Feb	Grab	6.0	180	420	68	90	0.12	0.16	0.89	0.74	0.016	0.23	0.11	0.049	BDL
	Spr. '09	4-Jun	Grab	5.5	78	440	140	270	0.12	0.68	4.10	3.40	0.099	0.45	3.50	1.500	7.0
Average				**5.9**	**99**	**440**	**104**	**280**	**0.40**	**1.01**	**3.97**	**2.96**	**0.040**	**0.49**	**6.50**	**2.687**	**17.3**
Transfer Station I	Sum. '08	25-Aug	Grab	6.0	920	4100	1600	4100	4.30	3.20	18.00	15.00	0.880	3.80	5.80	4.600	48.0
	Fall '08	24-Nov	Grab	7.0	27	460	600	350	0.27	1.10	6.30	5.20	0.440	1.40	3.10	4.000	17.0
	Wtr. '09	25-Mar	Grab	6.0	120	1600	2400	880	0.22	0.55	20.00	19.00	1.000	4.90	4.90	21.000	BDL
	Spr. '09	1-May	Grab	6.0	320	740	660	230	BDL	0.20	11.00	11.00	1.300	3.50	4.30	0.074	BDL
Average				**6.3**	**347**	**1725**	**1315**	**1390**	**1.51**	**1.13**	**13.83**	**12.55**	**0.905**	**3.40**	**4.53**	**7.419**	**32.5**
*National NURP Study Average					11.9	90.8	na	na	na	*****	2.35	3.31	0.18	0.176	0.16		
*Characteristics of Urban Stormwater Range					1 - 700	5 - 3,100	2 - 11,300	200 - 14,600	na	0.1 - 2.5	0.01 - 4.5	na	0.0 - 1.9	na	0.1 - 10		

* Data was taken from tables 4-1 and 4-2 of the Stormwater Management for Maine: BMPS.

6.2.2 Laboratory Analysis Summary

Commercial Facilities Wet Weather Sampling Results

Point Source Sample Site	Date	Type	pH	BOD	COD	Suspended Solids (TSS)	Dissolved Solids (TDS)	Nitrate + Nitrite nitrogen	Ammonia	Total Kjeldahl Nitrogen	Total Organic Nitrogen	Lead	Zinc	Total Phosphorus	Ortho Phosphate	Oil/ Grease	E. Coli	Fecal Colif.
Units				mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	CFU/100ml	
Food City Pre-Tr (Middlebrrok Pike)	8/25/08	Grab	6.0	130	520	27	390	1.80	1.10	5.00	3.90	BDL	0.440	0.46	0.310	BDL	236	4,900
Food City Post-Tr (Middlebrrok Pike)	8/25/08	Grab	6.0	130	510	25	390	2.00	1.10	4.80	3.60	BDL	0.470	0.47	0.320	BDL	365	2,600
Waste Connections (Prosser Rd)	11/7/08	Grab	6.0	220	530	430	260	0.34	0.79	10.00	9.70	0.073	1.200	1.70	1.900	17.00	-	-
Burger King (Middlebrook Pike)	6/4/09	Grab	6.0	13	310	240	130	0.33	0.44	2.60	2.20	0.061	0.390	0.73	0.130	9.10	-	-
Taco Bell (Love Creek Rd)	6/10/09	Grab	6.5	490	1700	270	490	1.10	2.80	20.00	17.00	0.032	1.000	1.80	0.790	34.00	-	-
Food City (Love Creek Rd)	6/10/09	Grab	5.5	BDL	36	12	22	0.20	0.30	0.66	0.36	0.008	0.065	BDL	0.044	BDL	-	-
McDonalds (Broadway)	6/10/09	Grab	5.5	29	570	510	210	1.40	1.40	7.20	5.80	0.035	0.580	1.40	0.590	BDL	-	-
Food City (Western Ave)	6/10/09	Grab	5.5	BDL	190	23	20	BDL	0.14	0.43	0.29	BDL	0.035	BDL	0.048	BDL	-	-
Average			5.9	126.5	546	192	239	0.90	1.01	6.34	5.36	0.026	0.523	0.82	0.517	7.51	301	3,750
*National NURP Study Average				11.9	91	na	na	na	*****	2.35	3.31	0.18	0.176	0.16				
*Characteristics of Urban Stormwater Range				1 - 700	5 - 3,100	2 - 11,300	200 - 14,600	na	0.1 - 2.5	0.01 - 4.5	na	0.0 - 1.9	na	0.1 - 10				

* Data was taken from tables 4-1 and 4-2 of the Stormwater Management for Maine: BMPS.

6.2.2 Laboratory Analysis Summary

Transfer Station/Prosser Road Sampling Comparison

Point Source Sample Site		Date	Type	pH	BOD	COD	Suspended Solids (TSS)	Dissolved Solids (TDS)	Nitrate + Nitrite nitrogen	Ammonia	Total Kjeldahl Nitrogen	Total Organic Nitrogen	Lead	Zinc	Total Phosphorus	Ortho Phosphate	Oil/ Grease
					mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Prosser Road	**Win. '08**	**23-Jan**	**Grab**	**7.5**	**5.4**	**230**	**2200**	**380**	**0.27**	**11.00**	**75.0**	**64.0**	**0.20**	**0.69**	**13.00**	**0.340**	-
Transfer Station	Spr. '07	16-May	Grab	6.5	1100	3900	4200	4100	5.00	7.60	98.0	90.0	1.30	8.70	15.00	2.200	25
	Sum. '07	10-Jul	Grab	7.0	84	400	900	530	0.61	0.82	9.8	9.0	0.34	1.20	1.70	1.200	BDL
	Fall '07	13-Dec	Grab	6.5	38	200	160	240	BDL	0.14	1.6	1.6	0.13	0.37	0.41	0.069	48
	Win. '08	4-Mar	Grab	6.0	51	400	440	240	0.11	BDL	4.1	4.1	0.37	0.59	0.61	0.065	110
	Spr. '08	14-May	Grab	6.0	250	1200	400	2400	0.49	1.20	19.0	18.0	0.18	0.76	1.60	0.520	18
	Sum. '08	25-Aug	Grab	6.0	920	4100	1600	4100	4.30	3.20	18.0	15.0	0.88	3.80	5.80	4.600	48
	Fall '08	24-Nov	Grab	7.0	27	460	600	350	0.27	1.10	6.3	5.2	0.44	1.40	3.10	4.000	17
	Win. '09	25-Mar	Grab	6.0	120	1600	2400	880	0.22	0.55	20.0	19.0	1.00	4.90	4.90	0.210	BDL
	Spr. '09	1-May	Grab	6.0	320	740	660	230	BDL	0.20	11.0	11.0	1.30	3.50	4.30	0.074	BDL
Transfer Station Average				**6.3**	**323.3**	**1444**	**1262**	**1452**	**1.57**	**1.85**	**20.9**	**19.2**	**0.66**	**2.80**	**4.16**	**1.438**	**44**
*National NURP Study Average					11.9	90.8	na	na	na	*****	2.35	3.31	0.18	0.176	0.16		
*Characteristics of Urban Stormwater Range					1 - 700	5 - 3,100	2 - 11,300	200 - 14,600	na	0.1 - 2.5	0.01 - 4.5	na	0.0 - 1.9	na	0.1 - 10		

* Data was taken from tables 4-1 and 4-2 of the Stormwater Management for Maine: BMPS.

6.2.2 Laboratory Analysis Summary

Walden Drive Monitoring Station

Quarter	Date	Type	pH	Flow	Rainfall amount	BOD	COD	Suspended Solids (TSS)	Dissolved Solids (TDS)	Nitrate + Nitrite nitrogen	Ammonia	Total Kjeldahl Nitrogen	Total Organic Nitrogen	Lead	Zinc	Total Phosphorus	Ortho Phosphate
Units				cu-ft	inches	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
SUMMER 2008	22-Jul	Comp	6.0	515,284	0.16	BDL	66	270	150	0.60	0.38	1.40	1.40	0.015	0.200	0.25	BDL
FALL 2008	9-Oct	Comp	6.0	1,274,690	0.77	BDL	BDL	130	89	0.24	BDL	0.78	0.78	0.008	0.120	BDL	0.68
WINTER 2009	27-Jan	Comp	5.5	795,073	0.51	BDL	30	160	200	0.82	0.19	1.30	1.10	0.017	0.140	0.10	0.22
SPRING 2009	1-May	Comp	6.5	684,766	0.47	10	91	240	120	0.58	0.15	2.20	2.00	0.015	0.210	0.38	BDL
Sample Average			6.0	817,453	0.48	10	62	200	140	0.56	0.24	1.42	1.32	0.014	0.168	0.24	0.45

***National NURP Study Average**	11.9	90.8	na	na	na	*****	2.35	3.31	0.18	0.176	0.16
***Characteristics of Urban Stormwater Range**	1 - 700	5 - 3,100	2 - 11,300	200 - 14,600	na	0.1 - 2.5	0.01 - 4.5	na	0.0 - 1.9	na	0.1 - 10

* Data was taken from tables 4-1 and 4-2 of the Stormwater Management for Maine: BMPS.

6.2.2 Laboratory Analysis Summary

Williams Creek Monitoring Station

Quarter	Date	Type	pH	Flow	Rainfall amount	BOD	COD	Suspended Solids (TSS)	Dissolved Solids (TDS)	Nitrate + Nitrite nitrogen	Ammonia	Total Kjeldahl Nitrogen	Total Organic Nitrogen	Lead	Zinc	Total Phosphorus	Ortho Phosphate
Units				cu-ft	inches	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
SUMMER 2008	22-Jul	Comp	6.0	548,875	0.24	15	48.0	120	160	0.53	BDL	1.80	1.80	0.0210	0.160	0.24	BDL
FALL 2008	8-Oct	Comp	6.5	530,999	0.89	BDL	BDL	51	140	0.59	BDL	0.70	0.70	0.0088	0.060	BDL	0.10
WINTER 2009	27-Jan	Comp	6.0	1,344,170	0.54	BDL	33.0	48	150	1.00	0.15	3.40	3.20	0.0150	0.053	BDL	0.20
SPRING 2009	20-Apr	Comp	7.5	1,136,850	0.59	BDL	BDL	26	230	1.10	0.12	0.97	0.85	0.0067	0.100	0.14	BDL
Sample Average			6.5	890,224	0.57	4	20	61	170	0.81	0.07	1.72	1.64	0.0129	0.093	0.10	0.08

***National NURP Study Average**	11.9	90.8	na	na	na	*****	2.35	3.31	0.18	0.176	0.16
***Characteristics of Urban Stormwater Range**	1 - 700	5 - 3,100	2 - 11,300	200 - 14,600	na	0.1 - 2.5	0.01 - 4.5	na	0.0 - 1.9	na	0.1 - 10

* Data was taken from tables 4-1 and 4-2 of the Stormwater Management for Maine: BMPS.

6.2.2 Laboratory Analysis Summary

Third Creek Monitoring Station

Quarter	Date	Type	pH	Flow	Rainfall amount	BOD	COD	Suspended Solids (TSS)	Dissolved Solids (TDS)	Nitrate + Nitrite nitrogen	Ammonia	Total Kjeldahl Nitrogen	Total Organic Nitrogen	Lead	Zinc	Total Phosphorus	Ortho Phosphate
Units				cu-ft	inches	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
SUMMER 2008	22-Jul	Comp	6.0	5,653,350	0.88	9.6	130.0	440	130	0.48	BDL	1.90	1.90	0.037	0.19	0.44	BDL
FALL 2008	8-Oct	Comp	7.0	7,557,090	0.88	6.1	BDL	140	150	0.57	BDL	0.80	0.80	0.024	0.20	BDL	0.260
WINTER 2009	27-Jan	Comp	5.5	3,210,090	0.56	5.0	39.0	57	340	1.10	0.13	1.10	1.00	0.011	0.12	BDL	0.210
SPRING 2009	20-Apr	Comp	7.5	4,497,210	0.52	10.0	28.0	48	190	0.90	BDL	0.74	0.74	0.0072	0.21	0.11	BDL
Sample Average			6.5	5,229,435	0.71	7.7	66	171	203	0.76	0.03	1.14	1.11	0.020	0.18	0.14	0.118

***National NURP Study Average**	11.9	90.8	na	na	na	*****	2.35	3.31	0.18	0.176	0.16
***Characteristics of Urban Stormwater Range**	1 - 700	5 - 3,100	2 - 11,300	200 - 14,600	na	0.1 - 2.5	0.01 - 4.5	na	0.0 - 1.9	na	0.1 - 10

* Data was taken from tables 4-1 and 4-2 of the Stormwater Management for Maine: BMPS.

6.2.2 Laboratory Analysis Summary

Love Creek Monitoring Station

Quarter	Date	Type	pH	Flow	Rainfall amount	BOD	COD	Suspended Solids (TSS)	Dissolved Solids (TDS)	Nitrate + Nitrite nitrogen	Ammonia	Total Kjeldahl Nitrogen	Total Organic Nitrogen	Lead	Zinc	Total Phosphorus	Ortho Phosphate
Units				cu-ft	inches	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
SUMMER 2008	22-Jul	Comp	7.0	761,388	0.84	6.4	43.0	95.0	210	0.77	0.81	1.30	BDL	0.011	0.220	0.120	BDL
FALL 2008	9-Oct	Comp	7.0	181,142	0.74	BDL	BDL	62.0	190	0.60	BDL	0.71	0.71	BDL	0.065	BDL	0.29
WINTER 2009	28-Jan	Comp	7.0	20,757,000	0.65	BDL	32.0	56.0	230	1.10	BDL	1.10	1.10	0.0084	0.046	BDL	0.260
SPRING 2009	20-Apr	Comp	7.5	19,418,900	0.55	BDL	BDL	11.0	250	1.10	BDL	0.61	0.61	BDL	BDL	BDL	BDL
Sample Average			7.1	10,279,608	0.70	1.6	18.8	56.0	220	0.89	0.20	0.93	0.61	0.0049	0.083	0.030	0.14
***National NURP Study Average**						11.9	90.8	na	na	na	*****	2.35	3.31	0.18	0.176	0.16	
***Characteristics of Urban Stormwater Range**						1 - 700	5 - 3,100	2 - 11,300	200 - 14,600	na	0.1 - 2.5	0.01 - 4.5	na	0.0 - 1.9	na	0.1 - 10	

* Data was taken from tables 4-1 and 4-2 of the Stormwater Management for Maine: BMPS.

6.2.2 Laboratory Analysis Summary

First Creek Monitoring Station (KAT)

Quarter	Date	Type	pH	Flow	Rainfall amount	BOD	COD	Suspended Solids (TSS)	Dissolved Solids (TDS)	Nitrate + Nitrite nitrogen	Ammonia	Total Kjeldahl Nitrogen	Total Organic Nitrogen	Lead	Zinc	Total Phosphorus	Ortho Phosphate
Units				cu-ft	inches	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
SUMMER 2008	22-Jul	Comp	6.0	857,276	0.39	9.0	89.0	230.0	140	0.50	BDL	1.80	1.80	0.026	0.130	0.46	0.05
FALL 2008	8-Oct	Comp	7.0	643,319	0.79	5.4	BDL	82.0	160	0.51	BDL	BDL	BDL	0.009	0.077	BDL	0.22
WINTER 2009	28-Jan	Comp	7.0	1,188,080	0.57	BDL	43.0	54.0	240	1.30	BDL	0.97	0.97	0.007	0.046	BDL	0.14
SPRING 2009	20-Apr	Comp	7.5	1,522,540	0.46	BDL	BDL	9.9	230	1.10	BDL	0.40	0.40	BDL	BDL	BDL	BDL
Sample Average			6.9	1,052,804	0.55	3.6	33.0	94.0	193	0.85	BDL	1.06	1.06	0.014	0.084	0.12	0.14

***National NURP Study Average**	11.9	90.8	na	na	na	*****	2.35	3.31	0.18	0.176	0.16
***Characteristics of Urban Stormwater Range**	1 - 700	5 - 3,100	2 - 11,300	200 - 14,600	na	0.1 - 2.5	0.01 - 4.5	na	0.0 - 1.9	na	0.1 - 10

* Data was taken from tables 4-1 and 4-2 of the Stormwater Management for Maine: BMPS.

6.2.3 Noncompliance.

The City of Knoxville has complied with all permit requirements.

6.2.4 Estimated Runoff from Major Watersheds within the MS4 Area.

Part VI (A)(2)(e)(i)(3) of the NPDES permit requires an estimate of the total volume of urban runoff discharged by the City of Knoxville for the year. This estimate is to be based on total rainfall for the year and the estimated imperviousness of different land uses. The total rainfall for the year was determined to be an average of the annual rainfall recorded during the year from the City's five stormwater monitoring stations located throughout the city and the National Weather Service's rain gage at the McGhee Tyson Airport. The average recorded annual rainfall amount was 47.24 inches.

To estimate the total runoff volume, the City utilized the GIS to determine approximate areas for each watershed within the city limits along with the corresponding land uses. Each land use is assigned an approximated impervious percentage according to the Camp Dresser and McKee Watershed Management Model described in the Part 2 application, pages 4-14 to 4-18.

It was assumed for each watershed that 95 percent of the rainfall from the impervious fraction, and 15 percent of the rainfall from the pervious fraction of each land use was converted to runoff. Therefore the impervious runoff coefficient and the pervious runoff coefficient were assumed to be 0.95 and 0.15, respectively. For example, based upon an average annual rainfall volume of 47.24 inches/year, the average annual runoff from a single-family residential land use (25% impervious) is 15.05 in/yr (47.24*[(0.15*0.75)+(0.95*0.25)]). The runoff coefficient for a single land use is the sum of the impervious percentage multiplied times the impervious runoff coefficient plus the pervious percentage multiplied by the pervious runoff coefficient. For the previous example, the average runoff coefficient for the single-family residential land use is 0.35 ([0.15*0.75]+[0.95*0.25]). For a watershed, the average runoff coefficient is an area weighted average of each land use runoff coefficients times the percentage of the area of each land use.

The runoff from the major watersheds within the MS4 area was estimated by a formula in Camp Dresser & Mckee's Watershed Management Module shown below:

$$Qi = P \times Ci \times Ai$$

Where,

P = total precipitation (inches/year)

C = land use area weighted runoff coefficient = 0.15*Pervious% + 0.95*Impervious%

A = drainage area (acres) = acres x (43,560 ft2/acre) = ft2

Q = ΣQi = total runoff rate / 1,000,000 = Mgal

$Q_{tot\ 08/09}$ = 35,737 Million Gallons

Please find the analysis for the each watershed and for the entire city in table 6.2.4 on the following page.

6.2.4 ESTIMATED RUNOFF FROM MAJOR WATERSHEDS WITHIN THE MS4

July 1, 2008 - June 30, 2009

Watershed	Agricul./ Forest/ Vacant, Public Parks	Vacant (>10)	Rural Res.	Single Family Res.	Private Rec., Public Land	Multi-Family Res., Church	Insti-tutional	Mining, Office/ Service	Manu-facturing/ Whole-sale	Commer., Trans./ Utility/ Commun.	Major Roads/ Hwys/ ROWs	Under Const	Not Loaded	Total Acres in Watershed	Acres in the City Limits	Est. % Imperv-ious	C Value	Total Rainfall during 08/09 (in./yr)	Total Runoff for 08/09 (Mgal/yr)
Baker Cr.	412	2	107	640	90	77	32	1	1	3	269	13	27	1,674	1,674	32	0.41	47.24	876
East Fork	313	0	10	475	302	78	73	31	195	235	584	33	180	2,509	2,509	53	0.57	47.24	1,843
First Cr.	724	0	300	3,152	544	501	110	157	127	556	1,412	51	116	7,750	7,750	44	0.50	47.24	4,962
Fourth Cr.	965	57	423	2,026	468	406	93	206	201	568	881	61	414	6,769	5,920	41	0.48	47.24	3,626
Goose Cr.	639	40	126	669	213	67	8	21	77	131	327	34	29	2,381	1,755	35	0.43	47.24	963
Grassy Cr.	2,230	176	561	610	215	24	0	14	31	95	211	39	95	4,301	433	17	0.29	47.24	159
Holston R.	2,362	69	371	1,222	417	45	5	2	219	33	805	32	50	5,632	2,455	28	0.37	47.24	1,169
Inman Br.	563	33	214	138	4	12	0	0	0	0	145	0	34	1,143	99	21	0.31	47.24	40
Knob Cr.	1,719	195	481	843	125	84	1	19	1	29	296	4	169	3,966	989	19	0.30	47.24	386
Knob Fork	1,659	26	398	675	182	56	5	93	6	124	257	19	252	3,752	823	22	0.33	47.24	346
Love Cr.	1,735	102	505	1,625	311	212	51	94	178	408	1,038	46	103	6,408	5,090	36	0.44	47.24	2,880
Second Cr.	443	0	90	1,281	346	247	29	107	140	542	1,161	35	82	4,503	4,498	53	0.57	47.24	3,295
Sinking Cr.	1,614	146	459	1,266	284	90	17	33	31	267	881	12	347	5,447	2,434	33	0.41	47.24	1,295
Swanpond C	3,892	303	833	604	121	36	4	79	240	232	457	65	285	7,151	499	19	0.30	47.24	195
Ten Mile Cr.	1,879	0	638	3,421	165	895	55	115	58	615	1,500	24	641	10,006	3,921	38	0.45	47.24	2,266
Third Cr.	1,757	79	436	3,003	406	512	184	124	225	443	1,252	98	220	8,739	8,417	37	0.45	47.24	4,823
TN River	7,197	503	2,269	4,681	2,910	403	187	72	170	238	990	121	1,113	20,854	8,232	22	0.33	47.24	3,456
Toll Cr.	535	69	154	222	42	26	1	0	37	4	93	42	4	1,229	767	22	0.32	47.24	317
Turkey Cr.	3,353	235	603	2,693	264	343	121	104	91	442	1,161	68	738	10,216	1,677	29	0.38	47.24	827
Whites Cr.	2,733	154	782	1,298	575	59	31	11	49	126	608	51	578	7,055	1,634	23	0.34	47.24	706
Williams Cr.	358	11	47	561	46	96	125	17	10	61	276	3	30	1,641	1,605	37	0.45	47.24	926
Woods Cr.	1,220	106	281	371	0	26	0	2	140	43	261	1	157	2,608	143	23	0.33	47.24	61
Sink-East	1,226	0		728	9	17	0	17	3	27	0	0	0	2,027	91	12	0.24	47.24	29
Beaver Cr	21,174	0	0	21,230	1,292	845	4	259	283	712	0	160	0	45,959	162	16	0.28	47.24	58
Tuckahoe	4,293	0	0	1,829	18	14	0	8	2	1	0	4	0	6,169	229	8	0.22	47.24	64
Fr.Broad riv	8,954	0	0	2,744	73	40	24	24	497	117	0	166	0	12,639	551	11	0.24	47.24	169
COK Total	73,949	2,306	10,088	58,007	9,422	5,211	1,160	1,610	3,012	6,052	14,865	1,182	5,664	192,528	64,357				**35,737**

The runoff from the major watersheds within the MS4 area was estimated by a formula in Camp Dresser & Mckee's Watershed Management Module. Q = P x C x A

where, P = total precipitation (inches/year) = 47.24 in./yr. = 3.94 ft./yr.

C = land use area weighted runoff coefficient = 0.15*Pervious% + 0.95*Impervious%

A = drainage area (acres) = acres in watershed x (4.35E4 ft2/acre) = Ai ft2

Q = total runoff rate = sum of each watershed's Qi.

Total estimated runoff for Year Five = 35,737 Mgal

Approximate area and land use for each watershed was determined through the City's GIS. Total yearly rainfall amount was determined by averaging the amount of rain collected from the City's five monitoring stations located throughout the city (refer to map in appendix). Runoff coefficient (C) was calculated by adding 15 % of the pervious fraction to 95% of the impervious fraction in each watershed. This assumes that the fraction of rainfall producing runoff is 15% and 95% from pervious and impervious surfaces respectively. The summary of the runoff calculations are provided in the table above. Calculations for some of the watersheds were left out due to the insignificant amount of runoff that would be produced.

7.0 ASSESSMENT OF CONTROLS: ESTIMATED POLLUTANT LOADING REDUCTIONS FROM THE MS4.

Since the NPDES permit was first issued in 1996, the City of Knoxville has developed and implemented all of the scheduled programs. The ongoing monitoring program and the dry weather-screening program were started in during the 1996-1997 permit year. Each program has been implemented annually since that time. Data has been collected, analyzed, and archived for future reference.

Quantitative estimates of pollutant loads and event mean concentrations were reported as required in the fifth annual report. In the fifth year of the new permit term, the pollutant loads and event mean concentrations were calculated again and included in the Appendix of this report. Any quantitative reductions or groundwater impacts from the MS4 may become evident at that time and will be reported. However, as described in the dry weather-screening program (ILL-2), noticeable reductions in contaminated outfalls have been observed since the program began.

Although testing data may not be available to substantiate all of the illicit discharges and illegal dumping problems, which have been resolved, the qualitative effect on water quality within the MS4 and waters-of-the State is irrefutable. Many industries have removed illicit discharges, homeowners and utilities have replaced sections of leaking or broken sanitary sewers, the last known sections of the combined sewers were separated, unknown combined sewer systems have been located and planned for repair, creek restoration and cleanup activities have begun, and many educational and volunteer programs have been sponsored, conducted, and/or coordinated to reduce dumping.

Structural controls for water quality control include stormwater treatment facilities on most new development and significant redevelopment throughout the city since 1997. Covenants are in place to require that these water quality facilities are maintained and/or replaced as needed. The City has also installed oil/water separators or stormwater treatment devices at the following locations: the KAT bus facility on First Creek, Victor Ashe Park, Northwest Crossing regional detention pond, the Prosser Road garage, the Loraine Street facility, and the Solid Waste Transfer facility. The City is planning new structural controls at the Solid Waste Transfer Station during this permit term. Floating trash skimmers were installed near the mouth of some major creeks to prevent floating pollutants from discharging to the river. The Fort Loudon Lake Association has been contracted to maintain and replace the skimmers as needed.

All of the programs implemented to improve water quality in the creeks and river throughout the city should provide some quantitative evidence of improvement in future years. This data will be reported, as it becomes apparent.

8.0 SUMMARY OF MODIFICATIONS TO THE SWMP.

As expected, the new permit created several modifications to the existing SWMP. The City installed a new monitoring station on Third Creek and has since stop sampling at Acker Place. The current locations for all of the monitoring stations are shown on the detailed inventory map in the appendix. Future locations will be reported in each annual report.

9.0 FISCAL ANALYSIS

The Fiscal Analysis for this annual report will list the permit year budget sources and amounts along with estimates for the following permit year. Sources of funds are listed for each major program. Due to complexity, all of the support activities such as purchasing, payroll, legal support, information systems, fleet management, and human resources are not reflected in the table. Future funding sources may change if a stormwater utility fee is implemented.

Program Description	Fund Source	Actual FY 08/09	Est. FY 09/10
Solid Waste Recycling (includes: composting, education, staff, etc.)	Fund 230	$1,924,424	$2,013,452
Household Hazardous Waste Facility	Fund 230	$122,611	$140,000
Stormwater Mgmt Operating expenses	Fund 220	$1,731,475	$2,049,280
Public Service operating/maintenance (brush/leaf/litter pickup; street cleaning; curb/gutter repair; stormdrain/catch basin cleaning, repair, & installation; ditching; seed/sod in R.O.W.; grate replacement; water pumping; tree trimming, removal, and planting.)	General Fund 100	$3,240,657	$3,300,000
First Creek Restoration/Improvements	Mixed	$1,204,214	$333,673
Lake Ave/Drainage Improvements	Fund 401	$30,161	$319,839
MJP/Baker Creek Restoration	Fund 401	$1,288	$71,712
Emily Avenue Sinkhole Project Emily Avenue Sinkhole Reclamation	Fund 401	$1,062 $0	$197,568 $112,750
Solid Waste Transfer Station – SWPPP	Fund 401	$16,479	$112,987
Cross Park Dr. Drainage Improvement	Fund 401	$103,246	$1,096,754
Prosser Road Groundwater Study	Fund 401	$15,000	$75,000
MLK Jr./Chestnut MS4	Fund 401	$1,680	$1,305,320
Lower Second Creek Greenway	Fund 401	$24,981	$94,967
Neighborhood Drainage Projects	Fund 401	$91,090	$1,196,252
Total Estimated Stormwater Program Costs		**$8,508,368**	**$12,419,554**

APPENDIX A

Estimated Annual Pollutant Loading and Event Mean Concentrations

APPENDIX A

Estimated Seasonal Pollutant Loadings and Event Mean Concentrations (EMC) Watershed Management Model (WMM) Analysis

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LIST OF FIGURES and LIST OF TABLES

A.1 PURPOSE

The purpose of this appendix is to address the stated requirements mentioned within the 1996 NPDES Permit issued to the City of Knoxville, Tennessee (No. TNS068055). The overall requirements that are addressed in this appendix are summarized as:

- Estimate the seasonal event mean concentration (EMC) values for all routine parameters tested at wet weather monitoring stations, analyze seasonal variations and determine EMC values for the major watersheds within the City of Knoxville.
- Estimate the seasonal pollutant loadings for all routine parameters tested at wet-weather monitoring stations, provide pollutant loadings for the major watersheds within the City of Knoxville. The watershed drainage areas and land uses are included in the analysis.

The routine parameters are listed in Table V(1) of the 1996 NPDES permit (reproduced below). The parameter "Total phenols" was dropped from the routine laboratory analysis in June 1999, since it had not been detected in any of the routine sampled storms. The parameters Ammonia (NH_3) and Ortho Phosphate (PO_4) were both added and tested throughout this permit cycle. "pH" was also tested and recorded.

The following paragraphs (in italics) are taken from the 1996 NPDES Permit (No. TNS068055):

Part V (Monitoring):

2. a. Parameters to be sampled at a minimum are shown below:

TABLE V(1)	
PARAMETERS FOR ROUTINE WET WEATHER MONITORING	
Ph Biochemical Oxygen Demand (BOD_5) Chemical Oxygen Demand (COD) Total Suspended Solids (TSS) Total Dissolved Solids (TDS) Nitrate + Nitrite Nitrogen (N+NN) Total Ammonia Nitrogen (NH_3)	Total ammonia plus organic nitrogen (also called total Kjeldahl nitrogen – TKN) Total Nitrogen (TN) Total Recoverable Lead (Pb) Total Recoverable Zink (Zn) Total Phosphorus (TP) Ortho Phosphate (PO_4)
SPECIAL ANALYSES	
Fecal Coliform (1 storm/year)	Fecal Streptococcus (1 storm/year)

3. *Estimates of Seasonal Loadings and Event Mean Concentrations*

a. *The permittee shall provide estimates of the seasonal pollutant load and of the event mean concentration of representative storms for the parameters listed in Table V(1), excluding pH, for each of the 17 major watersheds within the MS4. The permittee shall document the method used to prepare these estimates.*

c. *The seasonal pollutant load and event mean concentration for each of the 17 major watersheds within the MS4 may be estimated from the representative monitoring locations, from regional NURP or State data, or from pooling results from other Tennessee MS4 monitoring activities and shall take into consideration land uses and drainage areas for the watersheds. The conclusions of the USGS sampling and pollutant loading report shall be used. Reference U.S. Geological Survey (USGS) Open-File Report 94-68 titled "Rainfall, Streamflow, and Water-Quality Data for Five Small Watersheds, Nashville, Tennessee, 1990-92" and USGS Water-Resources Investigations Report 95-4140 (in press).*

d. *The estimates of seasonal loadings and event mean concentrations shall be included in the Annual Report for the fifth year of the perm it.*

e. *The flow basis of the seasonal loadings shall be reported along with the estimates. In addition, an estimate for total runoff from each of the 17 major watersheds within the City of Knoxville area for the year shall be reported in each Annual Report.*

Part VI (Reporting Requirements):

(A) (1) (e)(i)(2) *For the Annual Report for year five of the perm it, estimates of seasonal pollutant loadings and event mean concentrations (EMC) for each major watershed required by Item V(A)(3) of the permit; the basis for estimates shall be clearly given.*

(A) (1) (e) (i) (3) *Based on total rainfall for the year, imperviousness of different land uses, etc., an estimate of the total volume of urban runoff discharged in the City of Knoxville for the year.*

(A)(1)(j) *The following information shall be included as Appendices with the Annual Report for the fifth year of the perm it:*

i. Analytical data collected from the monitoring program;

==========

A.2 SUMMARY OF NURP SAMPLING DATA (1983)

A primary source of objective stormwater sampling data is the Nationwide Urban Runoff Program (NURP), conducted at 28 metropolitan areas across the United States from 1978 through 1983. This resulted in a comprehensive study published by the U.S. Environmental Protection Agency (EPA) that identifies various types of pollutants and provides some statistics. The City of Knoxville was included as part of the NURP study, and is represented by two sites from the First Creek watershed and two sites from the Second Creek watershed. The four Knoxville sites are described in Table A-1 in order to provide some perspective. Some of the mean EMC stormwater values are tabulated in Table A-2 for the overall NURP program and the four Knoxville sites, in order to allow comparison with other background data.

TABLE A-1
Description of Knoxville NURP Sites

ID	Land Use	Population Density	Storms	Impervious	Area (sq.mi.)	Watershed
CBD	100% Commercial	0 persons/acre	15	99%	0.04	1st Creek
SC	Mixed use (strip)	3 persons/acre	13	43%	0.29	2nd Creek
R1	91% Residential	11 persons/acre	11	33%	0.09	1st Creek
R2	96% Residential	4 persons/acre	11	13%	0.14	2nd Creek

A.3 SUMMARY OF USGS SAMPLING DATA (1990-1992)

U.S. Geological Survey (USGS) investigated stormwater quality for Tennessee cities that were preparing NPDES permit applications in the early 1990s. This appendix will summarize values for Knoxville and Nashville. Each city investigated three storms each from five representative locations (for a total of 15 storms per city). The USGS sampling data for both cities contains a full suite of pollutant testing for volatile organic compounds, acidic and basic compounds, pesticides, PCBs, trace metals, fecal organisms, conventional pollutants, and physical properties of the stormwater runoff.

The report entitled "Stormwater Data for Knoxville, Tennessee, 1991-92" by Outlaw and Aycock (USGS Open-File Data Report 93 -xxx), initially presented within the NPDES Part 2 Permit Application, is summarized in Table A-3 for the 13 pollutants to be analyzed.

The report entitled "Rainfall, Streamflow, and Water-Quality Data for Five Small Watersheds, Nashville, Tennessee, 1990-92" (USGS Open-File Data Report 94-68) is summarized in Table A-4 for the 13 pollutants to be analyzed.

For each city, the arithmetic average is computed for each watershed and for the total data set. The standard deviation is only computed for the total data set. Based on the limited USGS data, Knoxville has lower values for total sediment and for phosphorus (which might be expected due to hard clay soils and less construction growth than Nashville). Knoxville has higher values for oxygen demand and nitrogen.

TABLE A-2

Summary of NURP EMC Sampling Data and Other Values

Description of data source	pH	BOD	COD	TSS	TDS	N+NN	NH3	TKN	TN	Pb	Zn	DP	TP
	---	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Nationwide Urban Runoff Program (EPA, 1983)													
Median EMC values by land use, NURP:													
Commercial	----	9.3	57	69	----	0.57	----	1.18	----	0.104	0.226	0.080	0.201
Mixed Use	----	7.8	65	67	----	0.56	----	1.29	----	0.114	0.154	0.056	0.263
Open / Nonurban	----	----	40	70	----	0.54	----	0.97	----	0.030	0.195	0.026	0.121
Residential	----	10.0	73	101	----	0.74	----	1.90	----	0.144	0.135	0.143	0.383
Coefficient of variation:													
Commercial	----	0.31	0.39	0.85	----	0.91	----	0.43	----	0.68	1.10	0.71	0.67
Mixed Use	----	0.52	0.58	1.10	----	0.67	----	0.50	----	1.40	0.78	0.75	0.75
Open / Nonurban	----	----	0.78	2.90	----	0.91	----	1.00	----	1.50	0.66	2.10	1.70
Residential	----	0.41	0.55	0.96	----	0.83	----	0.73	----	0.75	0.84	0.46	0.69
Knoxville NURP:													
CBD Commercial (central business district)	----	13	73	123	84	0.66	----	0.64	----	0.16	0.32	0.05	0.21
SC Commercial (strip development)	----	15	60	71	63	0.59	----	0.62	----	0.24	0.15	0.20	0.35
R2 Residential, low density	----	8	45	122	59	0.40	----	0.50	----	0.13	0.09	0.13	0.24
R1 Residential, medium density	----	----	121	601	103	0.58	----	1.13	----	0.44	0.41	0.14	0.70
Pollutants in natural rainfall:													
Knozville (1978,Betson) via Wanielista	5.1	----	65	16	----	0.47	----	2.5	----	----	----	----	0.36
Tested rainfall data, NURP, 1983	----	3.3	17	7	----	0.60	----	----	----	0.00	0.11	0.01	0.03
Various EMC values:													
Average, NURP study (1983) via Maine	----	11.9	91	----	----	----	----	2.35	3.31	0.180	0.176	0.16	0.46
General urban median EMC (1983), NURP	----	9	65	100	----	0.68	----	1.50	----	0.14	0.16	0.12	0.33
General coefficient of variation (1983), NURP		0.5 - 1	0.5 - 1	1 to 2	----	0.5 - 1	----	0.5 - 1	----	0.5 - 1	0.5 - 1	0.5 - 1	0.5 - 1
Highway runoff data (1990) via Wanielista	----	24	14.7	1147	261	1.14	----	2.99	----	0.96	0.41	----	0.79
USGS Reports for Knoxville and Nashville (1993, 1994) ..... Taken from Tables A-3 and A-4													
Knoxville, 1991-1992, 15 storms	7.73	68.6	144.7	119.3	96.0	0.83	0.30	1.51	----	0.024	0.161	0.333	0.561
Nashville, 1990-1992, 15 storms	7.71	40.1	126.3	156.9	168.3	0.72	----	1.15	----	0.025	0.148	0.284	1.159
Knoxville + Nashville, 30 storms	7.72	54.3	135.5	133.4	132.1	0.78	0.30	1.33	----	0.024	0.154	0.31	0.86

TABLE A-3
Summary of USGS Report (1993) for 15 Storm Events in Knoxville

Knoxville USGS Report:		1991-1992		pH	BOD	COD	TSS	TDS	N+NN	NH3	TKN	TN	Pb	Zn	DP	TP
Sta.	Date	Year	Watershed	---	mg/l	mg/l	mg/l	Mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
FC	April 19	1991	Ftn City - 1st	---	8	77	100	38	0.32	0.19	1.2		0.054	0.110	0.170	0.320
FC	March 06	1992	Ftn City - 1st	8.7	36	92	220	59	0.32	0.11	1.1		0.064	0.130	0.100	0.300
FC	April 15	1992	Ftn City - 1st	7.7	27	130	186	85	1.50	0.40	1.7		0.040	0.090	0.240	0.330
TM	14	1991	Ten Mile Cr.	7.7	8	32	1	89	0.99	0.12	0.7		----	0.020	0.050	0.090
TM	July 31	1992	Ten Mile Cr.	7.7	26	84	23	117	1.40	0.17	1.8		0.005	0.050	0.090	0.140
TM	Sept 18	1992	Ten Mile Cr.	8.0	24	37	21	38	0.36	0.05	0.5		0.005	0.050	0.070	0.140
TC	March 12	1992	Tank Farms - 3rd	7.5	72	220	87	129	0.61	0.41	2.2		0.015	0.150	0.910	1.500
TC	April 27	1992	Tank Farms - 3rd	7.9	10	98	143	100	0.46	0.21	1.3		0.023	0.200	0.560	1.000
TC	Feb. 13	1992	Tank Farms - 3rd	8.4	270	250	200	225	1.10	0.67	3.0		0.029	0.210	1.600	2.500
FM	27	1991	Acker Place - 4th	8.2	72	89	285	56	0.40	0.15	1.1		0.025	0.350	0.040	0.380
FM	Nov. 20	1991	Acker Place - 4th	7.4	21	100	101	135	0.92	0.37	1.4		0.018	0.240	0.380	0.530
FM	20	1992	Acker Place - 4th	---	52	71	281	54	0.50	0.15	0.3		0.014	0.150	0.040	0.100
FW	April 08	1991	Wellington - 4th	7.0	20	130	43	48	0.36	0.25	2.1		0.017	0.170	0.110	0.210
FW	Nov. 01	1991	Wellington - 4th	6.7	370	650	75	157	1.60	0.64	2.7		0.014	0.340	0.520	0.720
FW	18	1992	Wellington - 4th	7.6	13	110	23	110	1.60	0.60	1.6		0.012	0.150	0.120	0.160
Area	**Sta.**															
0.23	FC			8.20	23.7	99.7	168.7	60.7	0.71	0.23	1.33		0.053	0.110	0.170	0.317
0.27	TM			7.80	19.3	51.0	15.0	81.3	0.92	0.11	1.00		0.005	0.040	0.070	0.123
0.55	TC			7.93	117.3	189.3	143.3	151.3	0.72	0.43	2.17		0.022	0.187	1.023	1.667
0.91	FM			7.80	48.3	86.7	222.3	81.7	0.61	0.22	0.93		0.019	0.247	0.153	0.337
0.58	FW			7.10	134.3	296.7	47.0	105.0	1.19	0.50	2.13		0.014	0.220	0.250	0.363
0.508	**AVERAGE :**			**7.73**	**68.6**	**144.7**	**119.3**	**96.0**	**0.83**	**0.30**	**1.51**		**0.024**	**0.161**	**0.333**	**0.561**
0.275	**STD DEV - Sample :**			**0.54**	**105.8**	**151.6**	**95.2**	**51.8**	**0.50**	**0.20**	**0.77**		**0.018**	**0.097**	**0.430**	**0.663**
0.23		Lowest value :		6.7	8	32	1	38	0.32	0.05	0.3		0.005	0.020	0.040	0.090
----		Second highest :		8.4	270	250	281	157	1.60	0.64	2.7		0.054	0.340	0.910	1.500
0.91		Highest value :		8.7	370	650	285	225	1.60	0.67	3.0		0.064	0.350	1.600	2.500

TABLE A-4

Summary of USGS Report (1994) for 15 Storm Events in Nashville

Nashville USGS Report: 1990-1992				pH	BOD	COD	TSS	TDS	N+NN	NH3	TKN	TN	Pb	Zn	DP	TP
Sta.	Date	Year	Watershed	---	mg/l	mg/l	mg/l	Mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
SP	June 18	1990	Spring Cr.	8.6	13	90	----	163	0.82		0.6		0.023	0.158	0.23	0.47
SP	March 09	1992	Spring Cr.	7.5	20	76	96	67	0.43		1.3		0.032	0.170	0.15	0.48
SP	Sept. 02	1992	Spring Cr.	7.5	9	57	47	110	0.56		0.9		0.015	0.130	0.17	0.20
BR	Feb. 02	1990	Browns Cr. trib	7.4	28	228	----	178	1.00		1.8		0.065	0.326	0.14	0.20
BR	Feb. 15	1990	Browns Cr. trib	7.2	22	201	----	141	0.50		0.7		0.072	0.378	0.36	4.70
BR	Nov. 05	1990	Browns Cr. trib	----	38	162	----	139	0.70		2.4		0.043	0.301	0.46	1.90
ML	Jan. 17	1990	Mill Cr. trib	8.0	10	89	----	189	1.10		1.8		0.034	0.188	0.20	1.40
ML	Dec. 09	1991	Mill Cr. trib	7.7	5	51	109	137	1.00		0.5		0.027	0.109	0.20	0.57
ML	May 19	1992	Mill Cr. trib	7.6	26	130	82	181	1.30		1.8		0.001	0.130	0.32	1.20
WB	June 03	1992	W.Fk Browns Cr.	8.1	108	240	74	199	0.70		0.9		0.004	0.010	0.27	0.76
WB	Sept. 26	1992	W.Fk Browns Cr.	7.5	14	57	116	165	0.46		1.0		0.005	0.020	0.68	1.40
WB	Nov. 12	1992	W.Fk Browns Cr.	7.5	18	61	81	217	0.43		0.7		0.002	0.020	0.51	0.93
MC	June 18	1990	McCrory Cr.	8.4	17	108	----	198	0.50		0.9		0.043	0.139	0.27	0.77
MC	Dec. 13	1991	McCrory Cr.	7.9	250	260	215	269	0.71		0.7		0.008	0.040	0.15	1.20
MC	June 18	1992	McCrory Cr.	7.1	23	84	592	171	0.60		1.2		0.001	0.100	0.15	1.20
Area	**Sta.**	**Watershed**														
1.02	SP	Commercial / Resid		7.87	14.0	74.3	71.5	113.3	0.60		0.93		0.023	0.153	0.183	0.383
0.48	BR	Industr / Commercial		7.30	29.3	197.0	----	152.7	0.73		1.63		0.060	0.335	0.320	2.267
1.17	ML	Medium Density Resid		7.77	13.7	90.0	95.5	169.0	1.13		1.37		0.021	0.142	0.240	1.057
1.51	WB	Low Density Resid		7.70	46.7	119.3	90.3	193.7	0.53		0.87		0.004	0.017	0.487	1.030
7.31	MC	Undev / Industr / Comm		7.80	96.7	150.7	403.5	212.7	0.60		0.93		0.017	0.093	0.190	1.057
2.30	**AVERAGE :**			**7.71**	**40.1**	**126.3**	**156.9**	**168.3**	**0.72**		**1.15**		**0.025**	**0.148**	**0.284**	**1.159**
2.83	**STD DEV - Sample :**			**0.43**	**63.0**	**73.2**	**169.8**	**47.3**	**0.27**		**0.56**		**0.023**	**0.113**	**0.158**	**1.092**
0.48	Lowest value :			7.1	5	51	47	67	0.43		0.5		0.001	0.010	0.14	0.20
----	Second highest :			8.4	108	240	215	217	1.10		1.8		0.065	0.326	0.51	1.90
7.31	Highest value :			8.6	250	260	592	269	1.30		2.4		0.072	0.378	0.68	4.70

A.4 REVIEW OF EMC FORMULAS

Event mean concentration (EMC) is defined as the total pollutant mass discharge divided by the total runoff volume for a given storm event. It is computed by selective laboratory analysis of many samples taken during the storm event. The proportion of each sample that makes up the composite laboratory sample cannot be determined until after the storm event is over. Based on estimated flow volumes during the storm (from a predetermined flow-discharge curve), the composite sample is mixed and then tested.

The distribution of EMC values is based on a normal probability distribution of the natural logarithms (the log-normal distribution does not permit negative values). Since the mean value can be highly influenced by an extremely high value, the median value is typically used as the measure of central tendency. The following equations are used on EMC values from the individual storm events. After taking the natural logarithms (X_i) for each of "N" observations, the following statistical transformations are performed:

Mean	$M = (X_i)/N$	(mean of the natural logarithms)
Standard deviation	$S = [(Xi - M)_2 / (N-1)]^{0.5}$	(sample std dev : N < 50 typically)
Coefficient of variation	$C = S / M$	
Median	$m = M / (1+C^2)^{0.5}$	(median computed from log-mean)
Expected value	$X_{EXP} = \exp (M+ZS)$	

where: **M** = natural logarithm of mean value of the EMC observations

Xi = natural logarithm of an individual EMC observation

N = number of EMC observations

S = standard deviation of the natural logarithms of the EMC observations

C = coefficient of variation of the natural logarithms of the EMC observations **m** = median value of the natural logarithms of the EMC observations **Z** = standard normal probability deviate to compute expected values

$\mathbf{X_{EXP}}$ = expected actual value (not a logarithm) based on normal probability curve

The following values for Z (standard normal probability deviate) are typically used:

Values for 25% and 75% limits:	± 0.674 standard deviations
Values for 10% and 90% limits:	± 1.282 standard deviations
Values for 5 % and 95% limits:	± 1.645 standard deviations

The total pollutant loading for a given pollutant over a single type of land use can be estimated using the following equation:

Pollutant loading $L = 0.22661 * EMC * (0.15 + 0.80 I_F) * P * A$

where: **L** = pollution loading for a specific pollutant on a single land use, pounds

EMC = event mean concentration for a specific pollutant, mg/l I_F = fraction of impervious area

P = Precipitation (rainfall), inches
A = Area of watershed, acres
0.22661 = conversion factor from *"mg-inch-acre per liter"* into *"pounds"*

Pervious areas are considered to have a runoff coefficient of 0.15, and impervious areas have a runoff coefficient of 0.95 under all conditions. The term $(0.15 + 0.80\ I_F) * P * A$ represents the stormwater runoff and will be further discussed in Section A.7.

Total pollutant loading for a specific pollutant is the sum of the pollutant loadings from each type of land use in the watershed. EMC can be either the average value (which is interpreted as being the 50% exceedance level) or a different probability value computed from a standard log-normal probability curve.

According to Debo/Reese (1995):
EMC's also did not vary with storm volume. That is, over experienced storm depths or duration the mean concentration of the pollutant over the storm event did not vary significantly with runoff volume. What this implies, and what has been shown by various authors, is that the total volume of pollution (as opposed to the concentration) will vary directly with the volume of runoff. And since the volume of runoff varies directly with the amount of impervious area, the total pollution volume varies directly with impervious area.

A.5 OVERVIEW OF NPDES STORMWATER MONITORING DATA (1997-2001)

The NPDES permit issued in 1996 required the City of Knoxville to establish a wet weather monitoring program for stormwater pollutants. The City of Knoxville established five sampling stations by January 1997 at locations selected as representative homogeneous watersheds. The five sampling stations were installed in locations with favorable channel characteristics for estimating flows and water depths. Standardized equipment includes: Teledyne ISCO 4150 Data Logger with low profile Velocity Probe, 3700 Automatic Sampling Unit, 674 Tipping Bucket Rain Gauge, AC power or 12 volt Deep Cycle Marine Batteries with Solar Panel Recharging Units, Wireless Modems and Accessory's.
Results from the sampling stations have demonstrated that there is less variability in the concentration of stormwater pollutants per land use than previously suspected. A couple sampling stations have been periodically relocated in the attempt to verify these observations, with the permission of TDEC - Water Pollution Control. A partial explanation is that the Knoxville stream watersheds have multiple land uses at locations which are suitable for sampling.

Wet weather sampling involved a total of 104 sampled storms, taken from 8 locations on a total of 54 different days. Table A-5 gives the breakdown of the sampled storms with respect to location and the season of the year. The seasons are defined in this appendix as:

Winter	Quarter 01	January 1 to March 31
Spring	Quarter 02	April 1 to June 30
Summer	Quarter 03	July 1 to September 30
Fall	Quarter 04	October 1 to December 31

A total of 13 stormwater pollutant parameters were included in the routine sampling. All testing was done as composite samples based on the peak flow of each rain event. The parameter "Total phenols" was dropped from the routine laboratory analysis in June 1999, since it is generally below detection limits.

TABLE A-5
Number of Sampled Storms During the 5-Year NPDES Time Period

Location of sampling stations (with abbreviation)	2004		2005				2006				2007				2008				2009		TOTAL
	Quarter 03	Quarter 04	Quarter 01	Quarter 02	Quarter 03	Quarter 04	Quarter 01	Quarter 02	Quarter 03	Quarter 04	Quarter 01	Quarter 02	Quarter 03	Quarter 04	Quarter 01	Quarter 02	Quarter 03	Quarter 04	Quarter 01	Quarter 02	
Fourth Creek (AP)	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	0	0	0	0	17
First Creek (KAT)	0	0	0	0	2	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	18
Love Creek (LC)	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	19
Williams Creek (WC)	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	16
Fourth Creek (WD)	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	21
First Creek (FC)	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Second Creek (SC)	0	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Third Creek (TC)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	2	5
TOTAL	4	6	5	5	6	6	5	5	5	5	5	5	5	5	5	5	5	5	6	6	104
Different # of storm dates each quarter:	4	4	4	3	3	2	2	4	3	3	3	1	4	3	3	2	1	2	2	2	54
Average # stations per storm date:	1.00	1.50	1.25	1.67	2.00	3.00	2.50	1.25	1.67	1.67	1.67	5.00	1.25	1.67	1.67	2.50	5.00	2.50	3.00	3.00	1.93

The distribution of the 104 sampled storm events is further shown in Table A-6. The average number of sampled storm events per quarter is 5.2, and the average number of sampled storm events per year is 10.75. The average number of storm events which lead to a sampled storm event, however, is computed from Table A-5 as being 20.8 (104 different storm dates divided by 5 years).

The three driest months, according to 30-year normals given for UT-Knoxville and for the Knoxville airport (1961-1990), are typically the months of October, September and August (Quarters 03 and 04). Therefore the distribution in Table A-6 seems reasonable.

TABLE A-6
Distribution of Sampled Storm Events

Years	Quarter	# Storms	# storms / quarter	Year	# storms / year
(5)	01 - Winter	26	5.2	2005	12
(5)	02 - Spring	26	5.2	2006	12
(5)	03 - Summer	24	4.8	2007	11
(5)	04 - Fall	28	5.6	2008	8
TOTAL		104	**104 / 20 = 5.2**	-----	**43 / 4 = 10.75**

The individual storm data for the 104 sampled storms in Knoxville is given within Table A-7 on pages A-13 through A-18. This information has been compiled by the City of Knoxville on Excel spreadsheets for each NPDES Annual Report. In addition, the City of Knoxville also keeps the original laboratory analysis reports and other data as part of the permanent records.

Statistical analysis will be performed in Section A.6 to determine if there are seasonal variations for pollutant EMC values. In addition, the coefficient of variation (CV) will be computed to see trends and variations. However, the value of CV is generally not needed to estimate the seasonal and annual pollutant loads.

TABLE A-7
EMC Values For Individual Storm Events

Acker Place (AP)			Rain	pH	BOD	COD	TSS	TDS	N+NN	NH_3	TKN	TN	Pb	Zn	TP	PO_4
Storm event data			inches	----	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Qtr.	Year	Sample														
3	2004	AP082304	0.09	6.0	4.0	11.35	315	59	0.17	<.10	0.52	0.52	0.010	0.145	0.180	-
4	2004	AP110404	0.97	6.0	2.0	21.3	69	100	0.29	0.10	0.45	0.35	0.004	0.079	0.113	-
1	2005	AP020805	0.20	6.5	8.0	<10.0	32	136	0.86	0.23	0.53	0.30	0.003	0.107	0.600	-
2	2005	AP040805	0.44	7.0	<5.0	40.0	42	100	0.56	0.25	0.66	<0.10	<0.005	0	<0.10	0.11
3	2005	AP081905	0.35	7.5	<5.0	32.0	23	90	0.45	<.10	<.10	<0.10	<0.005	0.083	<0.10	<0.025
4	2005	AP112805	0.62	7.0	<5.0	42.0	76	110	<0.10	0.42	<.10	<0.10	<0.005	0.130	0.013	<0.025
4	2005	AP121605	0.83	6.0	<5.0	<10.0	55	34	0.18	<.10	<.10	<0.10	<0.005	0.098	<0.10	0.027
1	2006	AP012306	0.08	6.0	<5.0	<10.0	83	62	<0.10	<.10	<.10	<0.10	0.0065	0.220	0.220	<0.025
2	2006	AP042606	0.56	7.0	9.6	31	60	70	0.60	<.10	0.51	0.51	<0.005	0.170	<0.10	0.035
3	2006	AP083106	1.19	7.0	<5.0	32.0	120	40	0.25	0.26	0.50	<0.10	0.0110	0.220	<0.10	<0.025
4	2006	AP101206	0.10	7.0	<5.0	23	20	130	0.49	0.12	0.58	<0.10	<0.005	0.250	0.013	0.160
1	2007	AP031607	1.09	7.0	<5.0	30	32	70	1.10	<.10	1.10	1.10	0.0084	0.086	<0.10	<0.025
2	2007	AP041107	0.82	7.0	<5.0	31	98	72	0.44	<.10	0.78	0.78	0.0073	0.170	<0.10	0.048
3	2007	AP072407	0.61	7.0	<5.0	36.0	79	130	0.40	0.30	0.59	<0.10	0.010	0.160	<0.10	<0.025
4	2007	AP102307	0.63	7.0	<5.0	<10.0	80	82	0.11	<.10	<.10	<0.10	0.006	0.120	0.100	<0.025
1	2008	AP011708	0.32	6.0	<5.0	<10.0	29	59	0.35	<.10	<.10	<0.10	<0.005	0.100	<0.10	0.049
2	2008	AP051608	0.26	6.0	<5.0	<10.0	32	89	0.27	0.15	<.10	<0.10	<0.005	0.079	<0.10	<0.025

TABLE A-7 (continued)
EMC Values For Individual Storm Events

First Creek (KAT)			Rain	pH	BOD	COD	TSS	TDS	N+NN	NH_3	TKN	TN	Pb	Zn	TP	PO_4
Storm event data			inches	----	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Qtr.	Year	Sample														
3	2005	KAT073105	0.27	6.5	14	34	130	130	0.89	<.10	<.10	<0.10	0.012	0.076	<0.10	<0.025
3	2005	KAT081805	0.27	7.0	<5.0	<10.0	61	220	1.10	<.10	<.10	<0.10	<0.005	<0.030	<0.10	<0.025
4	2005	KAT121506	0.67	6.5	14	<10.0	77	190	0.63	<.10	0.58	0.58	0.0065	0.058	0.15	0.029
1	2006	KAT013006	0.24	7.0	11	<10.0	36	190	1.20	<.10	<.10	<0.10	<0.005	0.13	0.23	<0.025
2	2006	KAT051206	0.11	7.0	<5.0	<10.0	9	220	1.20	<.10	<.10	<0.10	<0.005	<0.030	<0.10	<0.025
3	2006	KAT081006	1.39	7.0	12	26	380	70	0.69	0.22	1.80	1.60	0.047	0.290	0.54	0.031
4	2006	KAT110206	0.97	7.0	5.1	<10.0	140	200	1.10	<.10	0.59	0.59	0.025	0.057	0.23	0.160
1	2007	KAT021407	0.17	7.0	<5.0	<10.0	23	210	1.00	<.10	<.10	<0.10	0.013	0.040	<0.10	0.046
2	2007	KAT041107	0.81	7.0	5.1	27	210	180	0.66	<.10	1.60	1.60	0.027	0.130	0.34	<0.025
3	2007	KAT070607	0.26	8.0	<5.0	33	59	240	0.84	0.20	0.63	0.71	<0.005	0.047	0.14	<0.025
4	2007	KAT101907	0.37	7.5	6	<10.0	64	160	0.70	0.22	0.69	<0.10	0.016	0.075	0.17	0.041
1	2008	KAT010908	0.19	6.5	<5.0	<10.0	24	200	0.72	<.10	<.10	<0.10	<0.005	<0.030	0.12	<0.025
2	2008	KAT050908	0.37	7.0	<5.0	<10.0	82	200	0.86	<.10	0.85	0.85	0.0069	0.035	<0.10	0.038
3	2008	KAT072208	0.39	6.0	9.0	89	230	140	0.50	<.10	1.80	1.80	0.026	0.130	0.46	0.05
4	2008	KAT100808	0.79	7.0	5.4	<10.0	82	160	0.51	<.10	<.10	<0.10	0.009	0.077	<0.10	0.22
1	2009	KAT012809	0.57	7.0	<5.0	43	54	240	1.30	<.10	0.97	0.97	0.007	0.046	<0.10	0.14
1	2009	KAT012709	0.57	6.0	<5.0	32	42	180	1.10	<.10	0.84	0.84	0.0067	0.073	<0.10	0.17
2	2009	KAT042009	0.46	7.5	<5.0	<10.0	9.9	230	1.10	<.10	0.40	0.40	<0.005	<0.030	<0.10	<0.025

TABLE A-7 (continued)
EMC Values For Individual Storm Events

Love Creek (LC)			Rain	pH	BOD	COD	TSS	TDS	N+NN	NH_3	TKN	TN	Pb	Zn	TP	PO_4
Storm event data			Inches	----	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Qtr.	Year	Sample														
3	2004	LC101304	0.92	7.0	6	15.9	175	195	0.84	<.10	0.64	0.64	0.011	0.054	0.093	-
1	2005	LC031405	0.17	6.5	<5.0	11.0	26	264	1.40	<.10	0.2	0.2	0.001	0.018	<0.10	-
2	2005	LC041305	0.69	6.5	<5.0	25	78	170	0.91	0.3	0.94	0.65	<0.005	<0.030	<0.10	-
3	2005	LC081905	0.34	8.0	<5.0	28	66	210	1.0	<.10	<.10	<0.10	<0.005	<0.030	<0.10	0.044
4	2005	LC121505	0.83	6.5	<5.0	<10.0	31	170	0.63	<.10	<.10	<0.10	<0.005	0.041	<0.10	0.055
1	2006	LC013006	0.25	6.5	<5.0	<10.0	10	240	1.40	<.10	<.10	<0.10	<0.005	0.11	0.32	<0.025
2	2006	LC052206	0.85	7.0	<5.0	57	160	140	0.85	<.10	<.10	<0.10	0.013	0.087	0.21	0.078
3	2006	LC070506	0.91	7.0	6.4	31	110	150	0.82	0.18	0.61	<0.10	0.012	0.062	<0.10	0.048
4	2006	LC110106	0.97	7.0	<5.0	<10.0	76	140	0.51	<.10	<.10	<0.10	0.013	0.039	0.13	0.073
1	2007	LC010507	0.18	7.0	<5.0	<10.0	10	250	1.10	<.10	0.56	0.56	0.0052	0.170	<0.10	0.035
2	2007	LC041107	0.74	7.0	<5.0	28	73	180	0.88	<.10	1.10	1.10	0.0084	0.055	0.12	0.034
3	2007	LC071807	0.09	8.5	<5.0	<10.0	13	300	0.93	<.10	<.10	<0.10	<0.005	0.031	<0.10	<0.025
4	2007	LC101907	0.34	7.5	5.0	<10.0	79	230	0.75	<.10	<.10	<0.10	0.0088	0.051	0.12	<0.025
1	2008	LC012908	0.35	7.0	5.4	<10.0	60	260	1.20	<.10	0.75	0.75	0.0087	0.041	<0.10	<0.025
2	2008	LC050908	0.55	7.0	9.1	26	120	260	0.92	<.10	2.40	2.40	0.0190	0.076	0.19	0.028
3	2008	LC072208	0.84	7.0	6.4	43	95	210	0.77	0.81	1.30	<0.10	0.011	0.22	0.12	<0.025
4	2008	LC100908	0.74	7.0	<5.0	<10.0	62	190	0.60	<.10	0.71	0.71	<0.005	0.065	<0.10	0.29
1	2009	LC012809	0.65	7.0	<5.0	32	56	230	1.10	<.10	1.10	1.10	0.0084	0.046	<0.10	0.260
2	2009	LC042009	0.55	7.5	<5.0	<10.0	11	250	1.10	<.10	0.61	0.61	<0.005	<0.030	<0.10	<0.025

TABLE A-7 (continued)
EMC Values For Individual Storm Events

Williams Creek (WC)			Rain	pH	BOD	COD	TSS	TDS	N+NN	NH_3	TKN	TN	Pb	Zn	TP	PO_4
Storm event data			inches	----	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Qtr.	Year	Sample														
3	2005	WC091605	0.69	7.0	<5.0	<10.0	3.6	280	1.40	<.10	<.10	<0.10	<0.005	0.031	<0.10	0.04
4	2005	WC122905	0.19	7.0	<5.0	26	16	160	0.86	<.10	<.10	<0.10	<0.005	<0.030	1.40	<0.025
1	2006	WC012306	0.28	7.0	<5.0	32	45	100	0.47	<.10	<.10	<0.10	0.0081	0.051	0.13	0.063
2	2006	WC050806	0.18	7.0	<5.0	<10.0	14	190	1.4	0.16	<.10	<0.10	<0.005	<0.030	<0.10	<0.025
3	2006	WC070606	0.95	7.0	9.0	43.0	22	150	0.88	<.10	<.10	<0.10	0.0057	0.038	<0.10	0.038
4	2006	WC110806	1.36	7.0	<5.0	25	21	140	0.49	<.10	0.82	0.82	<0.005	<0.030	<0.10	0.051
1	2007	WC010507	0.20	7.5	8.6	31.0	37	150	0.84	<.10	0.59	0.59	0.0064	0.042	<0.10	0.090
2	2007	WC041107	0.73	7.0	7.6	34.0	67	130	0.60	<.10	1.40	1.40	0.0160	0.069	0.25	0.041
3	2007	WC072407	0.51	7.0	<5.0	28.0	19	210	0.90	<.10	0.74	0.74	0.0064	0.044	<0.10	<0.025
4	2007	WC101907	0.30	7.0	7.0	23.0	69	110	0.74	<.10	0.85	0.85	0.0130	0.054	0.16	<0.025
1	2008	WC010908	0.23	6.5	8.0	<10.0	28	180	0.70	<.10	<.10	<0.10	<0.005	<0.030	<0.10	<0.025
2	2008	WC050908	0.48	7.0	<5.0	<10.0	12	170	1.10	<.10	0.56	0.56	<0.005	<0.030	<0.10	0.070
3	2008	WC072208	0.24	6.0	15	48.0	120	160	0.53	<.10	1.80	1.80	0.0210	0.160	0.24	<0.025
4	2008	WC100808	0.89	6.5	<5.0	<10.0	51	140	0.59	<.10	0.70	0.70	0.0088	0.060	<0.10	0.10
1	2009	WC012709	0.54	6.0	<5.0	33.0	48	150	1.00	0.15	3.40	3.20	0.0150	0.053	<0.10	0.20
2	2009	WC042009	0.59	7.5	<5.0	<10.0	26	230	1.10	0.12	0.97	0.85	0.0067	0.100	0.14	<0.025

TABLE A-7 (continued)
EMC Values For Individual Storm Events

Walden Drive (WD)			Rain	pH	BOD	COD	TSS	TDS	N+NN	NH_3	TKN	TN	Pb	Zn	TP	PO_4
Storm event data			inches	----	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Qtr.	Year	Sample														
3	2004	WD072604	1.48	7.7	7	23.42	407	132	0.74	<.10	0.22	0.22	0.021	0.138	0.08	-
4	2004	WD101404	1.17	6.0	4	7.99	194	124	0.42	<.10	0.21	0.21	0.010	0.091	0.059	-
4	2004	WD102804	0.71	7.0	6	14.0	174	128	0.71	<.10	0.97	0.97	0.009	0.083	0.217	-
1	2005	WD022105	1.35	6.0	4	8.60	116	107	0.48	<.10	0.20	0.20	0.006	0.064	0.06	-
2	2005	WD040805	0.34	7.0	<5.0	88	51	180	0.99	<.10	<.10	<0.10	<0.005	<0.030	<0.10	0.043
3	2005	WD081805	0.28	7.0	<5.0	22.0	37	170	0.72	<.10	0.58	0.58	<0.005	0.044	0.10	<0.025
4	2005	WD121505	0.59	-	20	49	210	120	0.39	0.33	1.10	0.77	0.015	0.14	<0.10	<0.025
1	2006	WD013006	0.25	6.0	5.4	34.0	68	120	0.62	<.10	<.10	<0.10	<0.005	0.16	0.17	0.084
2	2006	WD042606	0.18	7.0	<5.0	<10.0	26	180	0.99	<.10	0.52	0.52	<0.005	0.051	<0.10	<0.025
3	2006	WD070706	2.43	7.0	8.0	63.0	430	110	0.45	<.10	1.90	1.90	0.027	0.21	0.22	<0.025
4	2006	WD110806	0.94	7.0	<5.0	27.0	150	130	0.35	0.31	0.80	<0.10	<0.005	0.230	0.22	<0.025
1	2007	WD010507	0.22	7.5	<5.0	29.0	52	140	<0.10	<.10	0.64	0.64	<0.005	0.190	<0.10	0.081
2	2007	WD041207	0.72	7.0	<5.0	23.0	200	100	0.48	<.10	0.97	0.97	0.019	0.120	0.25	<0.025
3	2007	WD071107	0.14	8.0	<5.0	29.0	63	230	0.69	<.10	<.10	<0.10	<0.005	0.066	0.19	0.100
4	2007	WD100407	0.20	8.0	8.0	39.0	72	180	0.86	0.22	1.30	1.10	<0.005	0.084	<0.10	<0.025
1	2008	WD010908	0.19	7.0	<5.0	<10.0	170	160	0.46	<.10	0.54	0.54	0.0083	0.120	0.19	<0.025
2	2008	WD050908	0.47	7.0	9.2	38.0	110	180	0.94	0.12	1.60	1.50	0.0082	0..87	0.15	<0.025
3	2008	WD072208	0.16	6.0	<5.0	66	270	150	0.60	0.38	1.40	1.40	0.015	0.200	0.25	<0.025
4	2008	WD100908	0.77	6.0	<5.0	<10.0	130	89	0.24	<.10	0.78	0.78	0.008	0.120	<0.10	0.68
1	2009	WD012709	0.51	5.5	<5.0	30.0	160	200	0.82	0.19	1.30	1.10	0.017	0.140	0.10	0.22
2	2009	WD050109	0.47	6.5	10	91	240	120	0.58	0.15	2.20	2.00	0.015	0.210	0.38	<0.025

TABLE A-7 (continued)
EMC Values For Individual Storm Events

Fountain City (FC)			Rain	pH	BOD	COD	TSS	TDS	N+NN	NH_3	TKN	TN	Pb	Zn	TP	PO_4
Storm event data			inches	----	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Qtr.	Year	Sample														
3	2004	FC090804	1.82	6.5	4	16.8	61	111	0.38	<.10	0.58	0.58	0.007	0.036	0.096	-
4	2004	FC120104	1.58	6.0	4	13.30	234	90	0.164	0.04	0.75	0.71	0.017	0.064	0.241	-
1	2005	FC021405	0.75	6.0	4	16	233	167	1.1	0.03	0.24	0.21	0.021	0.088	0.01	-
2	2005	FC060705	2.68	6.5	6	53	280	120	0.82	0.32	2.00	1.7	0.023	0.10	0.91	0.063

TABLE A-7 (continued)
EMC Values For Individual Storm Events

Second Creek (SC)			Rain	pH	BOD	COD	TSS	TDS	N+NN	NH_3	TKN	TN	Pb	Zn	TP	PO_4
Storm event data			inches	----	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Qtr.	Year	Sample														
4	2004	SC101304	1.12	6.5	9	17.7	122	120	0.25	<.10	0.32	0.32	0.033	0.129	0.095	-
4	2004	SC110404	0.92	7.0	6	14.5	100	131	0.31	0.26	0.74	0.48	0.041	0.142	0.202	-
1	2005	SC021405	0.33	6.0	5	12	48	149	0.83	0.05	0.35	0.3	0.018	0.086	0.09	-
2	2005	SC040805	0.25	7.0	<5.0	88	26	190	1.20	0.3	<.10	<0.10	<0.005	0.066	<0.10	0.034

					TABLE A-7 (continued)											
					EMC Values For Individual Storm Events											
Third Creek (TC)			Rain	pH	BOD	COD	TSS	TDS	N+NN	NH_3	TKN	TN	Pb	Zn	TP	PO_4
Storm event data			inches	----	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Qtr.	Year	Sample														
3	2008	TC072208	0.88	6.0	9.6	130	440	130	0.48	<.10	1.90	1.90	0.037	0.19	0.44	<0.025
4	2008	TC100808	0.88	7.0	6.1	<10.0	140	150	0.57	<.10	0.80	0.80	0.024	0.20	<0.10	0.260
1	2009	TC012709	0.56	5.5	5.0	39.0	57	340	1.10	0.13	1.10	1.00	0.011	0.12	<0.10	0.210
2	2009	TC042009	0.52	7.5	10.0	28.0	48	190	0.90	<.10	0.74	0.74	0.0072	0.21	0.11	<0.025
2	2009	TC050109	0.67	6.5	17.0	41.0	0.5	166	0.96	0.46	1.80	1.30	0.0084	0.074	0.25	<0.025

A.6 STATISTICAL COMPUTATIONS FOR EMC VALUES

Statistical analysis will be performed in Section A.6 to determine if there are seasonal variations for pollutant EMC values. In addition, the coefficient of variation (CV) will be computed to see trends and variations. However, the value of CV is generally not needed to estimate the seasonal and annual pollutant loads.

Any values which were not measured or recorded are shown as "-". Of the 1456 values in the data matrix (104 x 14), there are a total of 17 unknown values; 1.17% of the values. All unrecorded values were Ortho Phosphate (PO4) except for one pH.

The values for NH_3 (which is the amount of total ammonia expressed as mg/l of nitrogen) were below the 0.10 mg/l threshold limits of detection approximately 73% of the time. Although a mean value for EMC and CV is computed, the analysis is generally unproductive.

Values listed on Table A-8 were taken from Table 6.2.4 (Estimated Runoff from Major Watersheds within the MS4). Table A-8 contains the overall watershed descriptions for the eight monitoring stations. The original land uses were chosen to be representative of homogeneous land uses within the City of Knoxville, subject to the needs of a monitoring station. Monitoring stations must have sufficient drainage area in order to provide mixed sampling volumes, allow estimation of flow depths and flows, and delineation of begin-to-end for storm events. Three monitoring stations were relocated during this five year permit cycle. New locations are located near the mouth of the creeks and support NPDES monitoring guidelines and requirements; they include: Williams Creek, First Creek (KAT) and Third Creek.

TABLE A-8 Watershed Descriptions for Monitoring Stations								
Monitoring Station	**AP**	**KAT**	**LC**	**WC**	**WD**	**FC**	**SC**	**TC**
Predominant Land Use	Commercial	Residential	Mixed	Residential	Mixed	Residential	Mixed	Mixed
Contributing Area (1000 acres)	6.77	7.75	6.41	1.64	6.77	7.75	4.50	8.42
Overall % impervious	41	44	36	37	41	44	53	37

Table A-9 summarizes the rainfall data over the NPDES sampling period. Each monitoring station has a rain gauge, and the daily rainfall amounts are compared with the reported rainfall amounts at McGhee-Tyson Airport. In most cases, there is very good agreement for the rainfall amounts at the monitoring stations and the airport.

TABLE A-9 Quarterly Rainfall Amounts for Knoxville					
Quarter	1	2	3	4	Annual total
(Season)	(Winter)	(Spring)	(Summer)	(Fall)	
Months	Jan - Mar	Apr - June	July - Sept	Oct - Dec	
2004	-----	-----	14.30	14.93	-----
2005	9.46	11.53	8.14	6.42	35.55
2006	9.13	9.01	16.27	9.17	43.58
2007	5.46	6.64	7.13	7.49	26.72
2008	11.64	8.98	8.86	12.51	41.99
2009	11.60	14.27	-----	-----	-----
Average	**9.46**	**10.09**	**10.94**	**10.10**	**40.59**
	(inches)	(inches)	(inches)	(inches)	(inches)

Tables A-10 through A-14 contains analysis for the five monitoring stations with a minimum of three years of data. This data provides the best opportunity to spot seasonal trends and variations. Overall, there doesn't appear to be too much difference in mean EMC values with respect to location for the various monitoring stations. Table A-15 contains analysis for the other four monitoring stations with shorter amounts of data. Table A- 16 contains an overall summary (taken from Tables A-10 through A-15) for mean EMC values. This will be the basis for choosing pollutant EMC values for the WMM analysis in Section A.8 for the individual watersheds.

Figures A-1 through A- 13 show the seasonal variation for the five monitoring stations with a minimum of three years of data. The following distribution of the various samples may be helpful in interpreting the trends within the figures:

Quarters:	1	2	3	4	Overall
AP, LC, KAT, WC, WD	23	22	23	23	91 samples
All 8 monitoring stations	26	26	25	27	104 samples

In connection with the rainfall amounts in Table A-9, there is more opportunity to regularly wash pollutants in Quarters 1 and 2, therefore the pollutant EMC values are likely to be lower. Pollutant EMC values are likely to be higher when there is less total rainfall (Quarters 3 and 4).

Figures A-14 through A-17 show the overall EMC values based on the predominant land use; the values are taken from Table A-16.

TABLE A-10
Statistical Analysis For Acker Place Monitoring Station (AP)

MEAN EMC			Rain Inches	pH -----	BOD mg/l	COD mg/l	TSS mg/l	TDS mg/l	N+NN mg/l	NH_3 mg/l	TKN mg/l	TN mg/l	Pb mg/l	Zn mg/l	TP mg/l	PO_4 mg/l
			Detectable Limit:		5.0	10.0	1	10	0.10	0.10	0.10	0.10	0.0050	0.030	0.100	0.025
Qtr	Year	#	MEAN		MEAN EMC for individual Quarters											
1	2005	1	0.20	6.5	8.0	10.0	32	136	0.86	0.23	0.53	0.30	0.0030	0.107	0.600	0.025
1	2006	1	0.08	6.0	5.0	10.0	83	62	0.10	0.10	0.10	0.10	0.0065	0.220	0.220	0.025
1	2007	1	1.09	7.0	5.0	30.0	32	70	1.10	0.10	1.10	1.10	0.0084	0.086	0.100	0.025
1	2008	1	0.32	6.0	5.0	10.0	29	59	0.35	0.10	0.10	0.10	0.0050	0.100	0.100	0.049
2	2005	1	0.44	7.0	5.0	40.0	42	100	0.56	0.25	0.66	0.10	0.0050	0.030	0.100	0.110
2	2006	1	0.56	7.0	9.6	31.0	60	70	0.60	0.10	0.51	0.51	0.0050	0.170	0.100	0.035
2	2007	1	0.82	7.0	5.0	31.0	98	72	0.44	0.10	0.78	0.78	0.0073	0.170	0.100	0.048
2	2008	1	0.26	6.0	5.0	10.0	32	89	0.27	0.15	0.10	0.10	0.0050	0.079	0.100	0.025
3	2004 *	1	0.09	6.0	4.0	11.4	315	59	0.17	0.10	0.52	0.52	0.0100	0.145	0.180	0.025
3	2005	1	0.35	7.5	5.0	32.0	23	90	0.45	0.10	0.10	0.10	0.0050	0.083	0.100	0.025
3	2006	1	1.19	7.0	5.0	32.0	120	40	0.25	0.26	0.50	0.10	0.0110	0.220	0.100	0.025
3	2007	1	0.61	7.0	5.0	36.0	79	130	0.40	0.30	0.59	0.10	0.0100	0.160	0.100	0.025
4	2004 *	1	0.97	6.0	2.0	21.3	69	100	0.29	0.10	0.45	0.35	0.0040	0.079	0.113	0.025
4	2005	1	0.62	7.0	5.0	42.0	76	110	0.10	0.42	0.10	0.10	0.0050	0.130	0.013	0.025
4	2005	1	0.83	6.0	5.0	10.0	55	34	0.18	0.10	0.10	0.10	0.0050	0.098	0.100	0.027
4	2006	1	0.10	7.0	5.0	23.0	20	130	0.49	0.12	0.58	0.10	0.0050	0.250	0.013	0.160
4	2007	1	0.63	7.0	5.0	10.0	80	82	0.11	0.10	0.10	0.10	0.0060	0.120	0.100	0.025

MEAN EMC			Rain Inches	pH -----	BOD mg/l	COD mg/l	TSS mg/l	TDS mg/l	N+NN mg/l	NH_3 mg/l	TKN mg/l	TN mg/l	Pb mg/l	Zn mg/l	TP mg/l	PO_4 mg/l
Qtr	#		MEAN		MEAN EMC by Quarter											
1	4		0.42	6.4	5.8	15.0	44.0	81.8	0.60	0.13	0.46	0.40	0.0057	0.128	0.255	0.031
2	4		0.52	6.8	6.2	28.0	58.0	82.8	0.47	0.15	0.51	0.37	0.0056	0.112	0.100	0.055
3	4		0.56	6.9	4.8	27.8	134.3	79.8	0.32	0.19	0.43	0.21	0.0090	0.152	0.120	0.025
4	5		0.63	6.6	4.4	21.3	60.0	91.2	0.23	0.17	0.27	0.15	0.0050	0.135	0.068	0.052
Year	#		MEAN		MEAN EMC by Year											
2004	2		0.53	6.0	3.0	16.3	192.0	79.5	0.23	0.10	0.49	0.44	0.0070	0.112	0.147	0.025
2005	5		0.49	6.8	5.6	26.8	45.6	94.0	0.43	0.22	0.30	0.14	0.0046	0.090	0.183	0.042
2006	4		0.48	6.8	6.2	24.0	70.8	75.5	0.36	0.15	0.42	0.20	0.0069	0.215	0.108	0.061
2007	4		0.79	7.0	5.0	26.8	72.3	88.5	0.51	0.15	0.64	0.52	0.0079	0.134	0.100	0.031
2008	2		0.29	6.0	5.0	10.0	30.5	74.0	0.31	0.13	0.10	0.10	0.0050	0.090	0.100	0.037
Total	**17**	**Overall**	**0.54**	**6.6**	***5.2***	***22.9***	**73.2**	**84.3**	***0.40***	***0.16***	***0.41***	***0.27***	***0.006***	***0.132***	***0.132***	***0.041***
Lowest EMC value:			0.08	6.0	2.0	10.0	20.0	34.0	0.10	0.10	0.10	0.10	0.0030	0.030	0.013	0.025
Median EMC value			0.56	7.0	5.0	23.0	60.0	82.0	0.35	0.10	0.50	0.10	0.0050	0.120	0.100	0.025
Highest EMC value:			1.19	7.5	9.6	42.0	315.0	136.0	1.10	0.42	1.10	1.10	0.0110	0.250	0.600	0.160
Qtr					COEFFICIENT OF VARIATION by Quarter											
1			1.08	0.08	0.26	0.67	0.59	0.45	0.76	0.49	1.04	1.19	0.40	0.48	0.93	0.39
2			0.45	0.07	0.37	0.45	0.50	0.17	0.32	0.47	0.58	0.90	0.21	0.62	0.00	0.70
3			0.84	0.09	0.11	0.40	0.95	0.49	0.41	0.55	0.52	1.02	0.30	0.37	0.33	0.00
4			0.52	0.08	0.30	0.62	0.41	0.40	0.69	0.84	0.87	0.75	0.14	0.50	0.74	1.15
Year					COEFFICIENT OF VARIATION by Year											
2004			1.17	0.00	0.47	0.43	0.91	0.36	0.37	0.00	0.10	0.28	0.61	0.42	0.32	0.00
2005			0.50	0.08	0.24	0.59	0.45	0.40	0.71	0.60	0.92	0.64	0.19	0.42	1.29	0.89
2006			1.08	0.07	0.37	0.42	0.59	0.51	0.63	0.53	0.52	1.01	0.41	0.15	0.79	1.08
2007			0.28	0.00	0.00	0.43	0.39	0.32	0.82	0.67	0.65	0.97	0.21	0.29	0.00	0.37
2008			0.15	0.00	0.00	0.00	0.07	0.29	0.18	0.28	0.00	0.00	0.00	0.17	0.00	0.46
Total	**17**	**Overall**	**0.65**	**0.08**	***0.30***	***0.52***	**0.94**	**0.36**	***0.69***	***0.60***	***0.74***	***1.08***	***0.37***	***0.45***	***0.98***	***0.90***

* Lab procedures were changed starting in 2005, therefore BDL values vary from test results reported in 2004.

Note: Actual BDL values were used to determine totals, the true values are actually less than the overall totals.

TABLE A-11
Statistical Analysis For First Creek Monitoring Station (KAT)

MEAN EMC			Rain Inches	pH -----	BOD mg/l	COD mg/l	TSS mg/l	TDS mg/l	N+NN mg/l	NH_3 mg/l	TKN mg/l	TN mg/l	Pb mg/l	Zn mg/l	TP mg/l	PO_4 mg/l
		Detectable Limit:	5.0	10.0	1	10	0.10	0.10	0.10	0.10	0.0050	0.030	0.100	0.025
Qtr	Year	#	MEAN		MEAN EMC for individual Quarters											
1	2006	1	0.24	7.0	11.0	10.0	36	190	1.20	0.10	0.10	0.10	0.0050	0.130	0.230	0.100
1	2007	1	0.17	7.0	5.0	10.0	23	210	1.00	0.10	0.10	0.10	0.0130	0.040	0.100	0.046
1	2008	1	0.19	6.5	5.0	10.0	24	200	0.72	0.10	0.10	0.10	0.0050	0.030	0.120	0.100
1	2009	1	0.57	7.0	5.0	43.0	54	240	1.30	0.10	0.97	0.97	0.0070	0.046	0.100	0.140
1	2009	1	0.57	6.0	5.0	32.0	42	180	1.10	0.10	0.84	0.84	0.0067	0.073	0.100	0.170
2	2006	1	0.11	7.0	5.0	10.0	9	220	1.20	0.10	0.10	0.10	0.0050	0.030	0.100	0.100
2	2007	1	0.81	7.0	5.1	27.0	210	180	0.66	0.10	1.60	1.60	0.0270	0.130	0.340	0.100
2	2008	1	0.37	7.0	5.0	10.0	82	200	0.86	0.10	0.85	0.85	0.0069	0.035	0.100	0.038
2	2009	1	0.46	7.5	5.0	10.0	10	230	1.10	0.10	0.40	0.40	0.0050	0.030	0.100	0.100
3	2005	1	0.27	6.5	14.0	34.0	130	130	0.89	0.10	0.10	0.10	0.0120	0.076	0.100	0.100
3	2005	1	0.27	7.0	5.0	10.0	61	220	1.10	0.10	0.10	0.10	0.0050	0.030	0.100	0.100
3	2006	1	1.39	7.0	12.0	26.0	360	70	0.69	0.22	1.80	1.60	0.0470	0.290	0.540	0.081
3	2007	1	0.26	8.0	5.0	33.0	59	240	0.84	0.20	0.63	0.71	0.0050	0.047	0.140	0.100
3	2008	1	0.39	6.0	9.0	89.0	230	140	0.50	0.10	1.80	1.80	0.0260	0.130	0.460	0.050
4	2005	1	0.67	6.5	14.0	10.0	77	190	0.63	0.10	0.58	0.58	0.0065	0.058	0.150	0.029
4	2006	1	0.97	7.0	5.1	10.0	140	200	1.10	0.10	0.59	0.59	0.0250	0.057	0.230	0.160
4	2007	1	0.37	7.5	6.0	10.0	64	160	0.70	0.22	0.69	0.10	0.0160	0.075	0.170	0.041
4	2008	1	0.79	7.0	5.4	10.0	82	160	0.51	0.10	0.10	0.10	0.0090	0.077	0.100	0.220

MEAN EMC			Rain Inches	pH -----	BOD mg/l	COD mg/l	TSS mg/l	TDS mg/l	N+NN mg/l	NH_3 mg/l	TKN mg/l	TN mg/l	Pb mg/l	Zn mg/l	TP mg/l	PO_4 mg/l
Qtr	#		MEAN		MEAN EMC by Quarter											
1	5		0.35	6.7	6.2	21.0	35.8	204.0	1.06	0.10	0.42	0.42	0.0073	0.064	0.130	0.111
2	4		0.44	7.1	5.0	14.3	77.7	207.5	0.96	0.10	0.74	0.74	0.0110	0.056	0.160	0.085
3	5		0.52	6.9	9.0	36.4	172.0	160.0	0.80	0.14	0.89	0.86	0.0190	0.115	0.268	0.076
4	4		0.70	7.0	7.6	10.0	90.8	177.5	0.74	0.13	0.49	0.34	0.0141	0.067	0.163	0.113
Year	#		MEAN		MEAN EMC by Year											
2005	3		0.40	6.7	11.0	18.0	89.3	180.0	0.87	0.10	0.26	0.26	0.0078	0.055	0.117	0.076
2006	4		0.68	7.0	8.3	14.0	141.3	170.0	1.05	0.13	0.65	0.60	0.0205	0.127	0.275	0.098
2007	4		0.40	7.4	5.3	20.0	89.0	197.5	0.80	0.16	0.76	0.63	0.0153	0.073	0.188	0.072
2008	4		0.44	6.6	6.1	29.8	104.5	175.0	0.65	0.10	0.71	0.71	0.0117	0.068	0.195	0.102
2009	3		0.53	6.8	5.0	28.3	35.3	216.7	1.17	0.10	0.74	0.74	0.0062	0.050	0.100	0.137
Total	18	Overall	**0.49**	**6.9**	*7.0*	*21.9*	**95.2**	**186.7**	**0.89**	*0.12*	*0.64*	*0.60*	*0.0123*	*0.077*	*0.182*	*0.096*
Lowest EMC value:			0.11	6.0	5.0	10.0	9.0	70.0	0.50	0.10	0.10	0.10	0.0050	0.030	0.100	0.029
Median EMC value			0.38	7.0	5.1	10.0	62.5	195.0	0.88	0.10	0.59	0.49	0.0070	0.058	0.110	0.100
Highest EMC value:			1.39	8.0	14.0	89.0	380.0	240.0	1.30	0.22	1.80	1.80	0.0470	0.290	0.540	0.220
Qtr					COEFFICIENT OF VARIATION by Quarter											
1			0.59	0.07	0.43	0.74	0.36	0.11	0.21	0.00	1.05	1.05	0.45	0.63	0.44	0.42
2			0.66	0.04	0.01	0.60	1.22	0.11	0.25	0.00	0.88	0.88	0.98	0.88	0.75	0.37
3			0.95	0.11	0.45	0.78	0.79	0.44	0.28	0.42	0.97	0.94	0.94	0.92	0.80	0.44
4			0.36	0.06	0.56	0.00	0.37	0.12	0.35	0.46	0.54	0.82	0.59	0.16	0.33	0.83
Year					COEFFICIENT OF VARIATION by Year											
2005			0.70	0.00	0.00	0.94	0.42	0.24	0.21	0.00	1.31	1.31	0.50	0.23	0.30	0.66
2006			0.90	0.00	0.45	0.57	1.20	0.40	0.23	0.46	1.24	1.18	0.98	0.92	0.68	0.54
2007			0.70	0.06	0.09	0.59	0.93	0.18	0.19	0.41	0.82	1.13	0.60	0.56	0.56	0.46
2008			0.58	0.07	0.32	1.33	0.84	0.17	0.27	0.00	1.13	1.13	0.82	0.68	0.91	0.81
2009			0.12	0.11	0.00	0.59	0.65	0.15	0.10	0.00	0.41	0.41	0.17	0.44	0.00	0.26
Total	18	Overall	**0.67**	**0.07**	*0.48*	*0.92*	**1.00**	**0.23**	**0.28**	*0.37*	*0.93*	*0.97*	*0.89*	*0.83*	*0.73*	*0.55*

* Lab procedures were changed starting in 2005, therefore BDL values vary from test results reported in 2004.

Note: Actual BDL values were used to determine totals, the true values are actually less than the overall totals.

TABLE A-12
Statistical Analysis For Love Creek Monitoring Station (LC)

MEAN EMC			Rain Inches	pH ----	BOD mg/l	COD mg/l	TSS mg/l	TDS mg/l	N+NN mg/l	NH_3 mg/l	TKN mg/l	TN mg/l	Pb mg/l	Zn mg/l	TP mg/l	PO_4 mg/l
			Detectable Limit:		5.0	10.0	1	10	0.10	0.10	0.10	0.10	0.0050	0.030	0.100	0.025
Qtr	Year	#	MEAN		MEAN EMC for individual Quarters											
1	2005	1	0.17	6.5	5.0	11.0	26	264	1.40	0.10	0.20	0.20	0.0010	0.018	0.100	-
1	2006	1	0.25	6.5	5.0	10.0	10	240	1.40	0.10	0.10	0.10	0.0050	0.110	0.320	0.025
1	2007	1	0.18	7.0	5.0	10.0	10	250	1.10	0.10	0.56	0.56	0.0052	0.170	0.100	0.035
1	2008	1	0.35	7.0	5.4	10.0	60	260	1.20	0.10	0.75	0.75	0.0087	0.041	0.100	0.025
1	2009	1	0.65	7.0	5.0	32.0	56	230	1.10	0.10	1.10	1.10	0.0084	0.046	0.100	0.260
2	2005	1	0.69	6.5	5.0	25.0	78	170	0.91	0.30	0.94	0.65	0.0050	0.030	0.100	-
2	2006	1	0.85	7.0	5.0	57.0	160	140	0.85	0.10	0.10	0.10	0.0130	0.087	0.210	0.078
2	2007	1	0.74	7.0	5.0	28.0	73	180	0.88	0.10	1.10	1.10	0.0084	0.055	0.120	0.034
2	2008	1	0.55	7.0	9.1	26.0	120	260	0.92	0.10	2.40	2.40	0.0190	0.076	0.190	0.028
2	2009	1	0.55	7.5	5.0	10.0	11	250	1.10	0.10	0.61	0.61	0.0050	0.030	0.100	0.025
3	2004 *	1	0.92	7.0	6.0	15.9	175	195	0.84	0.10	0.64	0.64	0.0110	0.054	0.093	-
3	2005	1	0.34	8.0	5.0	28.0	66	210	1.00	0.10	0.10	0.10	0.0050	0.030	0.100	0.044
3	2006	1	0.91	7.0	6.4	31.0	110	150	0.82	0.18	0.61	0.10	0.0120	0.062	0.100	0.048
3	2007	1	0.09	8.5	5.0	10.0	13	300	0.93	0.10	0.10	0.10	0.0050	0.031	0.100	0.025
3	2008	1	0.84	7.0	6.4	43.0	95	210	0.77	0.81	1.30	0.10	0.0110	0.220	0.120	0.025
4	2005	1	0.83	6.5	5.0	10.0	31	170	0.63	0.10	0.10	0.10	0.0050	0.041	0.100	0.055
4	2006	1	0.97	7.0	5.0	10.0	76	140	0.51	0.10	0.10	0.10	0.0130	0.039	0.130	0.073
4	2007	1	0.34	7.5	5.0	10.0	79	230	0.75	0.10	0.10	0.10	0.0088	0.051	0.120	0.025
4	2008	1	0.74	7.0	5.0	10.0	62	190	0.60	0.10	0.71	0.71	0.0050	0.065	0.100	0.290

MEAN EMC			Rain Inches	pH ----	BOD mg/l	COD mg/l	TSS mg/l	TDS mg/l	N+NN mg/l	NH_3 mg/l	TKN mg/l	TN mg/l	Pb mg/l	Zn mg/l	TP mg/l	PO_4 mg/l
Qtr	#		MEAN		MEAN EMC by Quarter											
1	5		0.32	6.8	5.1	14.6	32.4	248.8	1.24	0.10	0.54	0.54	0.0057	0.077	0.144	0.086
2	5		0.68	7.0	5.8	29.2	88.4	200.0	0.93	0.14	1.03	0.97	0.0101	0.056	0.144	0.041
3	5		0.62	7.5	5.8	25.6	91.8	213.0	0.87	0.26	0.55	0.21	0.0088	0.079	0.103	0.036
4	4		0.72	7.0	5.0	10.0	62.0	182.5	0.62	0.10	0.25	0.25	0.0080	0.049	0.113	0.111
Year	#		MEAN		MEAN EMC by Year											
2004	1		0.92	7.0	6.0	15.9	175.0	195.0	0.84	0.10	0.64	0.64	0.0110	0.054	0.093	#DIV/0!
2005	4		0.51	6.9	5.0	18.5	50.3	203.5	0.99	0.15	0.34	0.26	0.0040	0.030	0.100	0.050
2006	4		0.75	6.9	5.4	27.0	89.0	167.5	0.90	0.12	0.23	0.10	0.0108	0.075	0.190	0.056
2007	4		0.34	7.5	5.0	14.5	43.8	240.0	0.92	0.10	0.47	0.47	0.0069	0.077	0.110	0.030
2008	4		0.62	7.0	6.5	22.3	84.3	230.0	0.87	0.28	1.29	0.99	0.0109	0.101	0.128	0.092
2009	2		0.60	7.3	5.0	21.0	33.5	240.0	1.10	0.10	0.86	0.86	0.0067	0.038	0.100	0.143
Total	**19**	**Overall**	**0.58**	**7.1**	***5.4***	***20.4***	**69.0**	**212.6**	**0.93**	***0.15***	***0.61***	***0.51***	***0.0081***	***0.066***	***0.126***	***0.068***
Lowest EMC value:			0.09	6.5	5.0	10.0	10.0	140.0	0.51	0.10	0.10	0.10	0.0010	0.018	0.093	0.025
Median EMC value			0.65	7.0	5.0	11.0	66.0	210.0	0.91	0.10	0.61	0.20	0.0084	0.051	0.100	0.035
Highest EMC value:			0.97	8.5	9.1	57.0	175.0	300.0	1.40	0.81	2.40	2.40	0.0190	0.220	0.320	0.290
Qtr					COEFFICIENT OF VARIATION by Quarter											
1			0.62	0.04	0.04	0.67	0.75	0.06	0.12	0.00	0.75	0.75	0.55	0.81	0.68	1.25
2			0.19	0.05	0.32	0.59	0.63	0.26	0.10	0.64	0.83	0.90	0.59	0.47	0.36	0.69
3			0.62	0.09	0.12	0.51	0.65	0.26	0.11	1.20	0.90	1.16	0.40	1.01	0.10	0.54
4			0.38	0.06	0.00	0.00	0.35	0.21	0.16	0.00	1.21	1.21	0.48	0.24	0.13	1.09
Year					COEFFICIENT OF VARIATION by Year											
2004			-	-	-	-	-	-	-	-	-	-	-	-	-	-
2005			0.60	0.11	0.00	0.50	0.51	0.22	0.32	0.67	1.21	1.00	0.50	0.32	0.00	0.58
2006			0.45	0.04	0.13	0.83	0.71	0.29	0.41	0.33	1.12	0.00	0.36	0.41	0.52	0.44
2007			0.85	0.09	0.00	0.62	0.85	0.21	0.16	0.00	1.02	1.02	0.30	0.82	0.10	0.18
2008			0.35	0.00	0.29	0.71	0.34	0.15	0.29	1.28	0.61	1.00	0.54	0.81	0.34	1.43
2009			0.12	0.05	0.00	0.74	0.95	0.06	0.00	0.00	0.41	0.41	0.36	0.30	0.00	1.17
Total	**19**	**Overall**	**0.50**	**0.07**	***0.19***	***0.67***	**0.70**	**0.22**	**0.26**	***1.09***	***0.97***	***1.14***	***0.52***	***0.78***	***0.45***	***1.16***

* Lab procedures were changed starting in 2005, therefore BDL values vary from test results reported in 2004.

Note: Actual BDL values were used to determine totals, the true values are actually less than the overall totals.

TABLE A-13
Statistical Analysis For Williams Creek Monitoring Station (WC)

MEAN EMC			Rain Inches	pH -----	BOD mg/l	COD mg/l	TSS mg/l	TDS mg/l	N+NN mg/l	NH_3 mg/l	TKN mg/l	TN mg/l	Pb mg/l	Zn mg/l	TP mg/l	PO_4 mg/l
		Detectable Limit:			5.0	10.0	1	10	0.10	0.10	0.10	0.10	0.0050	0.030	0.100	0.025
Qtr	Year	#	MEAN		MEAN EMC for individual Quarters											
1	2006	1	0.28	7.0	5.0	32.0	45	100	0.47	0.10	0.10	0.10	0.0081	0.051	0.130	0.063
1	2007	1	0.20	7.5	8.6	31.0	37	150	0.84	0.10	0.59	0.59	0.0064	0.042	0.100	0.090
1	2008	1	0.23	6.5	8.0	10.0	28	180	0.70	0.10	0.10	0.10	0.0050	0.030	0.100	0.025
1	2009	1	0.54	6.0	5.0	33.0	48	150	1.00	0.15	3.40	3.20	0.0150	0.053	0.100	0.200
2	2006	1	0.18	7.0	5.0	10.0	14	190	1.40	0.16	0.10	0.10	0.0050	0.030	0.100	0.025
2	2007	1	0.73	7.0	7.6	34.0	67	130	0.60	0.10	1.40	1.40	0.0160	0.069	0.250	0.041
2	2008	1	0.48	7.0	5.0	10.0	12	170	1.10	0.10	0.56	0.56	0.0050	0.030	0.100	0.070
2	2009	1	0.59	7.5	5.0	10.0	26	230	1.10	0.12	0.97	0.85	0.0067	0.100	0.140	0.025
3	2005	1	0.69	7.0	5.0	10.0	4	280	1.40	0.10	0.10	0.10	0.0050	0.031	0.100	0.040
3	2006	1	0.95	7.0	9.0	43.0	22	150	0.88	0.10	0.10	0.10	0.0057	0.038	0.100	0.038
3	2007	1	0.51	7.0	5.0	28.0	19	210	0.90	0.10	0.74	0.74	0.0064	0.044	0.100	0.025
3	2008	1	0.24	6.0	15.0	48.0	120	160	0.53	0.10	1.80	1.80	0.0210	0.160	0.240	0.025
4	2005	1	0.19	7.0	5.0	26.0	16	160	0.86	0.10	0.10	0.10	0.0050	0.030	1.400	0.025
4	2006	1	1.36	7.0	5.0	25.0	21	140	0.49	0.10	0.82	0.82	0.0050	0.030	0.100	0.051
4	2007	1	0.30	7.0	7.0	23.0	69	110	0.74	0.10	0.85	0.85	0.0130	0.054	0.160	0.025
4	2008	1	0.89	6.5	5.0	10.0	51	140	0.59	0.10	0.70	0.70	0.0088	0.060	0.100	0.100

MEAN EMC			Rain Inches	pH -----	BOD mg/l	COD mg/l	TSS mg/l	TDS mg/l	N+NN mg/l	NH_3 mg/l	TKN mg/l	TN mg/l	Pb mg/l	Zn mg/l	TP mg/l	PO_4 mg/l
Qtr	#		MEAN		MEAN EMC by Quarter											
1	4		0.31	6.8	6.7	26.5	39.5	145.0	0.75	0.11	1.05	1.00	0.0086	0.044	0.108	0.095
2	4		0.50	7.1	5.7	16.0	29.8	180.0	1.05	0.12	0.76	0.73	0.0082	0.057	0.148	0.040
3	4		0.60	6.8	8.5	32.3	41.2	200.0	0.93	0.10	0.69	0.69	0.0095	0.068	0.135	0.032
4	4		0.69	6.9	5.5	21.0	39.3	137.5	0.67	0.10	0.62	0.62	0.0080	0.044	0.440	0.050
Year	#		MEAN		MEAN EMC by Year											
2005	2		0.44	7.0	5.0	18.0	9.8	220.0	1.13	0.10	0.10	0.10	0.0050	0.031	0.750	0.033
2006	4		0.69	7.0	6.0	27.5	25.5	145.0	0.81	0.12	0.28	0.28	0.0060	0.037	0.108	0.044
2007	4		0.44	7.1	7.1	29.0	48.0	150.0	0.77	0.10	0.90	0.90	0.0105	0.052	0.153	0.045
2008	4		0.46	6.5	8.3	19.5	52.8	162.5	0.73	0.10	0.79	0.79	0.0100	0.070	0.135	0.055
2009	2		0.57	6.8	5.0	21.5	37.0	190.0	1.05	0.14	2.19	2.03	0.0109	0.077	0.120	0.113
Total	**16**	**Overall**	**0.52**	**6.9**	*6.6*	*23.9*	**37.4**	**165.6**	**0.85**	*0.11*	*0.78*	*0.76*	*0.0086*	*0.053*	*0.208*	*0.054*
Lowest EMC value:			0.18	6.0	5.0	10.0	3.6	100.0	0.47	0.10	0.10	0.10	0.0050	0.030	0.100	0.025
Median EMC value			0.50	7.0	5.0	25.5	27.0	155.0	0.85	0.10	0.65	0.65	0.0064	0.043	0.100	0.039
Highest EMC value:			1.36	7.5	15.0	48.0	120.0	280.0	1.40	0.16	3.40	3.20	0.0210	0.160	1.400	0.200
Qtr					COEFFICIENT OF VARIATION by Quarter											
1			0.50	0.10	0.29	0.42	0.23	0.23	0.30	0.22	1.51	1.49	0.51	0.24	0.14	0.80
2			0.47	0.04	0.23	0.75	0.86	0.23	0.32	0.24	0.73	0.75	0.65	0.59	0.48	0.53
3			0.50	0.07	0.56	0.53	1.29	0.30	0.39	0.00	1.17	1.17	0.81	0.90	0.52	0.25
4			0.80	0.04	0.18	0.35	0.64	0.15	0.24	0.00	0.57	0.57	0.48	0.36	1.46	0.70
Year					COEFFICIENT OF VARIATION by Year											
2005			0.80	0.00	0.00	0.63	0.89	0.39	0.34	0.00	0.00	0.00	0.00	0.02	1.23	0.33
2006			0.81	0.00	0.33	0.50	0.53	0.25	0.54	0.26	1.29	1.29	0.25	0.27	0.14	0.37
2007			0.54	0.04	0.22	0.16	0.51	0.29	0.17	0.00	0.39	0.39	0.46	0.24	0.46	0.68
2008			0.67	0.06	0.57	0.97	0.90	0.11	0.35	0.00	0.91	0.91	0.76	0.88	0.52	0.67
2009			0.06	0.16	0.00	0.76	0.42	0.30	0.07	0.16	0.79	0.82	0.54	0.43	0.24	1.10
Total	**16**	**Overall**	**0.64**	**0.06**	*0.41*	*0.53*	**0.78**	**0.27**	**0.35**	*0.18*	*1.11*	*1.09*	*0.58*	*0.64*	*1.55*	*0.85*

* Lab procedures were changed starting in 2005, therefore BDL values vary from test results reported in 2004.

Note: Actual BDL values were used to determine totals, the true values are actually less than the overall totals.

TABLE A-14
Statistical Analysis For Walden Drive Monitoring Station (WD)

MEAN EMC			Rain Inches	pH -----	BOD mg/l	COD mg/l	TSS mg/l	TDS mg/l	N+NN mg/l	NH_3 mg/l	TKN mg/l	TN mg/l	Pb mg/l	Zn mg/l	TP mg/l	PO_4 mg/l
		Detectable Limit:			5.0	10.0	1	10	0.10	0.10	0.10	0.10	0.0050	0.030	0.100	0.025
Qtr	Year	#	MEAN		MEAN EMC for individual Quarters											
1	2005	1	1.35	6.0	4.0	8.6	116	107	0.48	0.10	0.20	0.20	0.0060	0.064	0.060	0.025
1	2006	1	0.25	6.0	5.4	34.0	68	120	0.62	0.10	0.10	0.10	0.0050	0.160	0.170	0.084
1	2007	1	0.22	7.5	5.0	29.0	52	140	0.10	0.10	0.64	0.64	0.0050	0.190	0.100	0.081
1	2008	1	0.19	7.0	5.0	10.0	170	160	0.46	0.10	0.54	0.54	0.0083	0.120	0.190	0.025
1	2009	1	0.51	5.5	5.0	30.0	160	200	0.82	0.19	1.30	1.10	0.0170	0.140	0.100	0.220
2	2005	1	0.34	7.0	5.0	88.0	51	180	0.99	0.10	0.10	0.10	0.0050	0.030	0.100	0.043
2	2006	1	0.18	7.0	5.0	10.0	26	180	0.99	0.10	0.52	0.52	0.0050	0.051	0.100	0.025
2	2007	1	0.72	7.0	5.0	23.0	200	100	0.48	0.10	0.97	0.97	0.0190	0.120	0.250	0.025
2	2008	1	0.47	7.0	9.2	38.0	110	180	0.94	0.12	1.60	1.50	0.0082	0.870	0.150	0.025
2	2009	1	0.47	6.5	10.0	91.0	240	120	0.58	0.15	2.20	2.00	0.0150	0.210	0.380	0.025
3	2004 *	1	1.48	7.7	7.0	23.4	407	132	0.74	0.10	0.22	0.22	0.0210	0.138	0.080	0.025
3	2005	1	0.28	7.0	5.0	22.0	37	170	0.72	0.10	0.58	0.58	0.0050	0.044	0.100	0.025
3	2006	1	2.43	7.0	8.0	63.0	430	110	0.45	0.10	1.90	1.90	0.0270	0.210	0.220	0.025
3	2007	1	0.14	8.0	5.0	29.0	63	230	0.69	0.10	0.10	0.10	0.0050	0.066	0.190	0.100
3	2008	1	0.16	6.0	5.0	66.0	270	150	0.60	0.38	1.40	1.40	0.0150	0.200	0.250	0.025
4	2004 *	1	1.17	6.0	4.0	8.0	194	124	0.42	0.10	0.21	0.21	0.0100	0.091	0.059	0.025
4	2004 *	1	0.71	7.0	6.0	14.0	174	128	0.71	0.10	0.97	0.97	0.0090	0.083	0.217	0.025
4	2005	1	0.59	-	20.0	49.0	210	120	0.39	0.33	1.10	0.77	0.0150	0.140	0.100	0.025
4	2006	1	0.94	7.0	5.0	27.0	150	130	0.35	0.31	0.80	0.10	0.0050	0.230	0.220	0.025
4	2007	1	0.20	8.0	8.0	39.0	72	180	0.86	0.22	1.30	1.10	0.0050	0.084	0.100	0.025
4	2008	1	0.77	6.0	5.0	10.0	130	89	0.24	0.10	0.78	0.78	0.0080	0.120	0.100	0.680

MEAN EMC			Rain Inches	pH -----	BOD mg/l	COD mg/l	TSS mg/l	TDS mg/l	N+NN mg/l	NH_3 mg/l	TKN mg/l	TN mg/l	Pb mg/l	Zn mg/l	TP mg/l	PO_4 mg/l
Qtr	#		MEAN		MEAN EMC by Quarter											
1	5		0.50	6.4	4.9	22.3	113.2	145.4	0.50	0.12	0.56	0.52	0.0083	0.135	0.124	0.087
2	5		0.44	6.9	6.8	50.0	125.4	152.0	0.80	0.11	1.08	1.02	0.0104	0.256	0.196	0.029
3	5		0.90	7.1	6.0	40.7	241.4	158.4	0.64	0.16	0.64	0.84	0.0146	0.132	0.168	0.040
4	6		0.73	6.8	8.0	24.5	155.0	128.5	0.50	0.19	0.86	0.66	0.0087	0.125	0.133	0.134
Year	#		MEAN		MEAN EMC by Year											
2004	3		1.12	6.9	5.7	15.1	258.3	128.0	0.62	0.10	0.47	0.47	0.0133	0.104	0.119	0.025
2005	4		0.64	6.7	8.5	41.9	103.5	144.3	0.65	0.16	0.50	0.41	0.0078	0.070	0.090	0.030
2006	4		0.95	6.8	5.9	33.5	168.5	135.0	0.60	0.15	0.83	0.66	0.0105	0.163	0.178	0.040
2007	4		0.32	7.6	5.8	30.0	96.8	162.5	0.53	0.13	0.75	0.70	0.0085	0.115	0.160	0.058
2008	4		0.40	6.5	6.1	31.0	170.0	144.8	0.56	0.18	1.08	1.06	0.0099	0.328	0.173	0.189
2009	2		0.49	6.0	7.5	60.5	200.0	160.0	0.70	0.17	1.75	1.55	0.0160	0.175	0.240	0.123
Total	**21**	**Overall**	**0.65**	**6.8**	***6.5***	***33.9***	**158.6**	**145.2**	**0.60**	***0.15***	***0.83***	***0.75***	***0.0104***	***0.160***	***0.154***	***0.075***
Lowest EMC value:			0.14	5.5	4.0	8.0	26.0	89.0	0.10	0.10	0.10	0.10	0.0050	0.030	0.059	0.025
Median EMC value			0.47	7.0	5.0	29.0	150.0	132.0	0.60	0.10	0.78	0.64	0.0082	0.120	0.100	0.025
Highest EMC value:			2.43	8.0	20.0	91.0	430.0	230.0	0.99	0.38	2.20	2.00	0.0270	0.870	0.380	0.680
Qtr					COEFFICIENT OF VARIATION by Quarter											
1			0.97	0.13	0.11	0.54	0.47	0.25	0.53	0.34	0.85	0.77	0.61	0.35	0.44	0.92
2			0.46	0.03	0.37	0.75	0.74	0.26	0.31	0.19	0.78	0.74	0.60	1.37	0.61	0.28
3			1.14	0.11	0.24	0.54	0.77	0.29	0.19	0.80	0.93	0.93	0.67	0.57	0.44	0.84
4			0.45	0.42	0.75	0.69	0.32	0.23	0.48	0.56	0.43	0.62	0.43	0.45	0.52	1.99
Year					COEFFICIENT OF VARIATION by Year											
2004			0.35	0.12	0.27	0.51	0.50	0.03	0.28	0.00	0.93	0.93	0.50	0.29	0.72	0.00
2005			0.77	0.50	0.90	0.84	0.76	0.25	0.42	0.73	0.92	0.76	0.63	0.71	0.22	0.31
2006			1.10	0.07	0.25	0.66	1.08	0.23	0.47	0.69	0.93	1.30	1.05	0.49	0.32	0.74
2007			0.84	0.06	0.26	0.22	0.72	0.34	0.62	0.46	0.68	0.63	0.82	0.48	0.46	0.67
2008			0.72	0.09	0.35	0.86	0.42	0.27	0.52	0.78	0.46	0.44	0.35	1.11	0.37	1.74
2009			0.06	0.12	0.47	0.71	0.28	0.35	0.24	0.17	0.36	0.41	0.09	0.28	0.82	1.13
Total	**21**	**Overall**	**0.88**	**0.24**	***0.54***	***0.73***	**0.70**	**0.25**	**0.40**	***0.59***	***0.73***	***0.78***	***0.62***	***1.08***	***0.53***	***1.94***

* Lab procedures were changed starting in 2005, therefore BDL values vary from test results reported in 2004.

Note: Actual BDL values were used to determine totals, the true values are actually less than the overall totals.

TABLE A-15
Statistical Analysis For The Other Three Monitoring Stations

MEANEMC				Rain Inches	pH -----	BOD mg/l	COD mg/l	TSS mg/l	TDS mg/l	N+NN mg/l	NH_3 mg/l	TKN mg/l	TN mg/l	Pb mg/l	Zn mg/l	TP mg/l	PO_4 mg/l
Detectable Limit:						5.0	10.0	1	10	0.10	0.10	0.10	0.10	0.0050	0.030	0.100	0.025
	Qtr	Year	#	MEAN		MEAN EMC for individual Quarters											
FC	1	2005	1	0.75	6.0	4.0	16.0	233	167	1.10	0.03	0.24	0.21	0.0210	0.088	0.010	0.025
FC	2	2005	1	2.68	6.5	6.0	53.0	280	120	0.82	0.32	2.00	1.70	0.0230	0.100	0.910	0.063
FC	3	2004 *	1	1.82	6.5	4.0	16.8	61	111	0.38	0.10	0.58	0.58	0.0070	0.036	0.096	0.025
FC	4	2004 *	1	1.58	6.0	4.0	13.3	234	90	0.16	0.04	0.75	0.71	0.0170	0.064	0.241	0.025
SC	1	2005	1	0.33	6.0	5.0	12.0	48	149	0.83	0.05	0.35	0.30	0.0180	0.086	0.090	0.025
SC	2	2005	1	0.25	7.0	5.0	88.0	26	190	1.20	0.30	0.10	0.10	0.0050	0.066	0.100	0.034
SC	4	2004	1	1.12	6.5	9.0	17.7	122	120	0.25	0.10	0.32	0.32	0.0330	0.129	0.095	0.025
SC	4	2004	1	0.92	7.0	6.0	14.5	100	131	0.31	0.26	0.74	0.48	0.0410	0.142	0.202	0.025
TC	1	2009	1	0.56	5.5	5.0	39.0	57	340	1.10	0.13	1.10	1.00	0.0110	0.120	0.100	0.210
TC	2	2009	1	0.52	7.5	10.0	28.0	48	190	0.90	0.10	0.74	0.74	0.0072	0.210	0.110	0.025
TC	2	2009	1	0.67	6.5	17.0	41.0	1	166	0.96	0.46	1.80	1.30	0.0084	0.074	0.250	0.025
TC	3	2008	1	0.88	6.0	9.6	130.0	440	130	0.48	0.10	1.90	1.90	0.0370	0.190	0.440	0.025
TC	4	2008	1	0.88	7.0	6.1	10.0	140	150	0.57	0.10	0.80	0.80	0.0240	0.200	0.100	0.260
	MEAN			Rain Inches	pH -----	BOD mg/l	COD mg/l	TSS mg/l	TDS mg/l	N+NN mg/l	NH_3 mg/l	TKN mg/l	TN mg/l	Pb mg/l	Zn mg/l	TP mg/l	PO_4 mg/l
		#		MEAN		MEAN EMC for Each Station											
FC		4		1.71	6.25	4.50	24.78	202.00	122.00	0.62	*0.12*	0.89	0.80	0.02	0.07	0.31	*0.03*
SC		4		0.66	6.63	*6.25*	33.05	74.00	147.50	0.65	*0.18*	*0.38*	*0.30*	*0.02*	0.11	*0.12*	*0.03*
TC		5		0.70	6.50	9.54	*49.60*	137.10	195.20	0.80	*0.18*	1.27	1.15	0.02	0.16	*0.20*	*0.11*

* Lab procedures were changed starting in 2005, therefore BDL values vary from test results reported in 2004.

Note: Actual BDL values were used to determine totals, the true values are actually less than the overall totals.

TABLE A-16
Overall EMC Statistical Analysis

MEAN EMC		Major Land Use	Rain Inches	pH ----	BOD mg/l	COD mg/l	TSS mg/l	TDS mg/l	N+NN mg/l	NH_3 mg/l	TKN mg/l	TN mg/l	Pb mg/l	Zn mg/l	TP mg/l	PO_4 mg/l
Location	#		MEAN		Overall Mean EMC for Individual Monitoring Stations											
Acker Place (AP)	17	Comm	0.54	6.6	5.2	22.9	73.2	84.3	0.40	0.16	0.41	0.27	0.0062	0.132	0.132	0.041
First Creek (KAT)	18	Resid	0.49	6.9	7.0	21.9	95.2	186.7	0.89	0.12	0.64	0.60	0.0129	0.077	0.182	0.096
Love Creek (LC)	19	Mixed	0.58	7.1	5.4	20.4	69.0	212.6	0.93	0.15	0.61	0.51	0.0081	0.066	0.126	0.068
Williams Creek (WC)	16	Resid	0.52	6.9	6.6	23.9	37.4	165.6	0.85	0.11	0.78	0.76	0.0086	0.053	0.208	0.054
Walden Drive (WD)	21	Mixed	0.65	6.8	6.5	33.9	158.6	145.2	0.60	0.15	0.83	0.75	0.0104	0.160	0.154	0.075
Fountain City (FC)	4	Resid	1.71	6.3	4.5	24.8	202.0	122.0	0.62	0.12	0.89	0.80	0.0170	0.072	0.314	0.035
Second Creek (SC)	4	Mixed	0.66	6.6	6.3	33.1	74.0	147.5	0.65	0.18	0.38	0.30	0.0243	0.106	0.122	0.027
Third Creek (TC)	5	Mixed	0.70	6.5	9.5	49.6	137.1	195.2	0.80	0.18	1.27	1.15	0.0175	0.159	0.200	0.109
Total	104		0.73	6.7	6.4	28.8	105.8	157.4	0.72	0.15	0.73	0.64	0.0131	0.103	0.180	0.063
	#				Overall Mean EMC for Individual Quarters											
Quarter 01	26		0.44	6.3	5.3	20.8	75.4	185.1	0.90	0.10	0.59	0.55	0.0107	0.093	0.120	0.084
Quarter 02	26		0.74	6.9	7.5	38.6	81.5	165.4	0.90	0.20	0.97	0.85	0.0099	0.110	0.235	0.044
Quarter 03	25		0.84	6.8	6.8	44.5	168.8	150.3	0.63	0.15	0.84	0.75	0.0150	0.110	0.190	0.037
Quarter 04	27		0.89	6.8	6.2	15.8	111.4	134.2	0.45	0.13	0.57	0.48	0.0176	0.106	0.173	0.088
	#				Overall Mean EMC for Different Types of Land Uses											
Commercial	17		0.54	6.6	5.2	22.9	73.2	84.3	0.40	0.16	0.41	0.27	0.0062	0.132	0.132	0.041
Industrial	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mixed (entire watershed)	49		0.65	6.8	6.9	34.2	109.7	175.1	0.75	0.16	0.77	0.68	0.0151	0.123	0.151	0.070
Residential	38		0.91	6.7	6.0	23.5	111.5	158.1	0.79	0.12	0.77	0.72	0.0128	0.067	0.235	0.062

* Lab procedures were changed starting in 2005, therefore BDL values vary from test results reported in 2004.

Note: Actual BDL values were used to determine totals, the true values are actually less than the overall totals.

Figure A-1
Seasonal Storm Event Rainfall Average

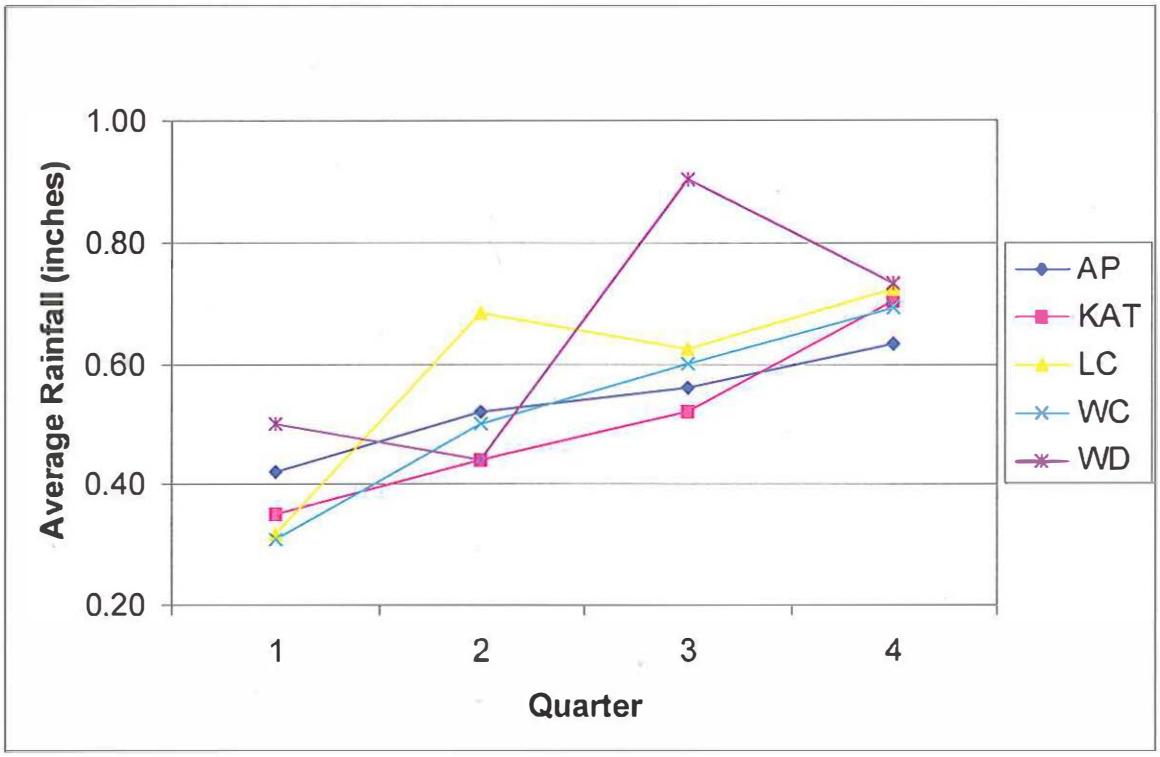


Figure A-2
Seasonal Storm Event pH Average

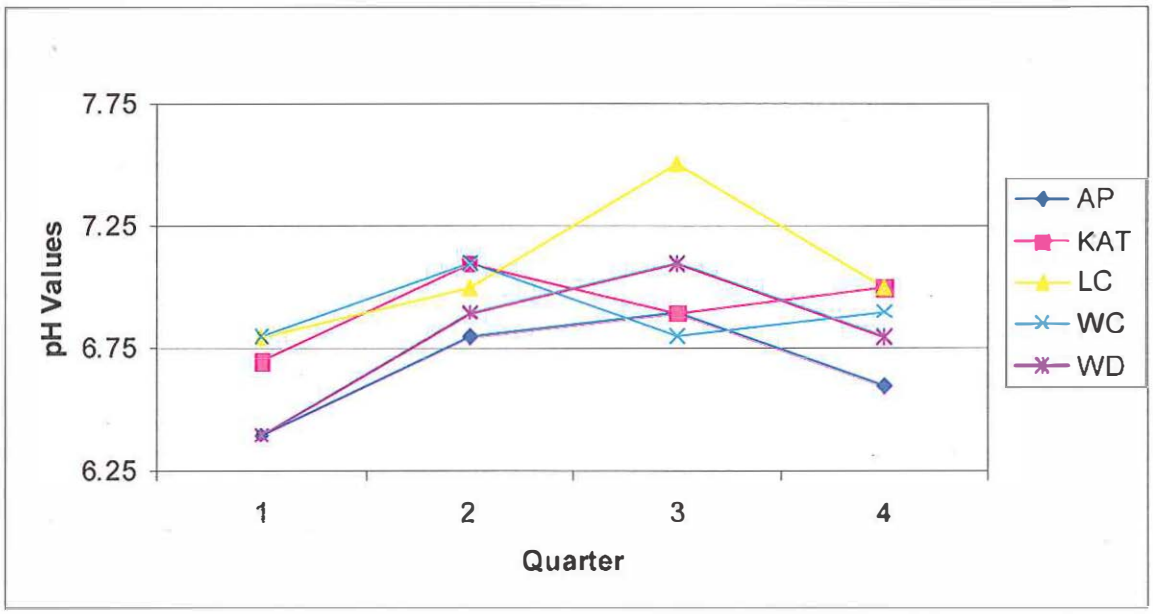


Figure A-3
Seasonal BOD Values

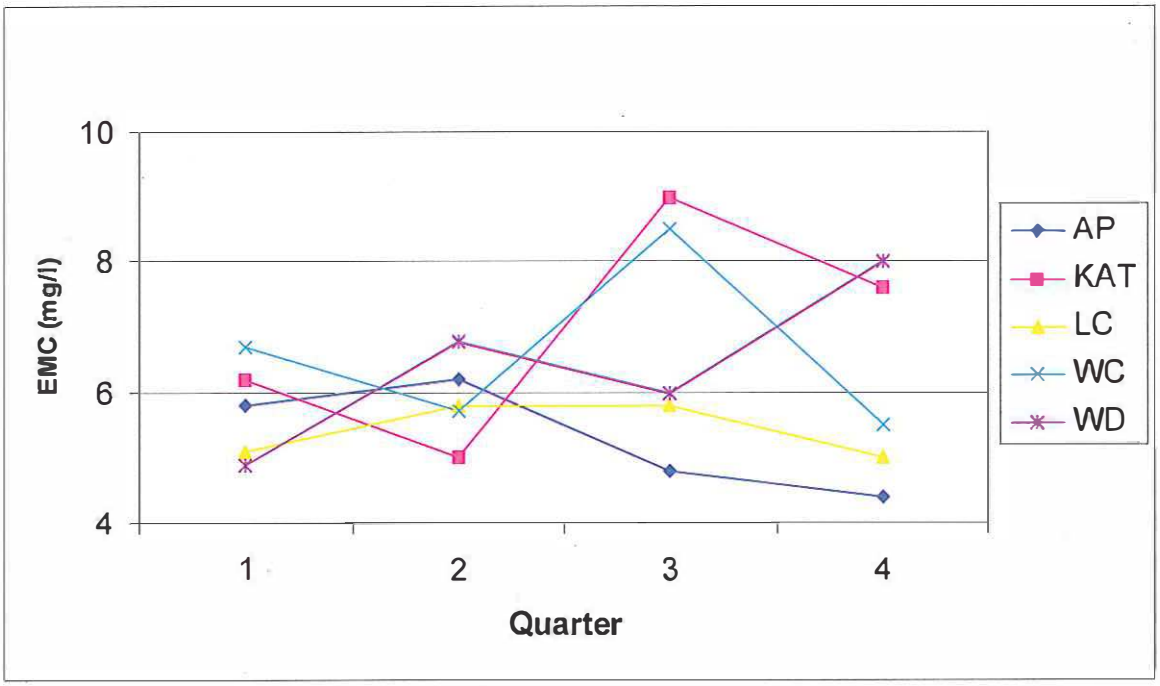


Figure A-4
Seasonal COD Values

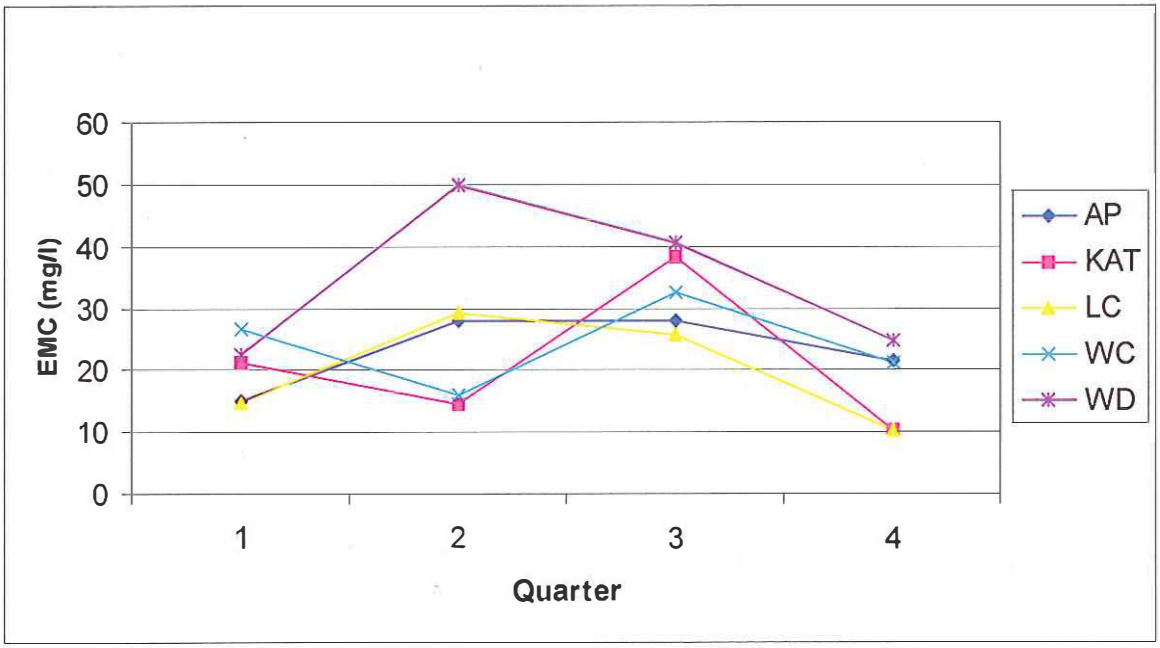


Figure A-5
Seasonal TSS Values

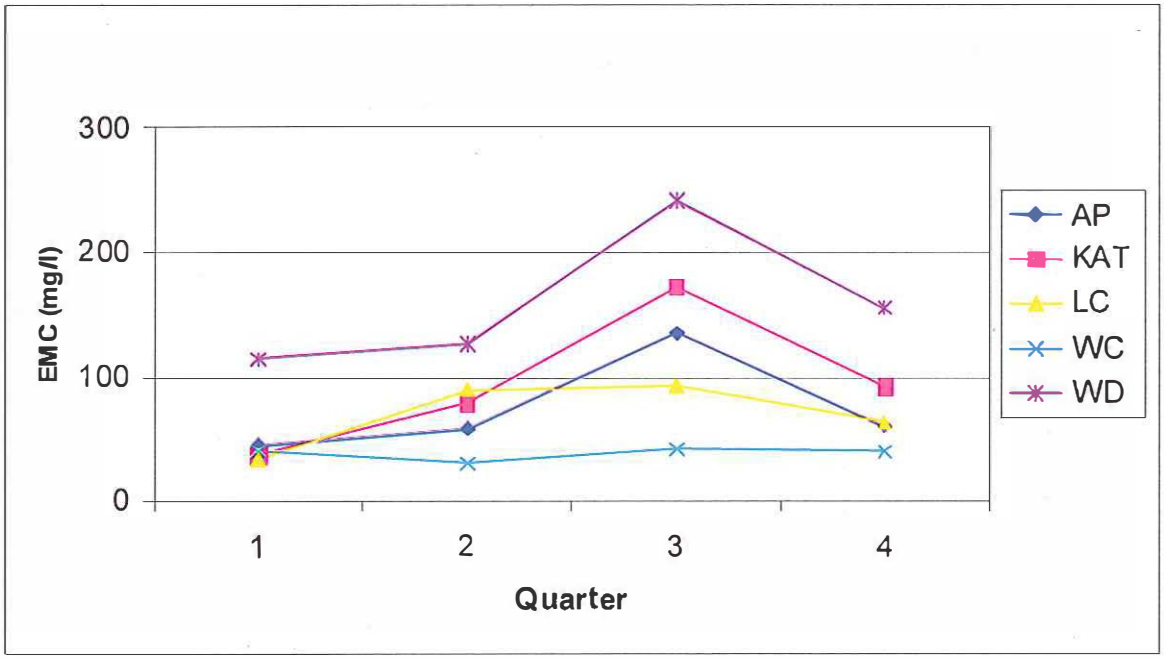


Figure A-6
Seasonal TDS Values

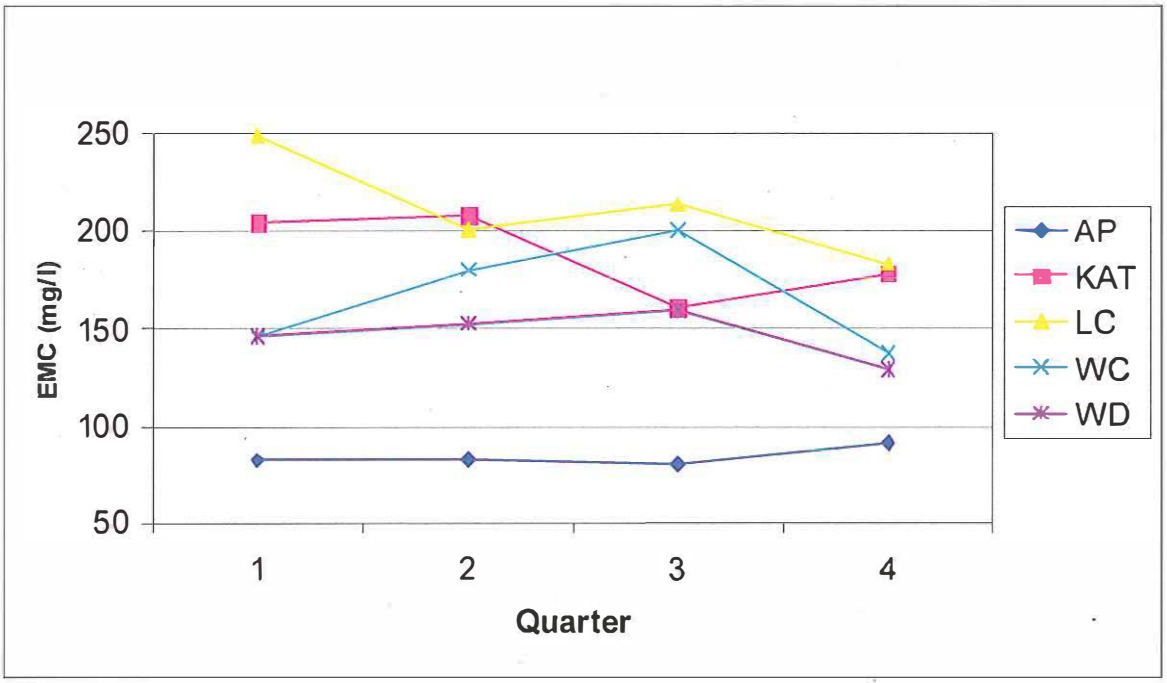


Figure A-7
Seasonal N+NN Values

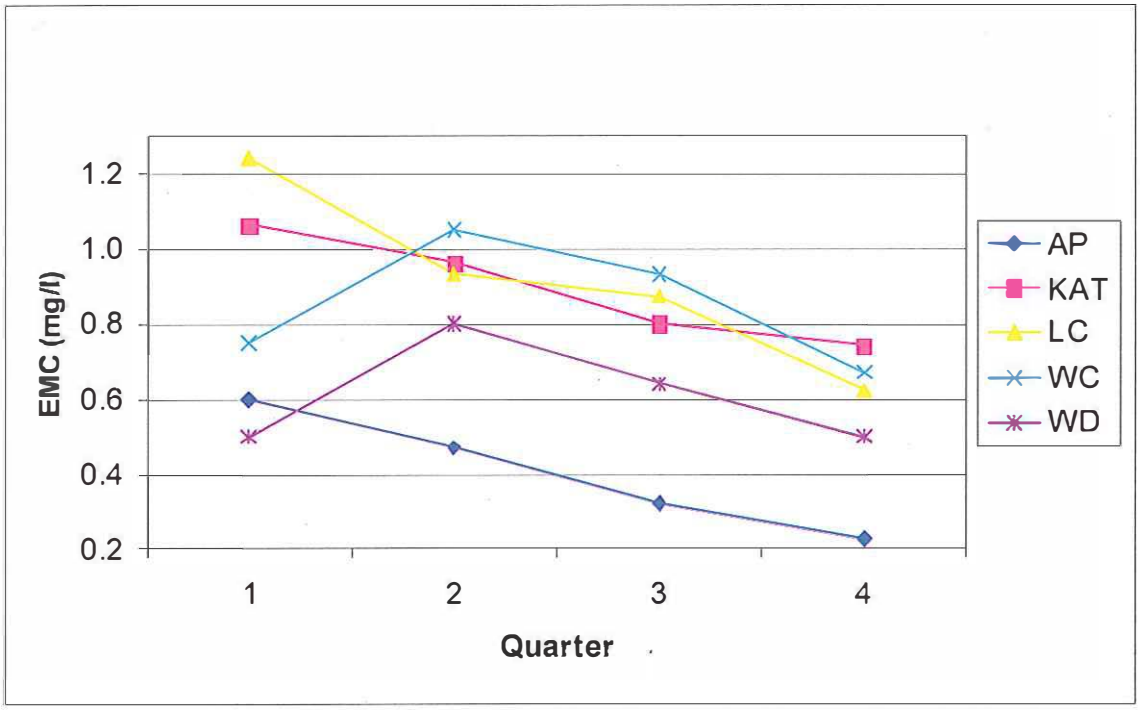


Figure A-8
Seasonal NH_3 Values

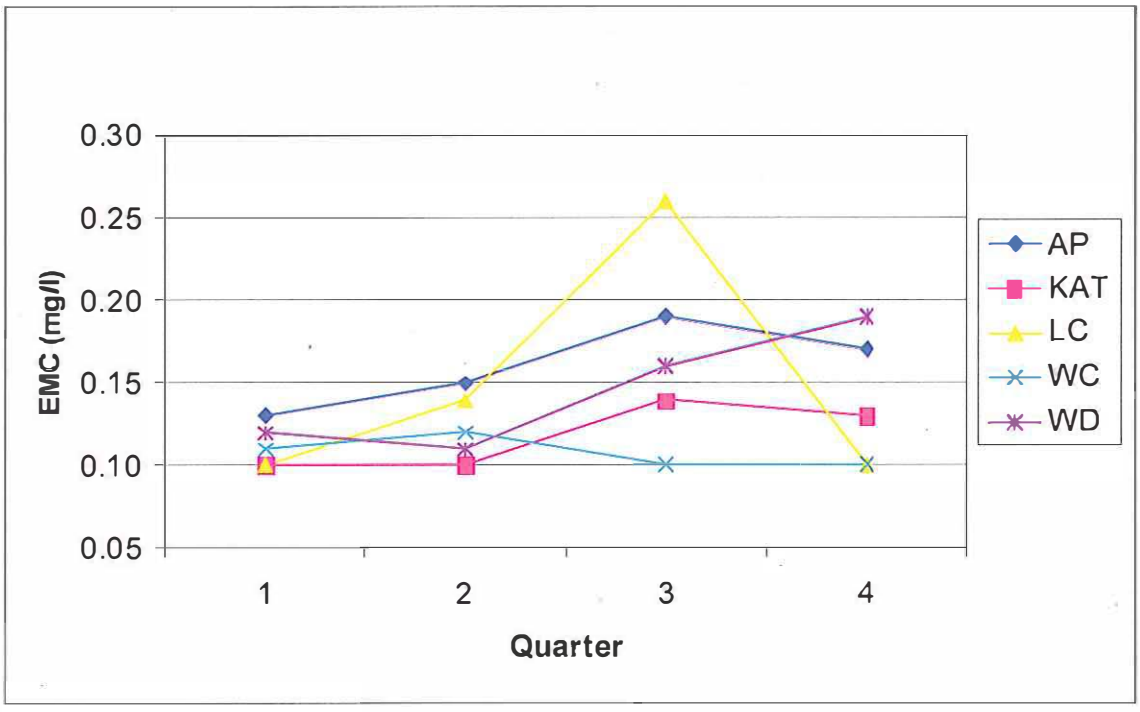


Figure A-9
Seasonal TKN Values

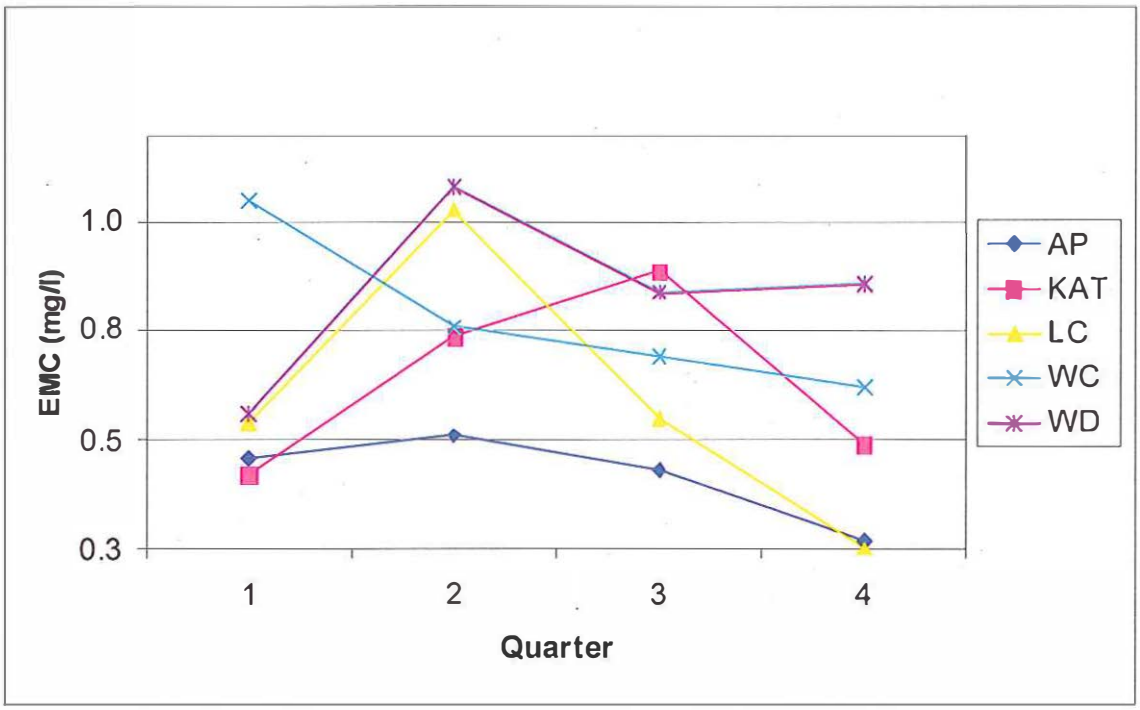


Figure A-10
Seasonal TN Values

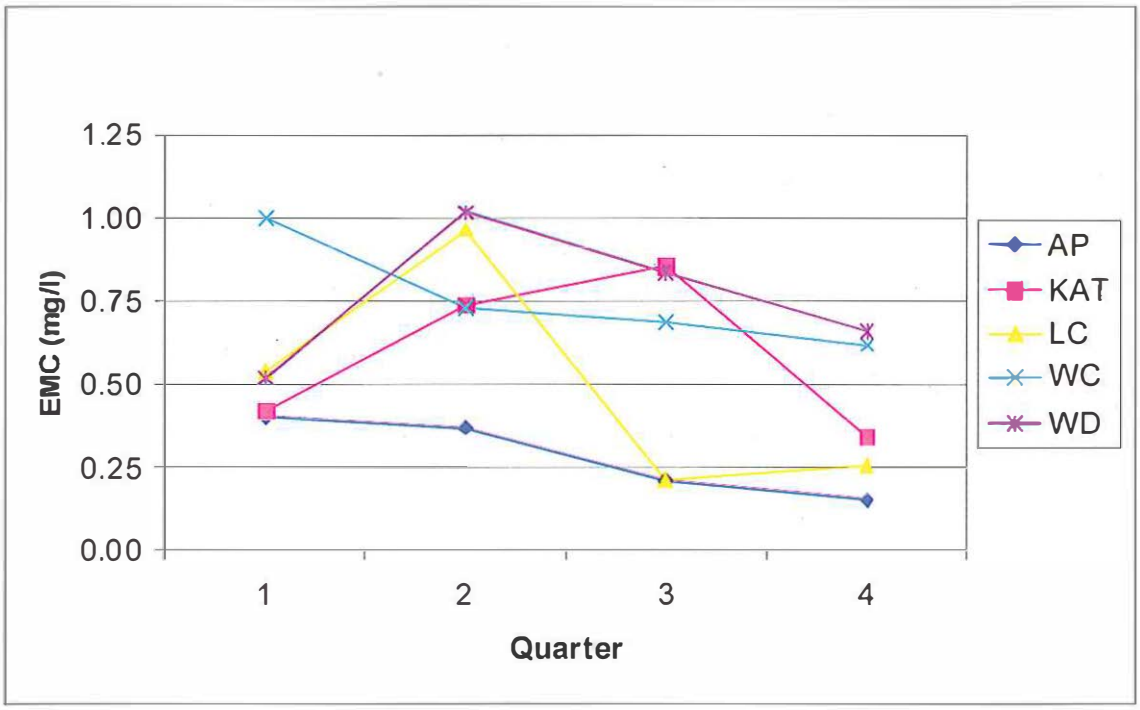


Figure A-11
Seasonal Pb Values

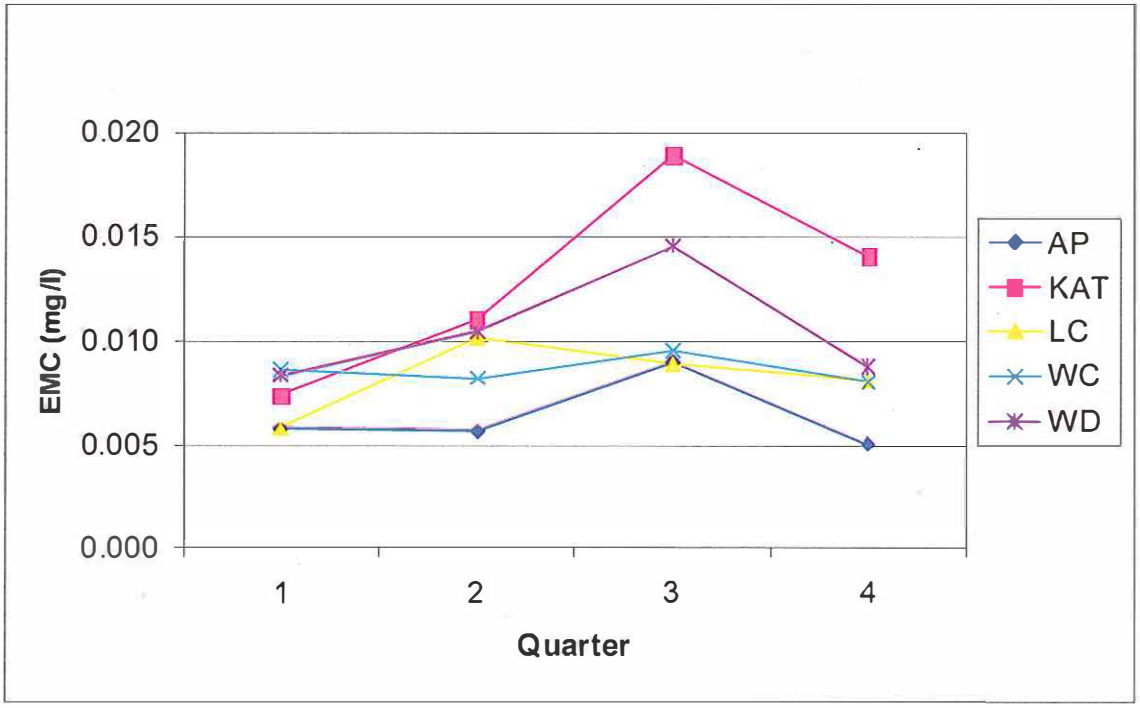


Figure A-12
Seasonal Zn Values

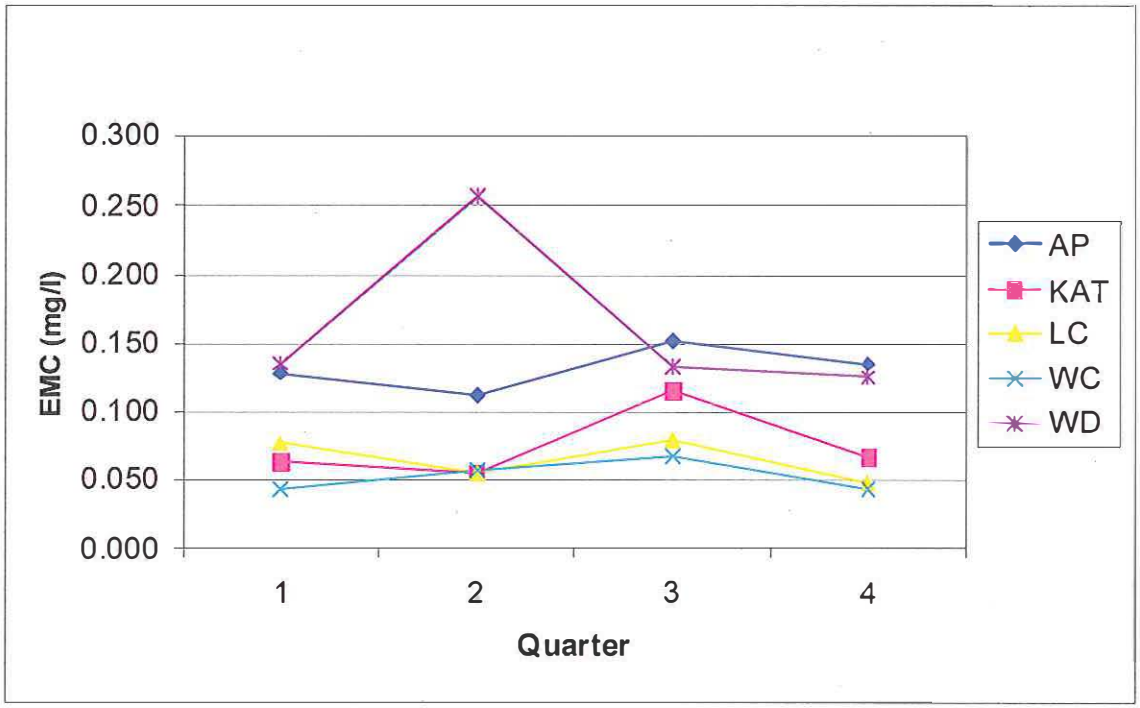


Figure A-13
Seasonal TP Values

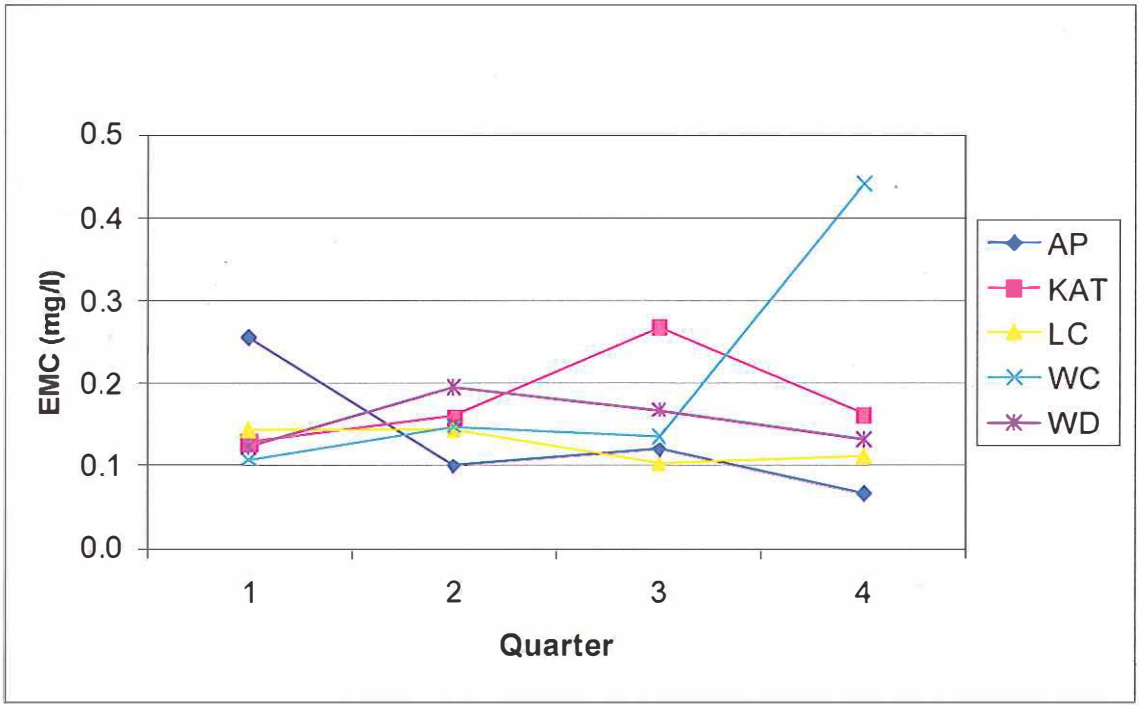


Figure A-14
Seasonal PO_4 Values

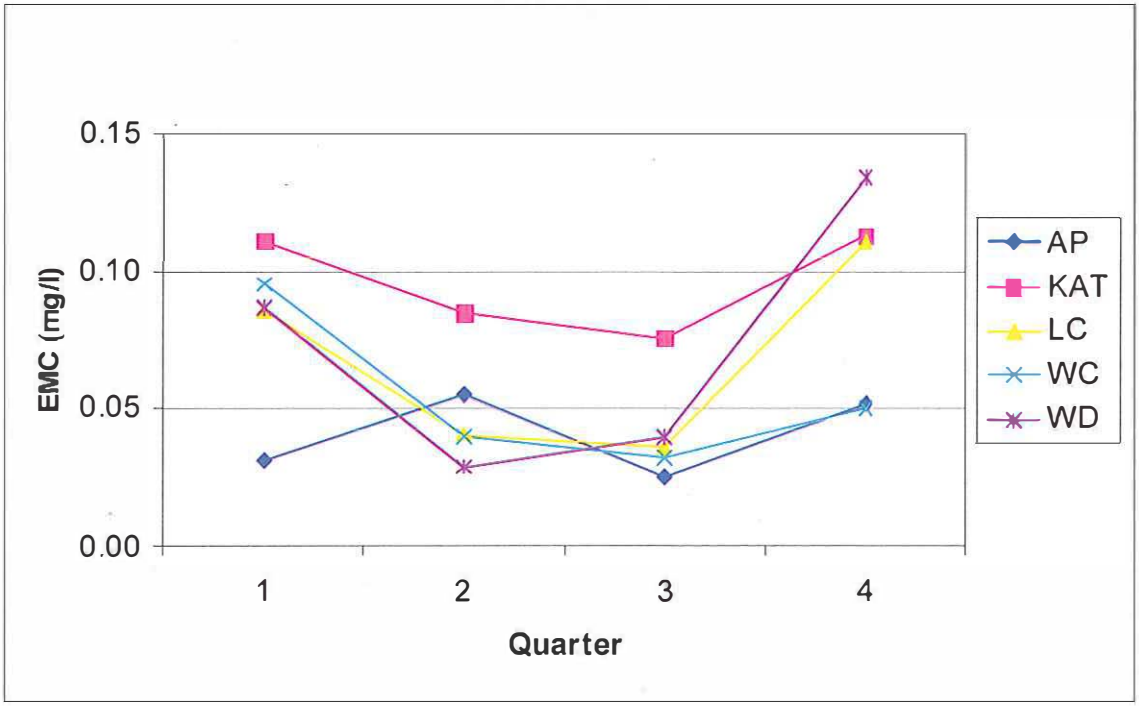


Figure A-15
EMCs by Land Use

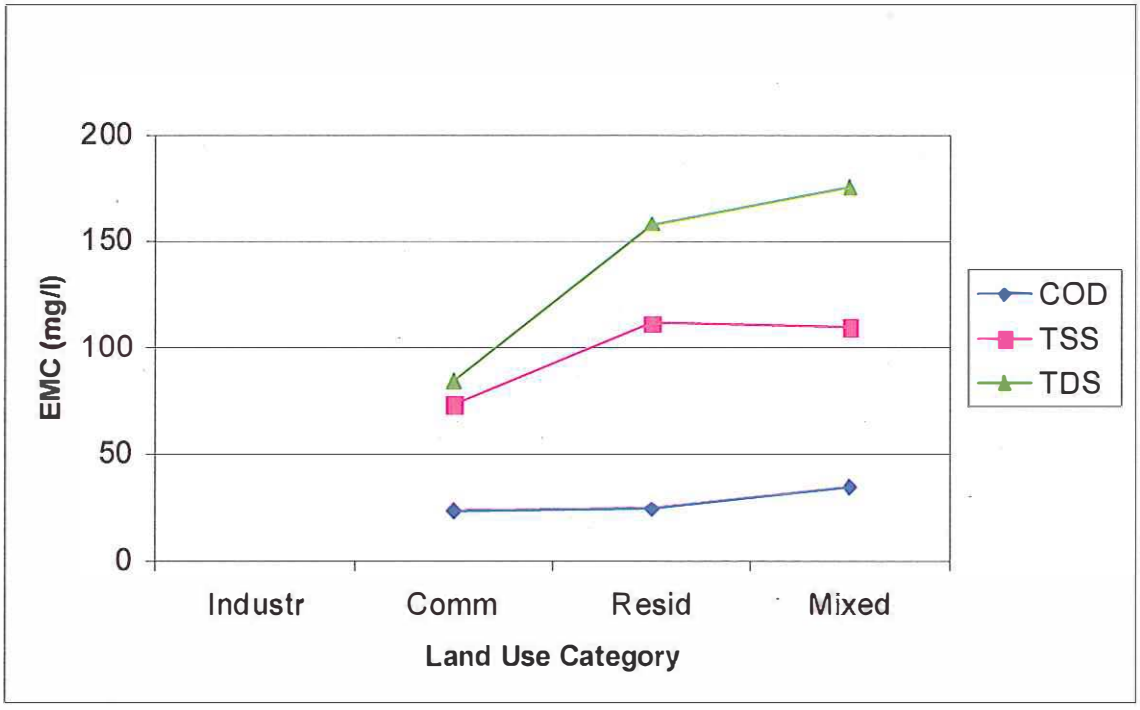


Figure A-16
EMCs by Land Use

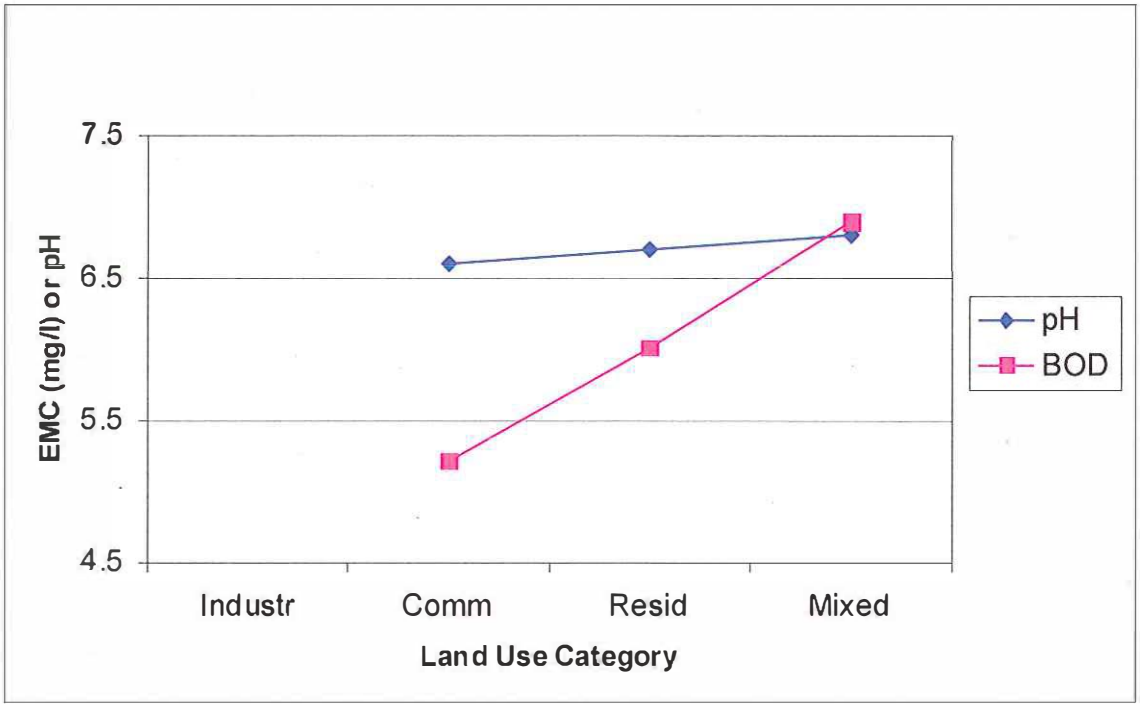


Figure A-17
EMCs by Land Use

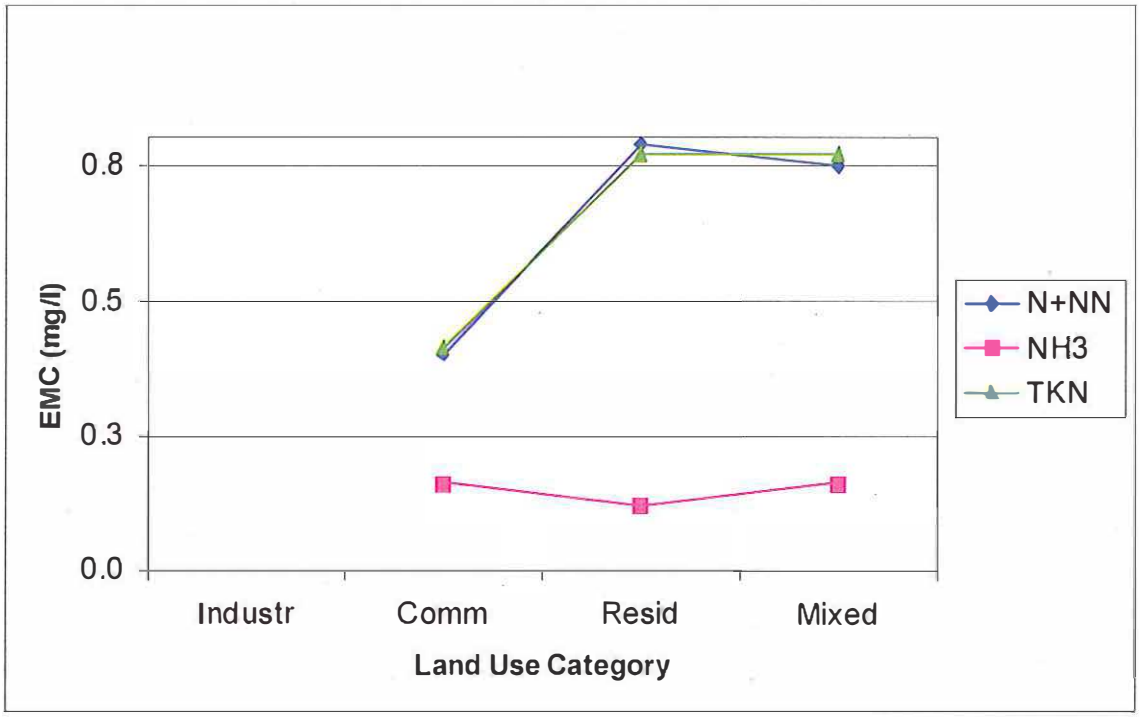
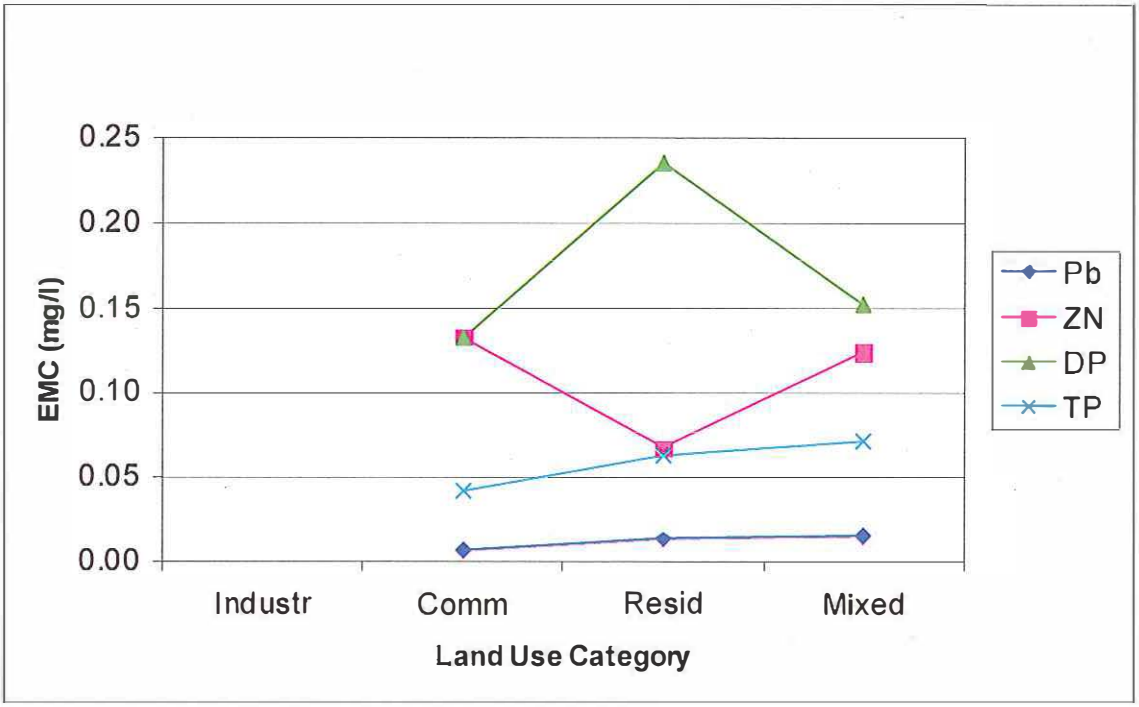


Figure A-18
EMCs by Land Use



A.7 COMPUTATION OF SEASONAL POLLUTANT LOADINGS

For each of the previous four NPDES annual reports, the City of Knoxville has computed an estimate of the total volume of urban runoff within Section 6.2, as required by Part VI (A)(2)(e)(i)(3) of the NPDES permit. The basic formulation for computing the total runoff estimate is described in Chapter 4 of the Part 2 NPDES Application (CDM, 1993),

Seasonal pollutant loadings are computed with the Watershed Management Module (WMM); current edition is WMM for Windows Version 4.17. WMM is a commonly used pollutant loading program, originally developed by CDM for the Rouge River watershed in southeastern Michigan. Each land use is assigned an impervious percentage according to the CDM model described in the Part 2 NPDES Application (pages 4-14 to 4-18). It is assumed for each land use that 95 percent of the rainfall from the impervious fraction, and 15 percent of the rainfall from the pervious fraction, is converted into stormwater runoff over a long-term period.

The City has updated watershed areas using GIS technology to determine approximate areas within the city limits, along with the corresponding land uses. The City of Knoxville has grown over the NPDES time period by a process of annexing property within the core watersheds and also property along the interstates and major roadways. Table A-17 illustrates the changes in city limits for the 26 watersheds that are currently reported for the City of Knoxville.

Table A- 18 shows the current watershed areas and land uses for the 26 watersheds. The land use categories are basically the original CDM categories, with a few modifications to more closely match the Knoxville zoning classifications. The data in Table A-18 is used as input to the WMM program.

Table A-19 shows the EMC values that were originally used in the 1993 CDM analysis (essentially the NURP general averages) and the EMC values used to generate new pollutant loadings. The new estimates have lower EMC values for BOD, COD, TSS, TKN, Pb and Zn. However, the new estimates have higher EMC values for N+NN and DP.
Tables A-20 through A-23 reported values from the WMM program using the seasonal rainfall averages. The results are summarized in Table A-24 and represent the best current estimate of seasonal pollutant loadings that are discharged from Knoxville's streams and creeks.

TABLE A-17
Changes to Knoxville Watersheds From 1993 to 2008

Knoxville Watershed		One of 17 major watersheds as listed in Part 2 NPDES Application (CDM, 1993)	Acres Within City Limits		Total Acres Within Stream Watershed	Current Values (Year 5)	
Name	ID #		Year 1 (1993)	Year 1 (2008)		% Within City Limits	Estimated % Impervious
Baker Creek	06	Yes	1674	1674	1674	100.0	32.2
Beaver Creek	71	---	---	162	45959	0.4	16.0
East Fork (Third)	13	***	2509	2509	2509	100.0	52.8
First Creek	01	Yes	7750	7750	7750	100.0	43.6
Fourth Creek	04	Yes	5919	5920	6769	87.5	40.9
French Broad River **	30	---	---	551	12639	0.4	11.1
Goose Creek	05	Yes	1672	1755	2381	73.7	34.7
Grassy Creek	77	---	217	433	4301	10.1	17.0
Holston River **	50	Yes	2455	2455	5632	43.6	27.7
Inman Branch	52	---	99	99	1143	8.7	20.6
Knob Creek	08	Yes	989	989	3966	24.9	19.3
Knob Fork	79	Yes	685	823	3752	21.9	22.2
Love Creek	53	Yes	4906	5090	6408	79.4	36.4
Second Creek	02	Yes	4335	4498	4503	99.9	52.6
Sinking Creek	18	Yes	368	2434	5447	44.7	33.1
Sinking Cr (East)*	---	---	---	91	2027	4.5	11.8
Swanpond Creek	51	---	226	499	7151	7.0	19.2
Ten Mile Creek	10	Yes	3648	3921	10006	39.2	37.6
Third Creek	03	Yes	8087	8417	8739	96.3	37.1
Tennessee River **	00	Yes	8232	8232	20854	39.5	22.2
Toll Creek	09	Yes	735	767	1229	62.4	21.6
Tuckahoe Creek	---	---	---	229	6169	3.7	8.5
Turkey Creek	12	Yes	831	1677	10216	16.4	29.3
Whites Creek	11	***	1543	1634	7055	23.2	23.4
Williams Creek	07	Yes	1598	1605	1641	97.8	37.5
Woods Creek	54	Yes	6	143	2608	5.5	23.0
TOTALS		Originally: 17 Currently: 26	**58,484**	**64,357**	**192,528**	**----**	**24.9**

** For the three main rivers, only a small defined portion of the total river watershed is included for the fifth column (Total Acres Within Stream Watershed).

*** East Fork and Whites Creek were each part of one of the 17 original watersheds (Third & First, respectively).

TABLE A-18																	Knoxville Watershed Land Uses
Watershed	Agriculture, Forest, Open, Public Parks	Vacant Land (>10 acres)	Rural Residential	Single Family Residential	Private Recreation, Public Land	Multi Family Residential, Churches	Institutional	Service Industries, Offices, Mining	Manufacturing, Wholesale	Commercial, Transportation, Utility, Commun	Major Roads, Highways, Right-Of-Ways	Under Construction	Unknown Land Use	Total Acres in the Stream Watershed	Total Acres Within Knoxville City Limits	% Impervious For Entire Watershed
% Impervious	*1*	*5*	*20*	*25*	*35*	*40*	*50*	*60*	*72*	*85*	*95*	*100*	----			
Baker Cr.	412	2	107	640	90	77	32	1	1	3	269	13	27	1,674	1,674	32.25
Beaver Cr	21,174	0	0	21,230	1,292	845	4	259	283	712	0	160	0	45,959	162	16.04
East Fork	313	0	10	475	302	78	73	31	195	235	584	33	180	2,509	2,509	52.84
First Cr.	724	0	300	3,152	544	501	110	157	127	556	1,412	51	116	7,750	7,750	43.64
Fourt Cr.	965	57	423	2,026	468	406	93	206	201	568	881	61	414	6,769	5,920	40.93
Fr.Broad riv	8,954	0	0	2,744	73	40	24	24	497	117	0	166	0	12,639	551	11.08
Goose Cr.	639	40	126	669	213	67	8	21	77	131	327	34	29	2,381	1,755	34.72
Grassy Cr.	2,230	176	561	610	215	24	0	14	31	95	211	39	95	4,301	433	17.02
Holston R.	2,362	69	371	1,222	417	45	5	2	219	33	805	32	50	5,632	2,455	27.66
Inman Br.	563	33	214	138	4	12	0	0	0	0	145	0	34	1,143	99	20.61
Knob Cr.	1,719	195	481	843	125	84	1	19	1	29	296	4	169	3,966	989	19.28
Knob Fork	1,659	26	398	675	182	56	5	93	6	124	257	19	252	3,752	823	22.17
Love Cr.	1,735	102	505	1,625	311	212	51	94	178	408	1,038	46	103	6,408	5,090	36.38
Second Cr.	443	0	90	1,281	346	247	29	107	140	542	1,161	35	82	4,503	4,498	52.63
Sinking Cr.	1,614	146	459	1,266	284	90	17	33	31	267	881	12	347	5,447	2,434	33.12
Sinking (East)	1,226	0		728	9	17	0	17	3	27	0	0	0	2,027	91	11.82
Swanpond Cr.	3,892	303	833	604	121	36	4	79	240	232	457	65	285	7,151	499	19.24
Ten Mile Cr.	1,879	0	638	3,421	165	895	55	115	58	615	1,500	24	641	10,006	3,921	37.56
Third Cr.	1,757	79	436	3,003	406	512	184	124	225	443	1,252	98	220	8,739	8,417	37.09
TN River	7,197	503	2,269	4,681	2,910	403	187	72	170	238	990	121	1,113	20,854	8,232	22.16
Toll Cr.	535	69	154	222	42	26	1	0	37	4	93	42	4	1,229	767	21.58
Tuckahoe	4,293	0	0	1,829	18	14	0	8	2	1	0	4	0	6,169	229	8.46
Turkey Cr.	3,353	235	603	2,693	264	343	121	104	91	442	1,161	68	738	10,216	1,677	29.30
Whites Cr.	2,733	154	782	1,298	575	59	31	11	49	126	608	51	578	7,055	1,634	23.37
Williams Cr.	358	11	47	561	46	96	125	17	10	61	276	3	30	1,641	1,605	37.49
Woods Cr.	1,220	106	281	371	0	26	0	2	140	43	261	1	157	2,608	143	23.01
TOTAL	73,949	2,306	10,088	58,007	9,422	5,211	1,160	1,610	3,012	6,052	14,865	1,182	5,664	**192,528**	**64,357**	**24.86**

TABLE A-19
EMC Values for WMM Analysis

	Imperv %	BOD mg/l	COD mg/l	TSS mg/l	TDS mg/l	N+NN mg/l	TKN mg/l	TN mg/l	Pb mg/l	Zn mg/l	DP mg/l	TP mg/l
Original WMM Analysis - CDM, 1993												
Forest/Open/Agriculture/Pasture/Cropland	5.0	8.0	51	216	100	0.73	1.36	----	0.00	0.00	0.06	0.23
Low Density Single Family (LDSF)	10.0	8.5	54	133	62	0.41	0.57	----	0.17	0.12	0.13	0.28
MDSF / Institutional	25.0	17.4	148	614	107	0.49	1.47	----	0.46	0.42	0.15	0.78
High Density Residential (HDR)	45.0	17.4	148	614	107	0.49	1.47	----	0.46	0.42	0.15	0.78
Commercial	90.0	13.5	74	100	68	0.50	0.83	----	0.29	0.17	0.19	0.45
Office / Light Industrial	65.0	12.6	70	116	90	0.60	0.63	----	0.16	0.30	0.05	0.21
Heavy Industrial	80.0	12.6	70	116	90	0.60	0.63	----	0.16	0.30	0.05	0.21
Water and Wetlands	100.0	9.7	61	91	100	0.63	1.28	----	0.13	0.33	0.10	0.24
Major Highway	90.0	9.7	94	104	30	0.74	1.65	----	0.26	0.24	0.17	0.33
Public Recreation / Public Land	35.0	17.4	148	614	107	0.49	1.47	----	0.46	0.42	0.15	0.78
WMM Analysis - COK, 2001												
Agriculture/Forest/Vacant/Public Parks	1.0	5.1	25	205	118	0.73	0.77	1.95	0.017	0.102	0.285	0.485
Vacant lots, greater than 10 acres	5.0	5.1	25	205	118	0.73	0.77	1.95	0.017	0.102	0.285	0.485
Rural Residential	20.0	5.1	25	205	118	0.73	0.77	1.95	0.017	0.102	0.285	0.485
Single Family Residential	25.0	5.1	25	205	118	0.73	0.77	1.95	0.017	0.102	0.285	0.485
Private Recreation / Public Lands	35.0	5.1	25	205	118	0.73	0.77	1.95	0.017	0.102	0.285	0.485
Multi Family Residential / Churches	40.0	5.1	25	205	118	0.73	0.77	1.95	0.017	0.102	0.285	0.485
Institutional	50.0	6.1	37	50	84	0.75	0.65	2.48	0.010	0.159	0.180	0.308
Office / Service	60.0	6.1	37	50	84	0.75	0.65	2.48	0.010	0.159	0.180	0.308
Manufacturing / Wholesale	72.0	6.1	37	165	110	0.75	0.65	2.48	0.010	0.159	0.180	0.308
Commercial / Utilities / Transportation	85.0	6.1	37	165	110	0.75	0.65	2.48	0.010	0.159	0.180	0.308
Major Roads / Highways / Right-Of-Way	95.0	6.1	37	165	110	0.75	0.65	2.48	0.010	0.159	0.180	0.308
Under Construction	100.0	6.1	37	165	110	0.75	0.65	2.48	0.010	0.159	0.180	0.308

TABLE A-20 Seasonal Pollutant Loadings - Quarter 01 (Winter)								
Watershed	A Area in City Limits	C Value	% Impervious over entire watershed	Flow Volume	P: Average quarterly inches of rainfall:			9.46
					BOD	**COD**	**TSS**	**TDS**
Baker Creek	1,674	0.41	32.25	175.4	7,760	30,454	110,397	271,014
Beaver Creek	162	0.28	16.00	11.6	502	2,008	7,279	17,870
East Fork (Third)	2,509	0.57	52.80	368.9	16,009	64,037	232,136	569,871
First Creek	7,750	0.50	43.64	993.6	43,120	172,481	625,242	1,534,911
Fourth Creek	5,920	0.48	40.90	725.6	31,492	125,967	456,629	1,120,982
French Broad River	551	0.24	11.10	33.8	1,467	5,867	21,268	52,211
Goose Creek	1,755	0.43	34.70	192.8	8,365	33,462	121,299	297,777
Grassy Creek	433	0.29	17.00	31.8	1,380	5,522	20,017	49,139
Holston River	2,455	0.37	27.70	234.3	10,170	40,678	147,458	361,996
Inman Branch	99	0.31	20.60	8.0	347	1,390	5,037	12,366
Knob Creek	989	0.30	19.30	77.3	3,356	13,424	48,661	119,459
Knob Fork	823	0.33	22.20	69.3	3,006	12,022	43,580	106,984
Love Creek	5,090	0.44	36.40	576.8	25,034	100,135	362,990	891,107
Second Creek	4,498	0.57	52.60	659.5	28,620	114,482	414,997	1,018,779
Sinking Creek	2,434	0.41	33.10	259.3	11,255	45,019	163,193	400,623
Sinking Creek (East)	91	0.24	11.80	5.7	248	992	3,595	8,825
Swanpond Creek	499	0.30	19.20	38.9	1,689	6,755	24,487	60,114
Ten Mile Creek	3,921	0.45	37.60	454.0	19,704	78,816	285,708	701,386
Third Creek	8,417	0.45	37.10	966.0	41,922	167,689	607,872	1,492,269
Tennessee River	8,232	0.33	22.20	692.7	30,062	120,249	435,904	1,070,104
Toll Creek	767	0.32	21.60	63.6	2,760	11,040	40,019	98,244
Tuckahoe Creek	229	0.22	8.50	12.8	557	2,226	8,069	19,809
Turkey Creek	1,677	0.38	29.30	165.6	7,186	28,744	104,198	255,796
Whites Creek	1,634	0.34	23.40	141.5	6,142	24,568	89,060	218,633
Williams Creek	1,605	0.45	37.50	185.5	8,051	32,205	116,743	286,592
Woods Creek	143	0.33	23.00	12.3	532	2,130	7,720	18,952
TOTALS	**64,357** Acres		**23.91** % Imperv	**7,157** Million gallons	**310,737** Pounds	**1,242,361** Pounds	**4,503,558** Pounds	**11,055,818** Pounds

TABLE A-20 (continued)
Seasonal Pollutant Loadings - Quarter 01 (Winter)

Watershed	Pounds: (using the average quarterly rainfall of: 9.46							
	N+NN	NH_3	TKN	TN	Pb	Zn	TP	PO_4
Baker Creek	1,318	146	864	805	16	136	1,757	123
Beaver Creek	87	10	57	53	1	9	116	8
East Fork (Third)	2,771	308	1,816	1,693	33	286	3,694	259
First Creek	7,463	829	4,892	4,561	89	771	9,951	697
Fourth Creek	5,450	606	3,573	3,331	65	563	7,267	509
French Broad River	254	28	166	155	3	26	338	24
Goose Creek	1,448	161	949	885	17	150	1,930	135
Grassy Creek	239	27	157	146	3	25	319	22
Holston River	1,760	196	1,154	1,076	21	182	2,347	164
Inman Branch	60	7	39	37	1	6	80	6
Knob Creek	581	65	381	355	7	60	774	54
Knob Fork	520	58	341	318	6	54	694	49
Love Creek	4,333	481	2,840	2,648	52	448	5,777	404
Second Creek	4,954	550	3,247	3,027	59	512	6,605	462
Sinking Creek	1,948	216	1,277	1,190	23	201	2,597	182
Sinking Creek (East)	43	5	28	26	1	4	57	4
Swanpond Creek	292	32	192	179	3	30	390	27
Ten Mile Creek	3,410	379	2,236	2,084	41	352	4,547	318
Third Creek	7,256	806	4,757	4,434	86	750	9,674	677
Tennessee River	5,203	578	3,411	3,180	62	538	6,937	486
Toll Creek	478	53	313	292	6	49	637	45
Tuckahoe Creek	96	11	63	59	1	10	128	9
Turkey Creek	1,244	138	815	760	15	129	1,658	116
Whites Creek	1,063	118	697	650	13	110	1,417	99
Williams Creek	1,393	155	914	852	17	144	1,858	130
Woods Creek	92	10	60	56	1	10	123	9
TOTALS	**53,756** Pounds	**5,973** Pounds	**35,240** Pounds	**32,851** Pounds	**639** Pounds	**5,555** Pounds	**71,675** Pounds	**5,017** Pounds

TABLE A-21 Seasonal Pollutant Loadings - Quarter 02 (Spring)								
Watershed	A Area in City Limits	C Value	% Impervious over entire watershed	Flow Volume	P: Average quarterly inches of rainfall:			10.09
					BOD	COD	TSS	TDS
Baker Creek	1,674	0.41	32.25	187.1	11,712	60,280	127,275	258,298
Beaver Creek	162	0.28	16.00	12.3	772	3,975	8,392	17,032
East Fork (Third)	2,509	0.57	52.80	393.5	24,628	126,753	267,626	543,133
First Creek	7,750	0.50	43.64	1,059.8	66,334	341,401	720,833	1,462,893
Fourth Creek	5,920	0.48	40.90	774.0	48,446	249,333	526,441	1,068,385
French Broad River	551	0.24	11.10	36.0	2,256	11,613	24,520	49,761
Goose Creek	1,755	0.43	34.70	205.6	12,869	66,233	139,844	283,805
Grassy Creek	433	0.29	17.00	33.9	2,124	10,930	23,077	46,834
Holston River	2,455	0.37	27.70	249.9	15,644	80,516	170,002	345,011
Inman Branch	99	0.31	20.60	8.5	534	2,751	5,808	11,786
Knob Creek	989	0.30	19.30	82.5	5,163	26,570	56,101	113,854
Knob Fork	823	0.33	22.20	73.9	4,624	23,796	50,243	101,965
Love Creek	5,090	0.44	36.40	615.3	38,511	198,203	418,486	849,296
Second Creek	4,498	0.57	52.60	703.4	44,029	226,601	478,444	970,977
Sinking Creek	2,434	0.41	33.10	276.6	17,314	89,108	188,143	381,826
Sinking Creek (East)	91	0.24	11.80	6.1	381	1,963	4,144	8,411
Swanpond Creek	499	0.30	19.20	41.5	2,598	13,371	28,231	57,294
Ten Mile Creek	3,921	0.45	37.60	484.3	30,312	156,005	329,389	668,477
Third Creek	8,417	0.45	37.10	1,030.3	64,491	331,916	700,807	1,422,251
Tennessee River	8,232	0.33	22.20	738.8	46,247	238,016	502,547	1,019,894
Toll Creek	767	0.32	21.60	67.8	4,246	21,852	46,138	93,634
Tuckahoe Creek	229	0.22	8.50	13.7	856	4,406	9,303	18,880
Turkey Creek	1,677	0.38	29.30	176.6	11,055	56,895	120,128	243,794
Whites Creek	1,634	0.34	23.40	151.0	9,449	48,629	102,676	208,375
Williams Creek	1,605	0.45	37.50	197.9	12,386	63,745	134,591	273,145
Woods Creek	143	0.33	23.00	13.1	819	4,215	8,900	18,063
TOTALS	**64,357** Acres		**23.91** % Imperv	**7,633** Million gallons	**477,800** Pounds	**2,459,075** Pounds	**5,192,088** Pounds	**10,537,073** Pounds

TABLE A-21 (continued)
Seasonal Pollutant Loadings - Quarter 02 (Spring)

Watershed	Pounds: (using the average quarterly rainfall of:							10.09
	N+NN	NH_3	TKN	TN	Pb	Zn	TP	PO_4
Baker Creek	1,405	312	1,515	1,327	15	172	367	69
Beaver Creek	93	21	100	88	1	11	24	5
East Fork (Third)	2,955	657	3,185	2,791	33	361	772	144
First Creek	7,960	1,769	8,579	7,518	88	973	2,078	389
Fourth Creek	5,813	1,292	6,266	5,490	64	711	1,518	284
French Broad River	271	60	292	256	3	33	71	13
Goose Creek	1,544	343	1,664	1,458	17	189	403	75
Grassy Creek	255	57	275	241	3	31	67	12
Holston River	1,877	417	2,023	1,773	21	229	490	92
Inman Branch	64	14	69	61	1	8	17	3
Knob Creek	620	138	668	585	7	76	162	30
Knob Fork	555	123	598	524	6	68	145	27
Love Creek	4,621	1,027	4,981	4,365	51	565	1,207	226
Second Creek	5,283	1,174	5,694	4,990	58	646	1,380	258
Sinking Creek	2,078	462	2,239	1,962	23	254	542	102
Sinking Creek (East)	46	10	49	43	1	6	12	2
Swanpond Creek	312	69	336	294	3	38	81	15
Ten Mile Creek	3,637	808	3,920	3,435	40	445	950	178
Third Creek	7,739	1,720	8,341	7,309	85	946	2,021	378
Tennessee River	5,550	1,233	5,981	5,241	61	678	1,449	271
Toll Creek	509	113	549	481	6	62	133	25
Tuckahoe Creek	103	23	111	97	1	13	27	5
Turkey Creek	1,327	295	1,430	1,253	15	162	346	65
Whites Creek	1,134	252	1,222	1,071	12	139	296	55
Williams Creek	1,486	330	1,602	1,404	16	182	388	73
Woods Creek	98	22	106	93	1	12	26	5
TOTALS	**57,336** Pounds	**12,741** Pounds	**61,795** Pounds	**54,151** Pounds	**631** Pounds	**7,008** Pounds	**14,971** Pounds	**2,803** Pounds

TABLE A-22
Seasonal Pollutant Loadings - Quarter 03 (Summer)

Watershed	A Area in City Limits	C Value	% Impervious over entire watershed	Flow Volume	P: Average quarterly inches of rainfall:			10.94
					BOD	COD	TSS	TDS
Baker Creek	1,674	0.41	32.25	202.9	11,514	75,348	285,815	254,490
Beaver Creek	162	0.28	16.00	13.4	759	4,968	18,846	16,781
East Fork (Third)	2,509	0.57	52.80	426.6	24,211	158,437	600,993	535,126
First Creek	7,750	0.50	43.64	1,149.0	65,210	426,740	1,618,734	1,441,325
Fourth Creek	5,920	0.48	40.90	839.2	47,624	311,658	1,182,200	1,052,634
French Broad River	551	0.24	11.10	39.1	2,218	14,516	55,062	49,028
Goose Creek	1,755	0.43	34.70	222.9	12,651	82,789	314,039	279,621
Grassy Creek	433	0.29	17.00	36.8	2,088	13,662	51,823	46,143
Holston River	2,455	0.37	27.70	271.0	15,379	100,643	381,765	339,925
Inman Branch	99	0.31	20.60	9.3	525	3,438	13,042	11,612
Knob Creek	989	0.30	19.30	89.4	5,075	33,212	125,982	112,175
Knob Fork	823	0.33	22.20	80.1	4,545	29,744	112,827	100,461
Love Creek	5,090	0.44	36.40	667.1	37,858	247,748	939,771	836,775
Second Creek	4,498	0.57	52.60	762.7	43,282	283,243	1,074,415	956,663
Sinking Creek	2,434	0.41	33.10	299.9	17,020	111,382	422,501	376,196
Sinking Creek (East)	91	0.24	11.80	6.6	375	2,454	9,307	8,287
Swanpond Creek	499	0.30	19.20	45.0	2,554	16,713	63,397	56,449
Ten Mile Creek	3,921	0.45	37.60	525.1	29,798	195,001	739,690	658,622
Third Creek	8,417	0.45	37.10	1,117.1	63,398	414,884	1,573,763	1,401,283
Tennessee River	8,232	0.33	22.20	801.1	45,463	297,513	1,128,543	1,004,858
Toll Creek	767	0.32	21.60	73.5	4,174	27,314	103,609	92,254
Tuckahoe Creek	229	0.22	8.50	14.8	842	5,507	20,891	18,601
Turkey Creek	1,677	0.38	29.30	191.5	10,867	71,117	269,765	240,199
Whites Creek	1,634	0.34	23.40	163.7	9,288	60,785	230,573	205,303
Williams Creek	1,605	0.45	37.50	214.5	12,176	79,679	302,243	269,118
Woods Creek	143	0.33	23.00	14.2	805	5,269	19,987	17,797
TOTALS	**64,357** Acres		**23.91** % Imperv	**8,276** Million gallons	**469,699** Pounds	**3,073,765** Pounds	**11,659,585** Pounds	**10,381,727** Pounds

TABLE A-22 (continued)
Seasonal Pollutant Loadings - Quarter 03 (Summer)

Watershed	Pounds: (using the average quarterly rainfall of: 10.94							
	N+NN	NH_3	TKN	TN	Pb	Zn	TP	PO_4
Baker Creek	1,067	254	1,422	1,270	25	186	322	63
Beaver Creek	70	17	94	84	2	12	21	4
East Fork (Third)	2,243	534	2,991	2,670	53	392	676	132
First Creek	6,041	1,438	8,055	7,192	144	1,055	1,822	355
Fourth Creek	4,412	1,051	5,883	5,253	105	770	1,331	259
French Broad River	206	49	274	245	5	36	62	12
Goose Creek	1,172	279	1,563	1,395	28	205	353	69
Grassy Creek	193	46	258	230	5	34	58	11
Holston River	1,425	339	1,900	1,696	34	249	430	84
Inman Branch	49	12	65	58	1	8	15	3
Knob Creek	470	112	627	560	11	82	142	28
Knob Fork	421	100	561	501	10	74	127	25
Love Creek	3,507	835	4,677	4,176	84	612	1,058	206
Second Creek	4,010	955	5,347	4,774	95	700	1,209	236
Sinking Creek	1,577	375	2,102	1,877	38	275	476	93
Sinking Creek (East)	35	8	46	41	1	6	10	2
Swanpond Creek	237	56	315	282	6	41	71	14
Ten Mile Creek	2,761	657	3,681	3,287	66	482	833	162
Third Creek	5,874	1,398	7,832	6,992	140	1,026	1,771	345
Tennessee River	4,212	1,003	5,616	5,014	100	735	1,270	247
Toll Creek	387	92	516	460	9	68	117	23
Tuckahoe Creek	78	19	104	93	2	14	24	5
Turkey Creek	1,007	240	1,342	1,199	24	176	304	59
Whites Creek	861	205	1,147	1,024	20	150	260	51
Williams Creek	1,128	269	1,504	1,343	27	197	340	66
Woods Creek	75	18	99	89	2	13	22	4
TOTALS	**43,516** Pounds	**10,361** Pounds	**58,022** Pounds	**51,805** Pounds	**1,036** Pounds	**7,598** Pounds	**13,124** Pounds	**2,556** Pounds

TABLE A-23 Seasonal Pollutant Loadings - Quarter 04 (Fall)								
Watershed	A Area in City Limits	C Value	% Impervious over entire watershed	Flow Volume	P: Average quarterly inches of rainfall:			10.10
					BOD	COD	TSS	TDS
Baker Creek	1,674	0.41	32.25	187.3	9,692	24,699	174,141	209,782
Beaver Creek	162	0.28	16.00	12.4	639	1,629	11,483	13,833
East Fork (Third)	2,509	0.57	52.80	393.8	20,379	51,935	366,173	441,116
First Creek	7,750	0.50	43.64	1,060.8	54,891	139,883	986,262	1,188,118
Fourth Creek	5,920	0.48	40.90	774.7	40,088	102,160	720,291	867,711
French Broad River	551	0.24	11.10	36.1	1,867	4,758	33,548	40,415
Goose Creek	1,755	0.43	34.70	205.8	10,649	27,138	191,338	230,498
Grassy Creek	433	0.29	17.00	34.0	1,757	4,478	31,575	38,037
Holston River	2,455	0.37	27.70	250.2	12,946	32,990	232,602	280,208
Inman Branch	99	0.31	20.60	8.5	442	1,127	7,946	9,572
Knob Creek	989	0.30	19.30	82.6	4,272	10,887	76,759	92,469
Knob Fork	823	0.33	22.20	73.9	3,826	9,750	68,743	82,813
Love Creek	5,090	0.44	36.40	615.9	31,867	81,210	572,584	689,773
Second Creek	4,498	0.57	52.60	704.1	36,433	92,846	654,620	788,599
Sinking Creek	2,434	0.41	33.10	276.9	14,327	36,510	257,422	310,108
Sinking Creek (East)	91	0.24	11.80	6.1	316	804	5,671	6,831
Swanpond Creek	499	0.30	19.20	41.5	2,150	5,478	38,627	46,532
Ten Mile Creek	3,921	0.45	37.60	484.7	25,083	63,920	450,678	542,917
Third Creek	8,417	0.45	37.10	1,031.3	53,366	135,997	958,862	1,155,110
Tennessee River	8,232	0.33	22.20	739.6	38,268	97,523	687,598	828,328
Toll Creek	767	0.32	21.60	67.9	3,513	8,953	63,127	76,047
Tuckahoe Creek	229	0.22	8.50	13.7	708	1,805	12,729	15,334
Turkey Creek	1,677	0.38	29.30	176.8	9,148	23,312	164,362	198,002
Whites Creek	1,634	0.34	23.40	151.1	7,819	19,925	140,483	169,236
Williams Creek	1,605	0.45	37.50	198.1	10,249	26,118	184,151	221,840
Woods Creek	143	0.33	23.00	13.1	678	1,727	12,178	14,670
TOTALS	64,357 Acres		23.91 % Imperv	7,641 Million gallons	395,372 Pounds	1,007,562 Pounds	7,103,950 Pounds	8,557,900 Pounds

TABLE A-23 (continued)
Seasonal Pollutant Loadings - Quarter 04 (Fall)

Watershed	Pounds: (using the average quarterly rainfall of: 10.10							
	N+NN	NH_3	TKN	TN	Pb	Zn	TP	PO_4
Baker Creek	703	203	891	750	28	166	270	138
Beaver Creek	46	13	59	49	2	11	18	9
East Fork (Third)	1,479	427	1,874	1,578	58	348	569	289
First Creek	3,984	1,151	5,046	4,250	156	938	1,532	779
Fourth Creek	2,910	841	3,686	3,104	114	685	1,119	569
French Broad River	136	39	172	145	5	32	52	27
Goose Creek	773	223	979	824	30	182	297	151
Grassy Creek	128	37	162	136	5	30	49	25
Holston River	940	271	1,190	1,002	37	221	361	184
Inman Branch	32	9	41	34	1	8	12	6
Knob Creek	310	90	393	331	12	73	119	61
Knob Fork	278	80	352	296	11	65	107	54
Love Creek	2,313	668	2,930	2,467	90	545	889	452
Second Creek	2,644	764	3,349	2,821	103	623	1,017	517
Sinking Creek	1,040	300	1,317	1,109	41	245	400	203
Sinking Creek (East)	23	7	29	24	1	5	9	4
Swanpond Creek	156	45	198	166	6	37	60	31
Ten Mile Creek	1,821	526	2,306	1,942	71	429	700	356
Third Creek	3,873	1,119	4,906	4,132	151	912	1,489	757
Tennessee River	2,778	802	3,518	2,963	109	654	1,068	543
Toll Creek	255	74	323	272	10	60	98	50
Tuckahoe Creek	51	15	65	55	2	12	20	10
Turkey Creek	664	192	841	708	26	156	255	130
Whites Creek	567	164	719	605	22	134	218	111
Williams Creek	744	215	942	793	29	175	286	145
Woods Creek	49	14	62	52	2	12	19	10
TOTALS	**28,696** Pounds	**8,290** Pounds	**36,349** Pounds	**30,609** Pounds	**1,122** Pounds	**6,760** Pounds	**11,032** Pounds	**5,612** Pounds

TABLE A-24 Summary of Seasonal Pollutant Loadings					
	01 Winter (Jan - March)	02 Spring (Apr - June)	03 Summer (July - Sep)	04 Fall (Oct - Dec)	Rain and Runoff Totals
Average Rainfall (inches)	9.46	10.09	10.94	10.10	**40.59**
Runoff Volume (million gallons)	7,157	7,633	8,276	7,641	**30,707**
Pollutants (in pounds)					Summary Totals
BOD	310,737	477,800	469,699	395,372	**1,653,608**
COD	1,242,361	2,459,075	3,073,765	1,007,562	**7,782,763**
TSS	4,503,558	5,192,088	11,659,585	7,103,950	**28,459,181**
TDS	11,055,818	10,537,073	10,381,727	8,557,900	**40,532,517**
N+NN	53,756	57,336	43,516	28,696	**183,305**
NH_3	5,973	12,741	10,361	8,290	**37,365**
TKN	35,240	61,795	58,022	36,349	**191,406**
TN	32,851	54,151	51,805	30,609	**169,416**
Pb	639	631	1,036	1,122	**3,428**
Zn	5,555	7,008	7,598	6,760	**26,920**
TP	71,675	14,971	13,124	11,032	**110,802**
PO_4	5,017	2,803	2,556	5,612	**15,988**

A.8 REFERENCES

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APPENDIX B

Dry Weather Screening Results Summary

1. List of outfalls tested during the permit year with status (10 pages)
2. Table of testing results for outfalls with dry-weather flow (9 pages)

Dry Weather Screening - Sample Events for 2009

Outfall Name	Outfall Status	Visit #1	Visit #2	Visit #3	Visit #4
00-300-0230	DRY	8/11/2008	8/11/2008	2/20/2009	2/20/2009
00-300-0285	DRY	8/11/2008	8/11/2008	2/20/2009	2/20/2009
00-400-0370	DRY	8/11/2008	8/11/2008	2/20/2009	2/20/2009
00-400-0375	DRY	10/31/2008	10/31/2008	2/20/2009	2/20/2009
00-300-0385	WET	8/11/2008	8/11/2008	2/20/2009	2/20/2009
00-400-0485	DRY	10/31/2008	10/31/2008	2/20/2009	2/20/2009
00-200-0520	DRY	9/29/2008	9/29/2008	2/20/2009	2/20/2009
01-300-0050	DRY	7/28/2008	7/28/2008	11/3/2008	11/3/2008
01-300-0055	DRY	7/28/2008	7/28/2008	11/3/2008	11/3/2008
01-300-0060	WET	7/28/2008	7/28/2008	11/3/2008	11/3/2008
01-300-0065	DRY	7/28/2008	7/28/2008	11/3/2008	11/3/2008
01-300-0070	ILLICIT CONNECTION	7/28/2007	7/28/2007	11/3/2008	11/3/2008
01-300-0085	DRY	7/28/2008	7/28/2008	11/3/2008	11/3/2008
01-300-0090	DRY	7/28/2008	7/28/2008	11/3/2008	11/3/2008
01-300-0095	DRY	7/28/2008	7/28/2008	11/3/2008	11/3/2008
01-300-0100	DRY	7/28/2008	7/28/2008	11/3/2008	11/3/2008
01-300-0110	DRY	7/30/2008	7/30/2008	11/3/2008	11/3/2008
01-300-0115	WET	7/30/2008	7/30/2008	11/3/2008	11/3/2008
01-300-0120	DRY	7/30/2008	7/30/2008	11/3/2008	11/3/2008
01-300-0125	DRY	7/30/2008	7/30/2008	11/3/2008	11/3/2008
01-300-0145	DRY	8/13/2008	8/13/2008	11/3/2008	11/3/2008
01-300-0160	ILLICIT CONNECTION	7/30/2008	7/30/2008	2/9/2009	2/9/2009
01-300-0200	DRY	7/30/2008	7/30/2008	2/9/2009	2/9/2009
01-100-0210	DRY	7/30/2008	7/30/2008	2/9/2009	2/9/2009
01-200-0215	DRY	7/30/2008	7/30/2008	2/9/2009	2/9/2009
01-400-0216	DRY	10/29/2008	10/29/2008	2/9/2009	2/9/2009

Outfall Name	Outfall Status	Visit #1	Visit #2	Visit #3	Visit #4
01-100-0225	DRY	8/11/2008	8/11/2008	2/13/2009	2/13/2009
01-400-0275	DRY	10/29/2008	10/29/2008	2/13/2009	2/13/2009
01-100-0280	DRY	8/11/2008	8/11/2008	2/13/2009	2/13/2009
01-400-0312	DRY	8/11/2008	8/11/2008	2/13/2009	2/13/2009
01-400-0315	DRY	10/29/2008	10/29/2008	2/13/2009	2/13/2009
01-400-0323	DRY	10/29/2008	10/29/2008	2/13/2009	2/13/2009
01-200-0325	DRY	8/11/2008	8/11/2008	2/13/2009	2/13/2009
01-400-0390	DRY	10/29/2008	10/29/2008	2/13/2009	2/13/2009
01-300-0395	WET	8/11/2008	8/11/2008	2/13/2009	2/13/2009
01-400-0399	DRY	10/29/2008	10/29/2008	2/13/2009	2/13/2009
01-200-0400	DRY	9/8/2008	9/8/2008	2/13/2009	2/13/2009
01-400-0405	DRY	10/29/2008	10/29/2008	2/13/2009	2/13/2009
01-400-0415	DRY	8/11/2008	8/11/2008	2/13/2009	2/13/2009
01-400-0425	DRY	10/29/2008	10/29/2008	12/3/2008	12/3/2008
01-200-0430	DRY	8/11/2008	8/11/2008	12/3/2008	12/3/2008
01-400-0465	DRY	9/8/2008	9/8/2008	12/3/2008	12/3/2008
01-100-0560	WET	9/8/2008	9/8/2008	12/3/2008	12/3/2008
01-400-0565	DRY	10/21/2008	10/21/2008	12/3/2008	12/3/2008
01-400-0670	DRY	9/8/2008	9/8/2008	12/3/2008	12/3/2008
01-200-0690	DRY	9/8/2008	9/8/2008	12/3/2008	12/3/2008
01-200-0695	WET	9/8/2008	9/8/2008	12/3/2008	12/3/2008
01-400-0705	DRY	9/8/2008	9/8/2008	12/3/2008	12/3/2008
01-200-0715	WET	8/13/2008	8/13/2008	12/3/2008	12/3/2008
01-400-0780	DRY	10/21/2008	10/21/2008	12/3/2008	12/3/2008
01-400-0785	DRY	10/21/2008	10/21/2008	12/3/2008	12/3/2008
01-400-0790	DRY	10/21/2008	10/21/2008	12/3/2008	12/3/2008
01-400-0795	DRY	10/21/2008	10/21/2008	12/3/2008	12/3/2008
01-400-0800	DRY	10/21/2008	10/21/2008	12/3/2008	12/3/2008

Outfall Name	Outfall Status	Visit #1	Visit #2	Visit #3	Visit #4
01-200-0810	DRY	8/13/2008	8/13/2008	12/30/2008	12/30/2008
01-200-0845	DRY	8/13/2008	8/13/2008	12/30/2008	12/30/2008
01-200-0850	DRY	8/13/2008	8/13/2008	12/30/2008	12/30/2008
01-400-0865	DRY	10/21/2008	10/21/2008	12/30/2008	12/30/2008
01-400-0870	DRY	10/21/2008	10/21/2008	12/30/2008	12/30/2008
01-400-0880	DRY	10/21/2008	10/21/2008	12/30/2008	12/30/2008
01-300-0916	DRY	8/13/2008	8/13/2008	12/30/2008	12/30/2008
01-300-0918	DRY	8/13/2008	8/13/2008	12/30/2008	12/30/2008
02-400-0050	ILLICIT CONNECTION	8/22/2008	8/22/2008	11/18/2008	11/19/2008
02-100-0053	DRY	8/22/2008	8/22/2008	11/18/2008	11/19/2008
02-400-0055	DRY	8/22/2008	8/22/2008	11/18/2008	11/19/2008
02-400-0122	DRY	10/10/2008	10/10/2008	11/18/2008	11/19/2008
02-300-0164	DRY	8/22/2008	8/22/2008	11/18/2008	11/19/2008
02-300-0165	DRY	8/22/2008	8/22/2008	11/18/2008	11/19/2008
02-300-0166	DRY	8/22/2008	8/22/2008	11/18/2008	11/19/2008
02-300-0167	DRY	8/22/2008	8/22/2008	11/18/2008	11/19/2008
02-300-0177	DRY	8/22/2008	8/22/2008	11/18/2008	11/19/2008
02-300-0180	ILLICIT CONNECTION	8/22/2008	8/22/2008	11/18/2008	11/19/2008
02-300-0253	DRY	8/22/2008	8/22/2008	11/18/2008	11/19/2008
02-400-0255	DRY	10/10/2008	10/10/2008	11/18/2008	11/19/2008
02-300-0270	DRY	8/22/2008	8/22/2008	11/18/2008	11/19/2008
02-400-0364	DRY	10/10/2008	10/10/2008	11/18/2008	11/19/2008
02-200-0437	DRY	9/24/2008	9/24/2008	11/18/2008	11/19/2008
02-400-0447	DRY	10/10/2008	10/10/2008	11/18/2008	11/19/2008
02-400-0460	DRY	9/24/2008	9/24/2008	11/18/2008	11/19/2008
02-400-0470	DRY	10/10/2008	10/10/2008	2/9/2009	2/9/2009
02-400-0475	DRY	9/24/2008	9/24/2008	2/9/2009	2/9/2009
02-400-0485	DRY	9/24/2008	9/24/2008	2/9/2009	2/9/2009

Outfall Name	Outfall Status	Visit #1	Visit #2	Visit #3	Visit #4
02-400-0489	WET	10/10/2008	10/10/2008	2/9/2009	2/9/2009
02-400-0502	DRY	10/10/2008	10/10/2008	2/9/2009	2/9/2009
02-400-0510	DRY	10/10/2008	10/10/2008	2/9/2009	2/9/2009
02-400-0520	WET	10/31/2008	10/31/2008	2/9/2009	2/9/2009
02-200-0530	DRY	9/24/2008	9/24/2008	2/9/2009	2/9/2009
03-300-0005	DRY	9/25/2008	9/25/2008	2/23/2009	2/23/2009
03-100-0090	DRY	9/25/2008	9/25/2008	2/23/2009	2/23/2009
03-400-0095	DRY	9/25/2008	9/25/2008	2/23/2009	2/23/2009
03-400-0360	DRY	10/14/2008	10/14/2008	2/23/2009	2/23/2009
03-100-0374	WET	9/25/2008	9/25/2008	12/23/2008	12/23/2008
03-400-0378	DRY	10/14/2008	10/14/2008	12/23/2008	12/23/2008
03-100-0379	DRY	9/25/2008	9/25/2008	12/23/2008	12/23/2008
03-400-0392	WET	10/14/2008	10/14/2008	12/23/2008	12/23/2008
03-300-0398	WET	9/25/2008	9/25/2008	12/23/2008	12/23/2008
03-300-0399	DRY	9/25/2008	9/25/2008	12/23/2008	12/23/2008
03-100-0403	WET	9/25/2008	9/25/2008	12/23/2008	12/23/2008
03-400-0404	WET	10/14/2008	10/14/2008	12/23/2008	12/23/2008
03-200-0436	DRY	9/25/2008	9/25/2008	12/23/2008	12/23/2008
03-100-0450	DRY	9/25/2008	9/25/2008	3/3/2009	3/3/2009
03-300-0460	DRY	9/25/2008	9/25/2008	3/3/2009	3/3/2009
03-400-0525	DRY	10/14/2008	10/14/2008	3/3/2009	3/3/2009
03-400-0552	WET	10/14/2008	10/14/2008	3/3/2009	3/3/2009
03-200-0579	DRY	9/29/2008	9/29/2008	3/3/2009	3/3/2009
03-400-0585	DRY	10/14/2008	10/14/2008	3/3/2009	3/3/2009
03-400-0590	DRY	9/29/2008	9/29/2008	3/3/2009	3/3/2009
03-100-0620	WET	9/29/2008	9/29/2008	3/3/2009	3/3/2009
03-300-0629	DRY	9/29/2008	9/29/2008	3/3/2009	3/3/2009
03-300-0631	DRY	9/29/2008	9/29/2008	3/3/2009	3/3/2009

Outfall Name	Outfall Status	Visit #1	Visit #2	Visit #3	Visit #4
03-300-0660	WET	9/29/2008	9/29/2008	4/8/2009	4/8/2009
03-300-0670	WET	9/29/2008	9/29/2008	4/8/2009	4/8/2009
03-200-0680	DRY	9/25/2008	9/25/2008	4/8/2009	4/8/2009
03-400-0695	DRY	10/14/2008	10/14/2008	3/30/2009	3/30/2009
03-400-0700	DRY	10/14/2008	10/14/2008	3/30/2009	3/30/2009
03-400-0705	DRY	10/14/2008	10/14/2008	3/30/2009	3/30/2009
03-400-0710	DRY	10/14/2008	10/14/2008	3/30/2009	3/30/2009
03-400-0715	DRY	9/22/2008	9/22/2008	3/30/2009	3/30/2009
03-400-0730	DRY	10/14/2008	10/14/2008	3/30/2009	3/30/2009
03-400-0800	DRY	10/14/2008	10/14/2008	3/30/2009	3/30/2009
03-400-0815	DRY	10/14/2008	10/14/2008	3/30/2009	3/30/2009
03-400-0835	WET	9/22/2008	9/22/2008	3/30/2009	3/30/2009
03-400-0850	DRY	10/14/2008	10/14/2008	3/30/2009	3/30/2009
03-400-0860	DRY	10/14/2008	10/14/2008	3/30/2009	3/30/2009
03-400-0885	DRY	9/22/2008	9/22/2008	3/19/2009	3/19/2009
03-400-0890	DRY	10/27/2008	10/27/2008	3/19/2009	3/19/2009
03-400-0906	WET	9/22/2008	9/22/2008	3/19/2009	3/19/2009
03-200-0907	WET	9/22/2008	9/22/2008	3/19/2009	3/19/2009
03-400-0910	DRY	10/27/2008	10/27/2008	3/19/2009	3/19/2009
03-400-0935	DRY	10/27/2008	10/27/2008	3/19/2009	3/19/2009
03-400-0940	DRY	10/27/2008	10/27/2008	3/19/2009	3/19/2009
03-400-0945	DRY	9/22/2008	9/22/2008	3/16/2009	3/16/2009
03-400-0955	DRY	10/27/2008	10/27/2008	3/19/2009	3/19/2009
04-400-0005	DRY	10/22/2008	10/22/2008	3/24/2009	3/24/2009
04-400-0085	WET	10/22/2008	10/22/2008	3/24/2009	3/24/2009
04-400-0105	DRY	10/22/2008	10/22/2008	3/24/2009	3/24/2009
04-400-0130	DRY	10/22/2008	10/22/2008	3/24/2009	3/24/2009
04-100-0143	DRY	9/22/2008	9/22/2008	3/23/2009	3/23/2009

Outfall Name	Outfall Status	Visit #1	Visit #2	Visit #3	Visit #4
04-400-0144	DRY	10/22/2008	10/22/2008	3/23/2009	3/23/2009
04-100-0155	DRY	9/22/2008	9/22/2008	3/23/2009	3/23/2009
04-400-0170	DRY	10/22/2008	10/22/2008	3/23/2009	3/23/2009
04-400-0175	DRY	9/26/2008	9/26/2008	3/23/2009	3/23/2009
04-400-0185	DRY	9/2/2008	9/2/2008	3/23/2009	3/23/2009
04-200-0203	DRY	9/2/2008	9/2/2008	3/23/2009	3/23/2009
04-400-0215	DRY	10/22/2008	10/22/2008	3/23/2009	3/23/2009
04-400-0220	DRY	10/22/2008	10/22/2008	3/23/2009	3/23/2009
04-400-0225	DRY	10/22/2008	10/22/2008	3/23/2006	3/23/2006
04-400-0230	DRY	10/31/2008	10/31/2008	3/24/2009	3/24/2009
04-400-0235	DRY	10/31/2008	10/31/2008	3/24/2009	3/24/2009
04-400-0242	DRY	9/22/2008	9/22/2008	3/24/2009	3/24/2009
04-400-0244	DRY	10/22/2008	10/22/2008	3/24/2009	3/24/2009
04-400-0255	WET	10/22/2008	10/22/2008	3/10/2009	3/10/2009
04-400-0258	DRY	10/22/2008	10/22/2008	3/10/2009	3/10/2009
04-400-0262	WET	10/22/2008	10/22/2008	3/10/2009	3/10/2009
04-400-0263	WET	10/22/2008	10/22/2008	3/10/2009	3/10/2009
04-300-0291	DRY	9/2/2008	9/2/2008	3/10/2009	3/10/2009
04-400-0293	DRY	9/2/2008	9/2/2008	3/10/2009	3/10/2009
04-400-0315	DRY	9/2/2008	9/2/2008	3/10/2009	3/10/2009
04-100-0323	DRY	9/2/2008	9/2/2008	3/10/2009	3/10/2009
04-300-0352	DRY	9/2/2008	9/2/2008	3/10/2009	3/10/2009
04-300-0354	DRY	9/2/2008	9/2/2008	3/10/2009	3/10/2009
04-300-0359	DRY	9/2/2008	9/2/2008	3/10/2009	3/10/2009
04-300-0378	DRY	9/2/2008	9/2/2008	3/10/2009	3/10/2009
05-400-0160	DRY	10/30/2008	10/30/2008	3/5/2009	3/5/2009
05-300-0222	WET	9/23/2008	9/23/2008	3/5/2009	3/5/2009
05-400-0250	DRY	10/30/2008	10/30/2008	3/5/2009	3/5/2009

Outfall Name	Outfall Status	Visit #1	Visit #2	Visit #3	Visit #4
06-400-0010	DRY	10/28/2008	10/28/2008	2/16/2009	2/16/2009
06-400-0015	DRY	10/28/2008	10/28/2008	2/16/2009	2/16/2009
06-400-0030	DRY	10/28/2008	10/28/2008	2/16/2009	2/16/2009
06-400-0096	DRY	9/22/2008	9/22/2008	2/16/2009	2/16/2009
06-200-0129	DRY	9/23/2008	9/23/2008	2/16/2009	2/16/2009
06-400-0132	DRY	10/28/2008	10/28/2008	2/16/2009	2/16/2009
06-400-0134	DRY	9/23/2008	9/23/2008	2/16/2009	2/16/2009
06-400-0136	DRY	10/28/2008	10/28/2008	2/16/2009	2/16/2009
06-400-0138	DRY	10/28/2008	10/28/2008	2/16/2009	2/16/2009
06-400-0141	DRY	10/28/2008	10/28/2008	2/16/2009	2/16/2009
06-400-0142	DRY	10/28/2008	10/28/2008	2/16/2009	2/16/2009
06-400-0185	DRY	9/23/2008	9/23/2008	2/16/2009	2/16/2009
07-100-0055	ILLICIT CONNECTION	9/23/2008	9/23/2008	12/8/2008	12/8/2008
07-400-0060	DRY	9/23/2008	9/23/2008	12/8/2008	12/8/2008
07-400-0105	DRY	10/30/2008	10/30/2008	12/8/2008	12/8/2008
07-400-0135	DRY	10/30/2008	10/30/2008	12/8/2008	12/8/2008
07-400-0200	DRY	9/23/2008	9/23/2008	12/8/2008	12/8/2008
08-400-0020	DRY	10/30/2008	10/30/2008	2/16/2009	2/16/2009
09-400-0025	DRY	10/30/2008	10/30/2008	2/16/2009	2/16/2009
10-400-0365	DRY	10/23/2008	10/23/2008	2/4/2009	2/4/2009
10-400-0420	DRY	10/6/2008	10/6/2008	2/4/2009	2/4/2009
10-300-0424	DRY	8/20/2008	8/20/2008	2/4/2009	2/4/2009
10-100-0440	DRY	8/20/2008	8/20/2008	2/4/2009	2/4/2009
10-300-0443	DRY	8/20/2008	8/20/2008	2/4/2009	2/4/2009
10-300-0445	DRY	8/20/2008	8/20/2008	2/4/2009	2/4/2009
10-100-0450	DRY	8/20/2008	8/20/2008	2/4/2009	2/4/2009
10-400-0465	DRY	10/23/2008	10/23/2008	2/4/2009	2/4/2009
10-400-0525	DRY	10/23/2008	10/23/2008	2/4/2009	2/4/2009

Outfall Name	Outfall Status	Visit #1	Visit #2	Visit #3	Visit #4
10-100-0530	DRY	8/20/2008	8/20/2008	2/4/2009	2/4/2009
10-200-0535	DRY	8/20/2008	8/20/2008	2/4/2009	2/4/2009
10-400-0558	DRY	10/23/2008	10/23/2008	2/4/2009	2/4/2009
10-100-0562	DRY	8/20/2008	8/20/2008	2/4/2009	2/4/2009
10-100-0564	DRY	8/20/2008	8/20/2008	2/4/2009	2/4/2009
11-100-0596	DRY	8/20/2008	8/20/2008	12/8/2008	12/8/2008
11-400-0597	DRY	8/20/2008	8/20/2008	12/8/2008	12/8/2008
11-100-0598	DRY	8/20/2008	8/20/2008	12/8/2008	12/8/2008
11-400-0599	DRY	10/30/2008	10/30/2008	12/8/2008	12/8/2008
11-100-0601	DRY	8/20/2008	8/20/2008	12/8/2008	12/8/2008
12-300-0563	DRY	8/4/2008	8/4/2008	11/17/2008	11/17/2008
12-400-0585	DRY	10/6/2008	10/6/2008	11/17/2008	11/17/2008
12-100-0600	WET	8/4/2008	8/4/2008	11/17/2008	11/17/2008
12-300-0714	DRY	8/4/2008	8/4/2008	11/17/2008	11/17/2008
12-400-0715	DRY	10/23/2008	10/23/2008	2/4/2009	2/4/2009
12-200-0716	DRY	8/4/2008	8/4/2008	11/17/2008	11/17/2008
12-100-0723	WET	8/4/2008	8/4/2008	11/17/2008	11/17/2008
12-400-0725	WET	10/23/2008	10/23/2008	11/26/2008	11/26/2008
12-200-0741	DRY	8/4/2008	8/4/2008	11/17/2008	11/17/2008
12-300-0743	DRY	8/4/2008	8/4/2008	11/17/2008	11/17/2008
12-200-0745	WET	8/4/2008	8/4/2008	11/17/2008	11/17/2008
12-300-0746	DRY	8/4/2008	8/4/2008	11/17/2008	11/17/2008
12-300-0747	DRY	8/4/2008	8/4/2008	11/17/2008	11/17/2008
12-100-0748	WET	8/4/2008	8/4/2008	11/17/2008	11/17/2008
12-300-0749	WET	8/4/2008	8/4/2008	11/17/2008	11/17/2008
12-200-0751	DRY	8/4/2008	8/4/2008	11/17/2008	11/17/2008
13-300-0135	ILLICIT CONNECTION	9/17/2008	9/17/2008	3/4/2009	3/4/2009
13-300-0140	ILLICIT CONNECTION	9/17/2008	9/17/2008	3/4/2009	3/4/2009

Outfall Name	Outfall Status	Visit #1	Visit #2	Visit #3	Visit #4
13-300-0150	WET	9/17/2008	9/17/2008	3/4/2009	3/4/2009
13-300-0155	WET	9/17/2008	9/17/2008	3/4/2009	3/4/2009
13-300-0190	WET	9/17/2008	9/17/2008	3/4/2009	3/4/2009
13-400-0220	DRY	10/20/2008	10/20/2008	3/4/2009	3/4/2009
13-400-0230	DRY	10/20/2008	10/20/2008	3/4/2009	3/4/2009
13-400-0275	DRY	10/20/2008	10/20/2008	3/4/2009	3/4/2009
13-400-0290	DRY	10/20/2008	10/20/2008	3/4/2009	3/4/2009
13-300-0350	WET	9/17/2008	9/17/2008	3/4/2009	3/4/2009
13-300-0355	DRY	9/17/2008	9/17/2008	3/4/2009	3/4/2009
13-300-0365	WET	9/17/2008	9/17/2008	3/4/2009	3/4/2009
18-100-0701	DRY	9/19/2008	9/19/2008	3/5/2009	3/5/2009
31-400-0507	DRY	10/30/2008	10/30/2008	3/5/2009	3/5/2009
50-400-0070	DRY	10/20/2008	10/20/2008	1/14/2009	1/14/2009
50-400-0080	DRY	10/20/2008	10/20/2008	1/14/2009	1/14/2009
50-400-0140	DRY	10/20/2008	10/20/2008	1/14/2009	1/14/2009
50-400-0145	DRY	10/20/2008	10/20/2008	1/14/2009	1/14/2009
53-100-0128	WET	8/6/2008	8/6/2008	1/14/2009	1/14/2009
53-200-0137	DRY	8/6/2008	8/6/2008	1/14/2009	1/14/2009
53-100-0139	DRY	8/6/2008	8/6/2008	1/14/2009	1/14/2009
53-400-0178	DRY	10/20/2008	10/20/2008	1/14/2009	1/14/2009
53-400-0179	DRY	10/20/2008	10/20/2008	1/14/2009	1/14/2009
55-100-0070	DRY	9/19/2008	9/19/2008	11/10/2008	11/10/2008
55-200-0151	DRY	9/19/2008	9/19/2008	11/10/2008	11/10/2008
70-400-0599	DRY	9/19/2008	9/19/2008	11/10/2008	11/10/2008
70-300-0615	DRY	9/19/2008	9/19/2008	11/10/2008	11/10/2008
79-200-0040	WET	9/24/2008	9/24/2008	11/10/2008	11/10/2008
79-200-0341	DRY	9/24/2008	9/24/2008	11/10/2008	11/10/2008
79-200-0344	DRY	9/24/2008	9/24/2008	11/10/2008	11/10/2008

Outfall Name	Outfall Status	Visit #1	Visit #2	Visit #3	Visit #4
79-100-0380	WET	9/24/2008	9/24/2008	11/10/2008	11/10/2008

TYPE CODE	COUNT
100	31
200	29
300	62
400	129

Dry Weather Screening Data for 2009

Outfall / Permit Year	Date	Visit #	Flow ?	Flow Rate (gpm)	pH (su)	Chlorine (ppm)	Copper (ppm)	Phenol (ppm)	Detergents (ppm)	Ammonia (ppm)	Fecal Sample (mpn/100ml)	Turbidity (ntu)	Color	Odor?	Surface Scum	Oil Sheen
00-300-0385																
2009	8/11/08	1	No													
2009	8/11/08	2	No													
2009	2/20/09	3	Yes	0.25	7.0									No	No	No
2009	2/20/09	4	Yes	0.25	7.0									No	No	No
01-300-0060																
2009	7/28/08	1	No													
2009	7/28/08	2	No													
2009	11/3/08	3	No													
2009	11/3/08	4	No													
01-300-0070																
2009	7/28/07	1	Yes	0.50	6.0									No	No	No
2009	7/28/07	2	Yes	0.50	6.0									No	No	No
2009	11/3/08	3	Yes	2	7.0	0.04	0	0		0		250	70	No	No	No
2009	11/3/08	4	Yes	2	7.0	0.04	0	0		0		250	70	No	No	No
01-300-0115																
2009	7/30/08	1	No													
2009	7/30/08	2	No													
2009	11/3/08	3	No													
2009	11/3/08	4	No													
01-300-0160																
2009	7/30/08	1	Yes	5	7.5	0.07								No		
2009	7/30/08	2	Yes	5	7.5	0.07								No		
2009	2/9/09	3	Yes	1	7.0	0.07								No	No	No
2009	2/9/09	4	Yes	1	7.0	0.07								No	No	No

Outfall / Permit Year	Date	Visit #	Flow ?	Flow Rate (gpm)	pH (su)	Chlorine (ppm)	Copper (ppm)	Phenol (ppm)	Detergents (ppm)	Ammonia (ppm)	Fecal Sample (mpn/100ml)	Turbidity (ntu)	Color	Odor?	Surface Scum	Oil Sheen
01-300-0395																
2009	8/11/08	1	No													
2009	8/11/08	2	No													
2009	2/13/09	3	Yes	2	7.0											
2009	2/13/09	4	Yes	2	7.0											
01-100-0560																
2009	9/8/08	1	Yes	5	6.0											
2009	9/8/08	2	Yes	5	6.0											
2009	12/3/08	3	Yes	2	6.3											
2009	12/3/08	4	Yes	2	6.3											
01-200-0695																
2009	9/8/08	1	No													
2009	9/8/08	2	No													
2009	12/3/08	3	No													
2009	12/3/08	4	No													
01-200-0715																
2009	8/13/08	1	Yes	4	7.3	1.00								No		
2009	8/13/08	2	Yes	4	7.0	1.00								No		
2009	12/3/08	3	Yes	1	6.5											
2009	12/3/08	4	Yes	1	6.5											
02-400-0050																
2009	8/22/08	1	No	20	7.0	0.09								No	No	No
2009	8/22/08	2	No	20	7.0	0.09								No	No	No
2009	11/18/08	3	Yes	20	7.5	0.09				0		0	0	No	No	No
2009	11/19/08	4	Yes	20	7.5	0.09				0		0	0	No	No	No
02-300-0180																
2009	8/22/08	1	Yes	2	7.0									No	No	No
2009	8/22/08	2	Yes	2	7.0									No	No	No
2009	11/18/08	3	Yes	2	7.0	0.08								No	No	No
2009	11/19/08	4	Yes	2	7.0	0.09								No	No	No

Outfall Permit Year	Date	Visit #	Flow ?	Flow Rate (gpm)	pH (su)	Chlorine (ppm)	Copper (ppm)	Phenol (ppm)	Detergents (ppm)	Ammonia (ppm)	Fecal Sample (mpn/100ml)	Turbidity (ntu)	Color	Odor?	Surface Scum	Oil Sheen
02-400-0489																
2009	10/10/08	1	Yes	25	5.8									No	No	No
2009	10/10/08	2	Yes	25	5.3									No		
2009	2/9/09	3	Yes	30	7.0											
2009	2/9/09	4	Yes	30	7.0											
02-400-0520																
2009	10/31/08	1	No													
2009	10/31/08	2	No													
2009	2/9/09	3	Yes	10	7.0											
2009	2/9/09	4	Yes	10	7.0											
03-100-0374																
2009	9/25/08	1	No													
2009	9/25/08	2	No													
2009	12/23/08	3	Yes	0.50	6.8									No	No	No
2009	12/23/08	4	Yes	0.50	6.8									No	No	No
03-400-0392																
2009	10/14/08	1	No													
2009	10/14/08	2	No													
2009	12/23/08	3	No													
2009	12/23/08	4	No													
03-300-0398																
2009	9/25/08	1	No													
2009	9/25/08	2	No													
2009	12/23/08	3	No													
2009	12/23/08	4	No													
03-100-0403																
2009	9/25/08	1	No													
2009	9/25/08	2	No													
2009	12/23/08	3	No													
2009	12/23/08	4	No													

Outfall / Permit Year	Date	Visit #	Flow ?	Flow Rate (gpm)	pH (su)	Chlorine (ppm)	Copper (ppm)	Phenol (ppm)	Detergents (ppm)	Ammonia (ppm)	Fecal Sample (mpn/100ml)	Turbidity (ntu)	Color	Odor?	Surface Scum	Oil Sheen
03-400-0404																
2009	10/14/08	1	No													
2009	10/14/08	2	No													
2009	12/23/08	3	No													
2009	12/23/08	4	No													
03-400-0552																
2009	10/14/08	1	Yes	40	6.0									No	No	No
2009	10/14/08	2	Yes	40	6.0									No	No	No
2009	3/3/09	3	Yes	50	6.8											
2009	3/3/09	4	Yes	50	6.8											
03-100-0620																
2009	9/29/08	1	No													
2009	9/29/08	2	No													
2009	3/3/09	3	Yes	4	7.0											
2009	3/3/09	4	Yes	4	7.0											
03-300-0660																
2009	9/29/08	1	No													
2009	9/29/08	2	No													
2009	4/8/09	3	No													
2009	4/8/09	4	No													
03-300-0670																
2009	9/29/08	1	No													
2009	9/29/08	2	No													
2009	4/8/09	3	No													
2009	4/8/09	4	No													
03-400-0835																
2009	9/22/08	1	No													
2009	9/22/08	1	No													
2009	3/30/09	3	No													
2009	3/30/09	4	No													

Outfall Permit Year	Date	Visit #	Flow ?	Flow Rate (gpm)	pH (su)	Chlorine (ppm)	Copper (ppm)	Phenol (ppm)	Detergents (ppm)	Ammonia (ppm)	Fecal Sample (mpn/100ml)	Turbidity (ntu)	Color	Odor?	Surface Scum	Oil Sheen
03-400-0906																
2009	9/22/08	1	No													
2009	9/22/08	2	No													
2009	3/19/09	3	Yes	0.50	7.0									No	No	No
2009	3/19/09	4	Yes	0.50	7.0									No	No	No
03-200-0907																
2009	9/22/08	1	No													
2009	9/22/08	2	No													
2009	3/19/09	3	Yes	5	7.0									No	No	No
2009	3/19/09	4	Yes	5	7.0									No	No	No
04-400-0085																
2009	10/22/08	1	No													
2009	10/22/08	2	No													
2009	3/24/09	3	No													
2009	3/24/09	4	No													
04-400-0255																
2009	10/22/08	1	Yes	3	7.0	0.80	0	0		0		0	0	No	No	No
2009	10/22/08	2	Yes	3	7.0	0.80	0	0		0		0	0	No	No	No
2009	3/10/09	3	Yes	3	7.0									No	No	No
2009	3/10/09	4	Yes	3	7.0									No	No	No
04-400-0262																
2009	10/22/08	1	No													
2009	10/22/08	2	No													
2009	3/10/09	3	Yes	2	6.8									No	No	No
2009	3/10/09	4	Yes	2	6.8									No	No	No
04-400-0263																
2009	10/22/08	1	No													
2009	10/22/08	2	No													
2009	3/10/09	3	Yes	8	7.0									No	No	No
2009	3/10/09	4	Yes	8	7.0									No	No	No

Outfall Permit Year	Date	Visit #	Flow ?	Flow Rate (gpm)	pH (su)	Chlorine (ppm)	Copper (ppm)	Phenol (ppm)	Detergents (ppm)	Ammonia (ppm)	Fecal Sample (mpn/100ml)	Turbidity (ntu)	Color	Odor?	Surface Scum	Oil Sheen
05-300-0222																
2009	9/23/08	1	No													
2009	9/23/08	2	No													
2009	3/5/09	3	Yes	5	7.0									No	No	No
2009	3/5/09	4	Yes	5	7.0									No	No	No
07-100-0055																
2009	9/23/08	1	No	15	6.5	0.03										
2009	9/23/08	2	No	15	6.5	0.03										
2009	12/8/08	3	Yes	15	6.8	0.07								No	No	No
2009	12/8/08	4	Yes	15	6.8	0.07								No	No	No
12-100-0600																
2009	8/4/08	1	No													
2009	8/4/08	2	No													
2009	11/17/08	3	No													
2009	11/17/08	4	No													
12-100-0723																
2009	8/4/08	1	No	5	5.8									No	No	No
2009	8/4/08	2	No	5	5.8									No	No	No
2009	11/17/08	3	Yes	15	6.0											No
2009	11/17/08	4	Yes	15	6.0											No
12-400-0725																
2009	10/23/08	1	No													
2009	10/23/08	2	No													
2009	11/26/08	3	No													
2009	11/26/08	4	No													
12-200-0745																
2009	8/4/08	1	No													
2009	8/4/08	2	No													
2009	11/17/08	3	No													
2009	11/17/08	4	No													

Outfall Permit Year	Date	Visit #	Flow ?	Flow Rate (gpm)	pH (su)	Chlorine (ppm)	Copper (ppm)	Phenol (ppm)	Detergents (ppm)	Ammonia (ppm)	Fecal Sample (mpn/100ml)	Turbidity (ntu)	Color	Odor?	Surface Scum	Oil Sheen
12-100-0748																
2009	8/4/08	1	No													
2009	8/4/08	2	No													
2009	11/17/08	3	No													
2009	11/17/08	4	No													
12-300-0749																
2009	8/4/08	1	Yes	0.15	5.5											
2009	8/4/08	2	Yes	0.15	5.5											
2009	11/17/08	3	No													
2009	11/17/08	4	No													
13-300-0135																
2009	9/17/08	1	Yes	4	7.0	0				0.06		100	30	No	No	No
2009	9/17/08	2	Yes	4	7.0	0				0.06		100	30	No	No	No
2009	3/4/09	3	Yes	4	7.0					0.06		100	30	No	No	No
2009	3/4/09	4	Yes	4	7.0					0.06		100	30	No	No	No
13-300-0140																
2009	9/17/08	1	Yes	15	6.8	1.00				0		0	0	No	No	No
2009	9/17/08	2	Yes	15	6.8	1.00				0		0	0	No	No	No
2009	3/4/09	3	Yes	15	6.8	0.09								No	No	No
2009	3/4/09	4	Yes	15	6.8	0.09								No	No	No
13-300-0150																
2009	9/17/08	1	No													
2009	9/17/08	2	No													
2009	3/4/09	3	Yes	3	6.8									No	No	No
2009	3/4/09	4	Yes	3	6.8									No	No	No
13-300-0155																
2009	9/17/08	1	No	6	5.5											
2009	9/17/08	2	No	6	5.5											
2009	3/4/09	3	No													
2009	3/4/09	4	No													

Outfall / Permit Year	Date	Visit #	Flow ?	Flow Rate (gpm)	pH (su)	Chlorine (ppm)	Copper (ppm)	Phenol (ppm)	Detergents (ppm)	Ammonia (ppm)	Fecal Sample (mpn/100ml)	Turbidity (ntu)	Color	Odor?	Surface Scum	Oil Sheen
13-300-0190																
2009	9/17/08	1	No													
2009	9/17/08	2	No													
2009	3/4/09	3	No													
2009	3/4/09	4	No													
13-300-0350																
2009	9/17/08	1	No													
2009	9/17/08	2	No													
2009	3/4/09	3	No													
2009	3/4/09	4	No													
13-300-0365																
2009	9/17/08	1	No													
2009	9/17/08	2	No													
2009	3/4/09	3	No													
2009	3/4/09	4	No													
53-100-0128																
2009	8/6/08	1	Yes	23	7.0									No	No	No
2009	8/6/08	2	Yes	35	7.0									No	No	No
2009	1/14/09	3	Yes	150	6.3											
2009	1/14/09	4	Yes	150	6.3											
79-200-0040																
2009	9/24/08	1	Yes	4	6.0											
2009	9/24/08	2	Yes	4	6.0											
2009	11/10/08	3	No													
2009	11/10/08	4	No													
79-100-0380																
2009	9/24/08	1	No													
2009	9/24/08	2	No													
2009	11/10/08	3	No													
2009	11/10/08	4	No													

Outfall Permit Year	Date	Visit #	Flow ?	Flow Rate (gpm)	pH (su)	Chlorine (ppm)	Copper (ppm)	Phenol (ppm)	Detergents (ppm)	Ammonia (ppm)	Fecal Sample (mpn/100ml)	Turbidity (ntu)	Color	Odor?	Surface Scum	Oil Sheen

Shaded rows represent samples which contained eleveated levels for at least 1 sampled parameter.

Oracle - Dry Weather Screening Data

Elevated readings have been underlined.

Below is a listing of sample parameters and their elevated reading criteria:

pH	< 6.5 or > 9 su
Chlorine	> 0.2 ppm
Copper	>= 0.1 ppm
Phenol	>=0.1 ppm
Detergents	> 0.25 ppm
Ammonia	>= 1 ppm
Fecal Sample	>= 200 mpn/100 ml

APPENDIX C

Summary Report for IBI Studies

INDEX OF BIOTIC INTEGRITY ON THIRD CREEK AND FOURTH CREEK IN THE CITY OF KNOXVILLE FINAL DATA REPORT MAY – JULY, 2009 CITY OF KNOXVILLE CONTRACT C-08-0184

CONDUCTED BY:

FORT LOUDOUN LAKE ASSOCIATION

REPORT PREPARED BY:

Michael S. Gaugler, Stormwater Services Program Director

IBI DATA PROVIDED BY:

Fish IBI Data Provided By: Michael S. Gaugler
Macroinvertebrate IBI Data Provided By: Michael S. Gaugler
Habitat Analysis Data Provided By: Michael S. Gaugler

INDEX OF BIOTIC INTEGRITY ON THIRD CREEK AND FOURTH CREEK IN THE CITY OF KNOXVILLE MAY - JULY, 2009

INTRODUCTION

This document represents data collected from two streams located in Knoxville, TN by the Fort Loudoun Lake Association (FLLA) for the City of Knoxville. Third Creek and Fourth Creek were the two streams surveyed for the Index of Biotic Integrity (IBI) May - July 2009. In this document we will state our plan, describe the study areas, explain methodology, and discuss results.

OBJECTIVES

1. Perform backpack electro-shocking for fish survey.
2. Perform a macroinvertebrate survey.
3. Perform a habitat assessment at each sampling location.
4. Perform water quality testing at each sampling location.
5. Provide photographic evidence of current conditions and environmental pressures at each sampling location.
6. Score IBI and deliver write-up to the city of Knoxville.

STUDY AREAS

FLLA assessed two sites along Third Creek. The upstream site was located at the intersection of Middlebrook Pike and Lonas Dr. (see Figure 1). This survey was conducted at approximately 4.75 miles up stream from the confluence with Fort Loudoun Lake and has an approximate drainage area of 3 square miles. The downstream site was located near the intersection of Cox St. and Sutherland Ave. at the Tennessee Stream Mitigation Project (see Figure 2). This survey site was conducted at approximately 3 miles up stream from the confluence with Fort Loudoun Lake with an approximate drainage area of 11.6 square miles

FLLA assessed three sites along Fourth Creek for this IBI. The upstream site was located near 1122 Old Weisgarber Rd. (see Figure 3). This survey was conducted at approximately 4 miles upstream from the confluence and has an approximate drainage area of 5 square miles. The downstream sites were located near the intersection of Kingston Pike and Northshore Dr. (see Figure 4). This survey site was conducted at approximately 1.75 miles upstream from the confluence has an approximate drainage area of 6 square miles. The macroinvertebrate site was chosen based upon the presence of a fast riffle and a slow riffle at the downstream most location next to Sacred Heart Cathedral School.

Figure 1. Upstream sampling site on Third Creek at Middlebrook Pike and Lonas Drive

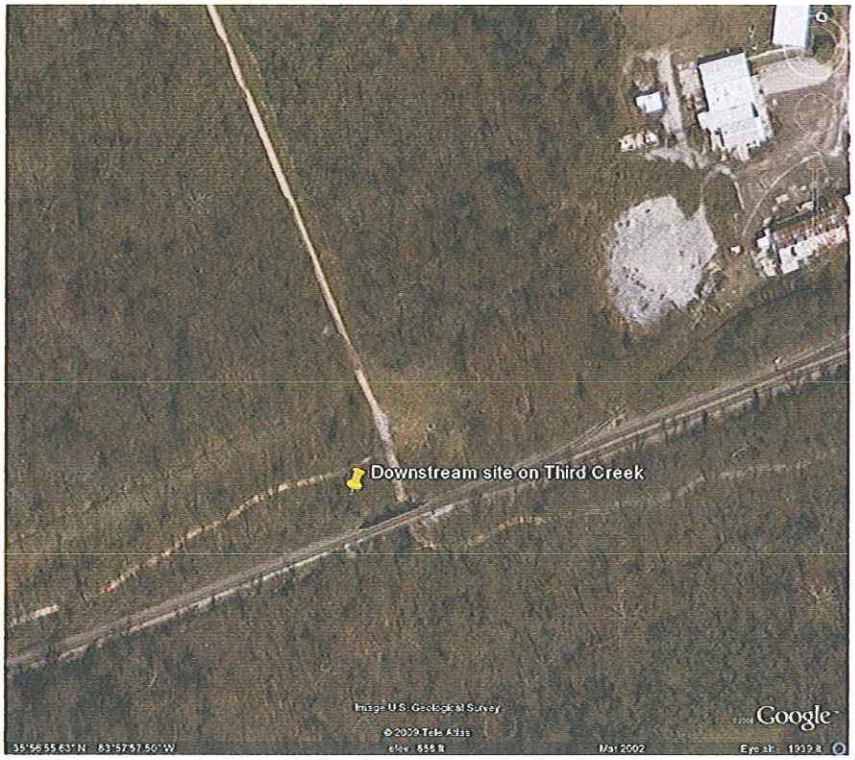

Figure 2. Downstream site on Third Creek at Sutherland Avenue and Cox Street

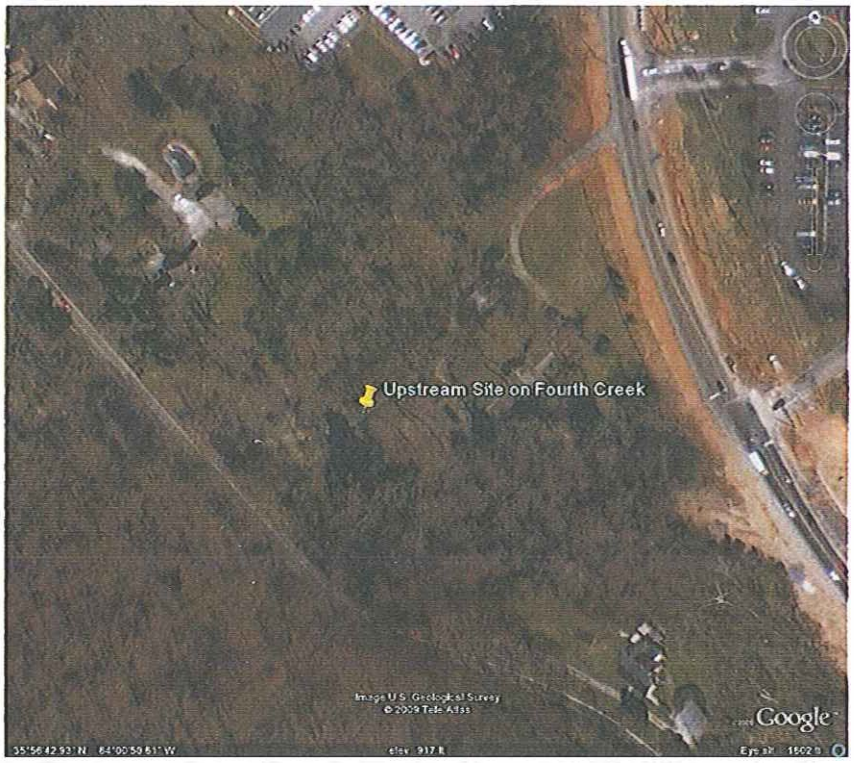

Figure 3. Upstream site on Fourth Creek adjacent to Old Weisgarber Road

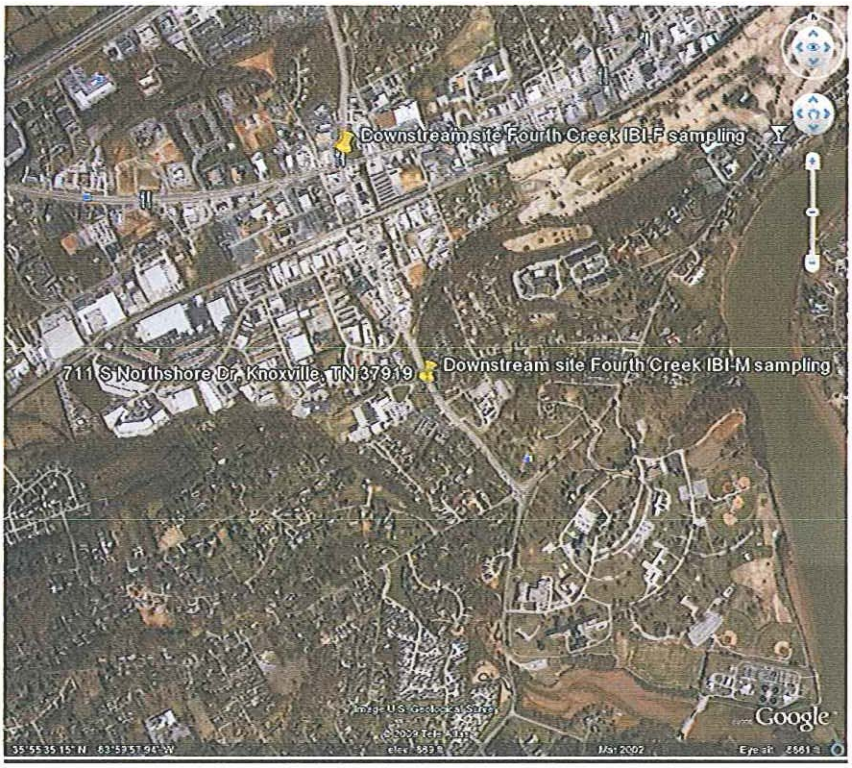

Figure 4. Downstream sites on Fourth Creek at Kingston Pike and Northshore Drive

METHODS

INDEX OF BIOTIC INTEGRITY OF FISH (IBI-F)

FLLA followed the United States Environmental Protection Agency (US EPA) Methodology for Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish (Barbour et al. 1999) for fish surveys, macroinvertebrate sampling using the multi-habitat approach, habitat assessment, and water quality sampling. This methodology is in compliance with the Tennessee Department of Environment and Conservation (TDEC), Division of Water Pollution Control Standard Operating Procedures for Stream Surveys (Arnwine 2006). Sampling sites were chosen based upon geographic location (within the City of Knoxville), the presence of suitable habitat, and easy of access. The biological conditions of Third Creek and Fourth Creek were assessed by collection and identification of the fish and benthic macroinvertebrates to lowest taxon possible usually to the species level. The physical environment was assessed looking at the instream and out of stream habitat parameters and water quality parameters.

The fish community was sampled based upon the methodologies of Karr (1981). The Index of Biotic Integrity (IBI) for the fish community (IBI-F) assesses the environmental quality of the stream at a sampling site by application of ecologically based metrics to fish community data (Karr 1981). Karr's twelve metrics address species richness and composition, trophic structure, fish abundance, and fish condition. Each metric shows the condition of one aspect of the fish community and is scored against an expected value under a reference condition. Scores are "1" or poor, "3" or intermediate, and "5" or the best to be expected. The twelve scores are summed and a total IBI score is determined for the sampling site. The total IBI score rates the site from "Very poor" to "Excellent" (Karr et al. 1986). Please see Table 1 below for the metric description and scoring criteria. IBI classification is as follows: 0 = no fish; 12 – 22 Very poor; 28 – 34 = Poor; 40 – 44 = Fair; 48 – 52 = Good; 59 – 60 = Excellent.

Table 1. Metrics and scoring criteria of fish IBI.

Metric Description	Scoring Criteria		
	1	3	5
Total number of native fish species	<5	(5-10)	>10
Number of darter species	<1.5	(1.5-2.5)	>2.5
Number of sunfish species, less *Micropterus*	<1.5	(1.5-2.5)	>5
Number of sucker species	<0.5	(0.5-1)	>1
Number of intolerant species	<1	(1-2.5)	>2.5
Percent of individuals as tolerant species	>40%	20%-40%	<20
Percent of individuals as omnivores and stoneroller species	>50%	25%-50%	<25
Percent of individuals as specialized insectivores	<10%	10%-20%	>20%
Percent of individuals as piscivores	<2%	2%-4%	>4%
Catch rate (average number of fish per 300 sq. ft. sampling unit)	<22	22-43.8	>43.8
Percent of individuals as hybrids	<1%	TR-1%	0%
Percent of individuals with diseases, tumors, fin damage, and other anomalies	>5%	2%-5%	<2%

For the IBI-F sampling a Smith-Root backpack shocker, one 20 foot seine, two collection nets and one five gallon bucket were used. Backpack shocking fish into the seine was used in the riffle, run, and pool habitats. The seine was positioned perpendicular to the stream flow at the downstream section of habitat sample. Working downstream the backpack operator shocked approximately 300 ft^2 area. Fish stunned became suspended in the water column and were transported downstream to the seine. Any stunned fish trapped under rocks were physically removed and placed in the collection bucket or into the water column allowing transport downstream. Upon sampling the area, the seine was picked up and all fish remaining in the seine were placed into the sampling bucket that contained water. Fish were examined for anomalies, identified to species and released. The sampling team worked from downstream to upstream to prevent sampling bias of previously caught fish. Each of the habitats was sampled until three sampling efforts produced no additional species for that habitat.

INDEX OF BIOTIC INTEGRITY FOR MACROINVERTEBRATES (IBI-M)

FLLA followed the Tennessee Department of Environment and Conservation's (TDEC) Quality System Standard Operating Procedure for Macroinvertebrate Stream Surveys (Arnwine 2006) for sampling procedures of collecting biological samples. The biological conditions of Third Creek and Fourth Creek were assessed by collecting and identifying the benthic macroinvertebrates (IBI-M) present at two sites per creek. Sampling sites were considered suitable based upon the presence of one fast flowing and one slow flowing riffles.

A semi-quantitative riffle kick (SQKICK) was used to collect samples. A one-meter kick net with 500 micrometer mesh was used to sample the riffles. At each site, four collection kicks were performed. Two kicks were in slower current velocity and two kicks were in a faster current velocity riffle. Sampling was conducted from the downstream riffle to the upstream sample. After each kick approximately one minute passed before removing the net from the riffle to allow all debris to wash into the net. Next all debris collected was washed into a sampling bucket with a 500 micrometer screen on the bottom. All kicks were combined and all debris was washed into a 1 L (1000 ml) bottle and samples were stored in 70% isopropyl alcohol. Any aquatic macroinvertebrates remaining on the net were removed and placed in the storage container. After completion at each site both the net and bucket were thoroughly washed to prevent contamination at the next sampling site.

Before sampling the physical and chemical field sheet was completed. After sampling the top portion of the "Benthic Macroinvertebrate Field Data Sheet" was completed as well as a habitat assessment (Form 3 of Barbour et al. 1999).

In the laboratory, samples were washed onto a 500 micrometer mesh sieve and washed with water to remove additional sediment and residual alcohol. Each sample was processed completely and all macroinvertebrates were removed and stored in a second container for identification purposes. The processed sample was returned to the original container and stored.

All macroinvertebrates were identified using a Fisher Scientific microscope and Brigham et al. (1982) along with recent corrections to this edition. Taxa counts were recorded and specimens were identified to species level when possible.

A macroinvertebrate index using seven biometrics was created based upon semi-quantitative macroinvertebrate surveys (Arnwine and Denton 2001). The index is based upon ecoregional reference data and calibrated by bioregion. The seven biometrics are:
EPT (Ephemeroptera Plecoptera Trichoptera Richness)
TR (Taxa richness)
% EPT (EPT abundance)
%OC (Oligochaetes and chironomids)
NCBI (North Carolina Biotic Index)
% NUTOL (% nutrient tolerant organisms)
% Clingers

After calculating the seven biometric values, the data are equalized and assigned a score of 0, 2, 4, or 6 based upon the reference database of the bioregion. The seven scores are totaled and the biological condition is determined. There are three categories of the index score:
Non-impaired (supporting) is equal to or greater than 32.
Slightly impaired (partially supporting) is 21 – 31.
Moderately impaired (partially supporting) is equal to or less than 20.

WATER QUALITY

Water parameters recorded included dissolved oxygen, pH, temperature, and conductivity. Parameters were recorded using YSI meters. The YSI 100 meter recorded temperature and pH and the YSI 85 was used to compare temperature and to measure DO

and conductivity. Before each field day the meters were calibrated per the manufacturer's directions and tested for reading drift at the end of each sampling day.

HABITAT ANALYSIS

A visual habitat assessment was conducted following Barbour et al (1999) methodology to evaluate the integrity of the habitat at each sampling site. The Physical Characterization and Water Quality Field Data Sheet (Appendix A-1, Form 1 of Barbour et al. 1999) and the Habitat Assessment Field Data Sheet (Appendix A-1, Form 2 of Barbour et al. 1999) were used. Because samples were collected in Ecoregion 67f, the High Gradient Stream Assessment Sheet was used to evaluate habitats. In all ten parameters were evaluated:

Epifaunal substrate/available cover
Embeddedness
Velocity/Depth combinations
Sediment deposition
Channel flow status
Channel alteration
Frequency of riffles or bends
Bank stability
Bank vegetative protection
Riparian vegetative zone width

Each parameter was individually scored 0 to 20 with 20 being the highest attainable score. A maximum of 200 points per site was possible. The scores were divided into four categories (Optimal, Suboptimal, Marginal and Poor) with a range of five points per category. After totaling the scores, the final score was compared with the Habitat Assessment Guidelines for Ecoregion 67f from Tennessee's Department of Environment and Conservation Quality System Standard Operating Procedure for Macroinvertebrate Stream Surveys (Arnwine 2006) to determine if the habitat is capable of supporting a healthy macroinvertebrate community. Scores for the Habitat Assessment are:

Scores greater than or equal to 130 indicate the habitat is not impaired.
Scores 103 – 129 indicate the habitat is moderately impaired.
Scores less than or equal to 102 indicate the habitat is severely impaired.

RESULTS

Table 2. Summary of IBI-F, IBI-M, and habitat assessment scores on Third Creek and Fourth Creek May 21 – 26, 2009.

	Third Creek		Fourth Creek	
	Upstream Site	Downstream Site	Upstream Site	Downstream Site
IBI-F score	28	28	26	34
Rating	Poor	Poor	Very Poor	Poor
IBI-M score	30	26	26	26
Rating	Slightly Impaired	Slightly Impaired	Slightly Impaired	Slightly Impaired
Habitat score	141	127	127	72
Rating	Not impaired	Moderately impaired	Moderately impaired	Severely impaired

Table 3. Densities of fish collected on Third Creek and Fourth Creek May 21, 2009.

			Third Creek		Fourth Creek	
Family	Species	Common Name	Upper Site	Lower Site	Upper Site	Lower Site
Cyprinidae (minnows)	*Capostoma anomalum*	Central stoneroller	100* (13)	139* (24)	89* (6)	419* (393)
	Luxilus chrysocephalus	Striped shiner		7		
	Pimephales notatus	Bluntnose minnow		3		
	Rhinichthys atratulus	Blacknose dace	38* (3)	28* (2)	149* (15)	600* (557)
	Semotilus atromaculatus	Creek chub	2* (1)	49* (10)	4	100* (89)
Catostomidae (suckers)	*Catostomus commersonnii*	White sucker				30
	Hypentelium nigricans	Northern hogsucker	2	5		1
Centrachidae (sunfishes)	*Micropterus dolomieu*	Smallmouth bass		2		
Ictaluridae (catfishes)	*Ictalurus punctatus*	Channel catfish		1		
Percidae (perches)	*Etheostoma simoterum*	Snubnose darter	7	43		
Cottidae (Sculpins)	*Cottus carolinae*	Banded sculpin	3	2	4	
		Totals	154	281	250	1150

Note: * equals abnormalities such as black spot and number in parenthesis is total number with an abnormality.

A total of 1835 fish among 11 species were collected, identified to species, and checked for anomalies. The most numerous fish species was *R. atratulus,* blacknose dace, with 815 specimens that represented 44.41% of the total catch. Fourth Creek's downstream site contained the most numerous collection with 1150 that represented 62.27% of the total catch. At each location, black spot was observed and recorded on both the stoneroller and black nose dace. At the Fourth Creek downstream site, lesions were also observed on these species. A majority of fish collected (> 80%) had some anomaly present at this location and many fish showed signs of both black spot and lesions throughout their bodies.

Table 4. Fish IBI score of the upper site of Third Creek May 21, 2009.

Metric Description	Scoring Criteria			Observed	Score
	1	3	5		
Total number of native fish species	<5	(5-10)	>10	6	3
Number of darter species	<1.5	(1.5-2.5)	>2.5	1	1
Number of sunfish species, less *Micropterus*	<1.5	(1.5-2.5)	>5	0	1
Number of sucker species	<0.5	(0.5-1)	>1	1	3
Number of intolerant species	<1	(1-2.5)	>2.5	0	1
Percent of individuals as tolerant species	>40%	20%-40%	<20%	5.96%	5
Percent of individuals as omnivores and stoneroller species	>50%	25%-50%	<25%	66.23%	1
Percent of individuals as specialized insectivores	<10%	10%-20%	>20%	29.80%	5
Percent of individuals as piscivores	<2%	2%-4%	>4%	0.00%	1
Catch rate (average number of fish per 300 sq. ft. sampling unit)	<22	22-43.8	>43.8	15.1	1
Percent of individuals as hybrids	<1%	TR-1%	0%	0.00%	5
Percent of individuals with diseases, tumors, fin damage, and other anomalies	>5%	2%-5%	<2%	11.25	1
			IBI		28
			IBI Classification		Poor

Fish sampling yielded an IBI score of 28 that equals poor.

Table 5. Fish IBI score of the lower site of Third Creek May 21, 2009.

Metric Description	Scoring Criteria			Observed	Score
	1	3	5		
Total number of native fish species	<5	(5-10)	>10	10	3
Number of darter species	<1.5	(1.5-2.5)	>2.5	1	1
Number of sunfish species, less *Micropterus*	<1.5	(1.5-2.5)	>5	0	1
Number of sucker species	<0.5	(0.5-1)	>1	1	3
Number of intolerant species	<1	(1-2.5)	>2.5	0	1
Percent of individuals as tolerant species	>40%	20%-40%	<20%	20.07%	3
Percent of individuals as omnivores and stoneroller species	>50%	25%-50%	<25%	53.76%	1
Percent of individuals as specialized insectivores	<10%	10%-20%	>20%	25.45%	5
Percent of individuals as piscivores	<2%	2%-4%	>4%	0.72%	1
Catch rate (average number of fish per 300 sq. ft. sampling unit)	<22	22-43.8	>43.8%	25.36%	3
Percent of individuals as hybrids	<1%	TR-1%	0%	0%	5
Percent of individuals with diseases, tumors, fin damage, and other anomalies	>5%	2%-5%	<2%	12.19%	1
			IBI		28
			IBI Classification		Poor

Fish sampling yielded an IBI score of 29 that equals poor.

Table 6. Fish IBI score of the upper site of Fourth Creek May 26, 2009.

Metric Description	Scoring Criteria			Observed	Score
	1	3	5		
Total number of native fish species	<5	(5-10)	>10	4	1
Number of darter species	<1.5	(1.5-2.5)	>2.5	0	1
Number of sunfish species, less *Micropterus*	<1.5	(1.5-2.5)	>5	0	1
Number of sucker species	<0.5	(0.5-1)	>1	0	1
Number of intolerant species	<1	(1-2.5)	>2.5	0	1
Percent of individuals as tolerant species	>40%	20%-40%	<20	1.63	5
Percent of individuals as omnivores and stoneroller species	>50%	25%-50%	<25	36.18	3
Percent of individuals as specialized insectivores	<10%	10%-20%	>20%	60.57	5
Percent of individuals as piscivores	<2%	2%-4%	>4%	0	1

Catch rate (average number of fish per 300 sq. ft. sampling unit)	<22	22-43.8	>43.8	20.5	1
Percent of individuals as hybrids	<1%	TR-1%	0%	0	5
Percent of individuals with diseases, tumors, fin damage, and other anomalies	>5%	2%-5%	<2%	8.54	1
			IBI		26
			IBI Classification		Very poor

Fish sampling yielded an IBI score of 26 that equals very poor.

Table 7. Fish IBI score of lower site of Fourth Creek, May 26, 2009.

Metric Description	Scoring Criteria			Observed	Score
	1	3	5		
Total number of native fish species	<5	(5-10)	>10	5	3
Number of darter species	<1.5	(1.5-2.5)	>2.5	0	1
Number of sunfish species, less *Micropterus*	<1.5	(1.5-2.5)	>5	0	1
Number of sucker species	<0.5	(0.5-1)	>1	1	3
Number of intolerant species	<1	(1-2.5)	>2.5	0	1
Percent of individuals as tolerant species	>40%	20%-40%	<20%	11.30%	5
Percent of individuals as omnivores and stoneroller species	>50%	25%-50%	<25%	39.04%	3
Percent of individuals as specialized insectivores	<10%	10%-20%	>20%	52.17%	5
Percent of individuals as piscivores	<2%	2%-4%	>4%	0%	1
Catch rate (average number of fish per 300 sq. ft. sampling unit)	<22	22-43.8	>43.8	115	5
Percent of individuals as hybrids	<1%	TR-1%	0%	0%	5
Percent of individuals with diseases, tumors, fin damage, and other anomalies	>5%	2%-5%	<2%	93.04%	1
			IBI		34
			IBI Classification		Poor

Fish sampling yielded an IBI score of 34 that equals poor.

Table 8. Densities of macroinvertebrates collected on May 25, 2009.

TAXA				
	Third Creek		Fourth Creek	
	Upstream	Downstream	Upstream	Downstream
OLIGOCHAETA (aquatic worms)				
Haplotaxidae				
Haplotaxis gordioides	13	9	11	13
EPHEMEROPTERA (mayflies)				
Baetidae				
Acentrella turbida		18	14	12
Baetis tricaudatus	3	14	11	4
TRICHOPTERA (Caddisflies)				
Hydropsychidae				
Cheumatopsyche sp.			36	29
Certatopsyche sparna	51	22	14	19
Hydropsyche demora	31	40	23	16
Hydropsyche phalerata		1		
Hydropsyche venularis	3			
COLEOPTERA (beetles)				
Dytiscidae				
Hydaticus modestus	2			
Elmidae				
Optioservus sp. (juv.)		3		
Stenelmis sp. (adult)		8	4	7
Stenelmis sp. (juv)	6	22	16	21
Psephenidae				
Psephenus herricki	18		4	1
DIPTERA (Flies)				
Tabanidae				
Tabanus sp.	1			1
Chironomidae				
Polypedilum sp.	14	22	9	14
Rheotanytarsus exiguus	8			
Tanytarsus sp.		3		
Tipulidae				
Antocha sp.	35	11	18	13
Dicranota sp.	1			
Hexatoma sp.	1			1
Tipula abdominalis	1	3	6	
Simuliidae				
Prosimulium rhizophorum	2		2	3
Simulium snowi	13	4		15

	Third Creek		Fourth Creek	
	Upstream	Downstream	Upstream	Downstream
ODONATA (dragonflies & damselflies)				
Aesheridae				
Boyeria vinosa		1		
TUBIFICIDA				
Naididae				
Nais sp.	5	1	3	7
AMPHIPODA				
Crangonyctidae				
Crangonyx sp.	50	48	39	31
Basommatophora (Snails)				
Ancylidae				
Ferissia sp.			13	11
TOTALS	258	230	223	218

A total of 929 specimens were collected at the four sampling sites. The Third Creek upstream site had the greatest number of specimens collected with 258 while the downstream site on Fourth Creek had the least with 218. Hydropsychid caddisflies were numerous at all locations as well as the beetle, *Stenelmis*, the midge *Polypedilum*, and *Antocha*.

Table 9. Summary Table for Macroinvertebrate Index of Four Sampling Sites on May 25, 2009.

		METRIC							
Site		**Taxa Richness**	**EPT Richness**	**% EPT**	**% OC**	**NCBI**	**% Clingers**	**% NUTROL**	**Index Score**
Third Creek, Upstream	Value	18	3	34.11	13.95	4.66	64.73	29.07	
	Score	2	0	4	6	6	6	6	**30**
Third Creek, Downstream	Value	15	4	41.30	14.78	6.81	46.96	34.35	
	Score	2	2	4	6	2	4	6	**26**
Fourth Creek, Upstream	Value	14	5	43.95	8.97	4.86	52.47	40.81	
	Score	2	2	4	6	4	4	4	**26**
Fourth Creek, Downstream	Value	17	5	36.70	12.84	4.77	56.88	47.71	
	Score	2	2	4	6	4	4	4	**26**

Table 9. Continued.

	INDEX SCORE	INDEX SCORE RATING
SITE		
Third Creek, Upstream	30	Slightly Impaired
Third Creek, Downstream	26	Slightly Impaired
Fourth Creek, Upstream	26	Slightly Impaired
Fourth Creek, Downstream	26	Slightly Impaired

Scores ranged from 26 to 30. Each site was classified as slightly impaired according to the macroinvertebrate community data.

Table 10. Summary of water quality analysis taken on Third Creek and Fourth Creek May 21 – 26, 2009.

	WATER QUALITY PARAMETERS			
Site	Temperature (°C)	DO (mg/L)	pH	Conductivity (um/hos)
Third Creek, Upstream	19.3	8.21	7.48	420.1
Third Creek, Downstream	19.6	8.17	7.40	413.8
Fourth Creek, Upstream	19.1	8.39	7.16	399.2
Fourth Creek, Downstream	19.9	7.88	7.30	388.3

Temperatures ranged 19.3 to 19.6 °C on Third Creek and 19.1 to 19.9 °C on Fourth Creek. Dissolved oxygen ranged from 8.17 to 8.21 mg/L on Third Creek and 7.88 to 8.39 mg/L on Fourth Creek. On Third Creek pH ranged 7.40 to 7.48 and 7.16 to 7.30 on Fourth Creek. Conductivity ranged from 413.8 to 420.1 on Third Creek and 388.3 to 399.2 on Fourth Creek.

Table 11. Summary for Habitat Assessment on Third Creek and Fourth Creek, May 21 – 26, 2009.

	SAMPLING SITE			
Habitat Parameter	**Third Creek, Upstream**	**Third Creek, Downstream**	**Fourth Creek, Upstream**	**Fourth Creek, Downstream**
Latitude	35°57'45.41"	35 ° 56'55.63"	35 ° 55'35.15"	35 ° 56'42.93"
Longitude	83 ° 58'34.67"	83 ° 57'57.50"	83 ° 59'57.94"	84 ° 00'50.61"
Epifaunal Cover	14	15	12	9
Embeddedness	13	10	12	2
Velocity/Depth Regime	16	14	14	10
Sediment Deposition	13	12	11	5
Channel Flow	14	12	12	12
Channel Alteration	14	13	11	9
Riffle Frequency	16	15	12	7
Bank stability (left/right)	9/6	7/7	7/7	4/4
Vegetative Protection (left/right)	9/6	6/6	7/7	3/3
Riparian Zone Width (left/right)	8/3	3/7	9/6	2/2
Total (200 max.)	**141**	**127**	**127**	**72**

	TOTAL SCORE	TOTAL SCORE RATING
SITE		
Third Creek, Upstream	141	Not impaired
Third Creek, Downstream	127	Moderately impaired
Fourth Creek, Upstream	127	Moderately impaired
Fourth Creek, Downstream	72	Severely impaired

The upstream site on Third Creek scored the highest on habitat assessment and was rated as not impaired. This location is on private property and with the exception of daily grounds activities is minimally disturbed. In each parameter the site scored in the optimal to suboptimal categories with the exception of the left bank, riparian vegetative zone width score of 3 due to the removal of the zone and being replaced with a manicured lawn.

The downstream site on Third Creek was rated as moderately impaired. Eight of the parameters were classified as suboptimal. There were issues with the amount of embeddedness throughout the reach and the width of the riparian zone along the left bank that is bordered by the paved walking trail.

The Fourth Creek upstream site was rated as moderately impaired. All parameters were scored as suboptimal except the left bank riparian zone width that scored as optimal. The area was relatively undisturbed and heavily wooded.

Of the sampling sites, the Fourth Creek downstream site scored the lowest and was rated as severely impaired. Only one category scored at least suboptimal, channel flow status. The remaining categories were scored lower including three parameters that were scored as poor. These included embeddedness, sediment deposit, and riparian zone width. This site is under construction upstream from the sampling and is boarded on both banks by impervious surfaces include parking lots and roadway.

DISCUSSION

Many streams within the 67f Ecoregion are characterized by reduced riparian cover, high amounts of erosion and sedimentation and nutrient loading (Arnwine and Denton 2001). Both creeks in the current IBI study are listed in the version of the 2008, 303 d list for the state of Tennessee (TDEC 2008). Third Creek's 20.7 impaired miles are listed because of nitrates, loss of biological integrity due to siltation, other anthropogenic habitat alterations and *Escherichia coli* due to discharges from MS4 area, urbanized high density area, land development and collection system failure. Fourth Creek's 14.9 impaired miles are listed due to physical substrate habitat alterations and *E. coli* due to discharges from a MS4 area and channelization.

Third Creek was scored as poor according to the IBI-F data at both sites. Central stonerollers dominated both sites and represented 54.94% of the fish identified at these locations. The upstream site had the lowest number of fish collected among all sites and only the stone rollers and blacknose dace were in abundance. The other four species had less than ten individuals each. The downstream site had the most species of the sampling locations and higher numbers of individuals were recorded for central stonerollers, blacknose dace, creek chub, and snubnose darters. One sunfish species and one catfish species was collected also. It is believed that over time that scouring of the sediment will improve instream habitats and additional species will be collected.

At both locations the macroinvertebrate community was classified as slightly impaired according to the data from the IBI-M. The upstream site had 18 taxa with only three EPT taxa and the downstream site had 15 taxa and four EPT taxa present. Both locations scored high for an urbanized stream in East Tennessee however both sites failed to meet TDEC's target TMI of 32.

Both locations scored high for urbanized streams in the area for the habitat assessment. The upstream site was classified as not impaired primarily due to its location on private property and minimal disturbances to the area except the removal of the riparian zone for a manicured lawn.

Fourth Creek received a very poor rating at the upstream location and a poor rating at the downstream location according to the IBI-F data. Only four fish species were identified at the upstream location even though the habitat received the same score as the downstream location on Third Creek that had ten fish species identified. These results raise the question of how much of an impact water quality is having on the fish community. Blacknose dace dominated the upstream location followed by central stonerollers. Overall the fish were in good health with few specimens with black spot. At the downstream location, the most individuals were collected but only five species were identified including a single northern hogsucker. Unlike the upstream location a majority of fish including central stoneroller, blacknose dace, and creek chub had anomalies throughout their body. Not only did these fish demonstrate black spot and/or skin lesions but the severity of these conditions are a concern.

Because of the conditions of the fish community there is a question concerning water quality in Fourth Creek. Even though the most individuals were collected in Fourth Creek the number of species identified and health conditions of these fish warrant

further sampling of the area to determine if the Fourth Creek's water quality is an additional concern to the biological community.

According to the IBI-M data, both locations are classified as slightly impaired. Hydropsychid caddisflies and the amphipod, *Crangonyx* sp., dominated the macroinvertebrate community. At the upstream location 14 taxa were identified and five of those were EPT taxa and the downstream location had 17 taxa with five EPT taxa present. Both locations failed to meet TDEC's target TMI score of 32.

Overall both streams are suffering due to anthropogenic forces throughout their stream lengths. Both of these streams have degraded in overall quality as evident of both of their biological scores. Even though the upstream location on Third Creek was classified as not impaired according to the habitat data, both communities scored in the same range as the moderately and severely impaired sites. If these pressures continue the biological community and the physical habitat will continue to degrade. Additional sampling on both of these creeks is warranted because of the current status of the biological communities along the sampling locations. Please refer to Appendix A photos for current conditions and pressures on Third Creek and Appendix B photos for current conditions and pressures on Fourth Creek.

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APPENDIX A: PHOTOS OF THIRD CREEK

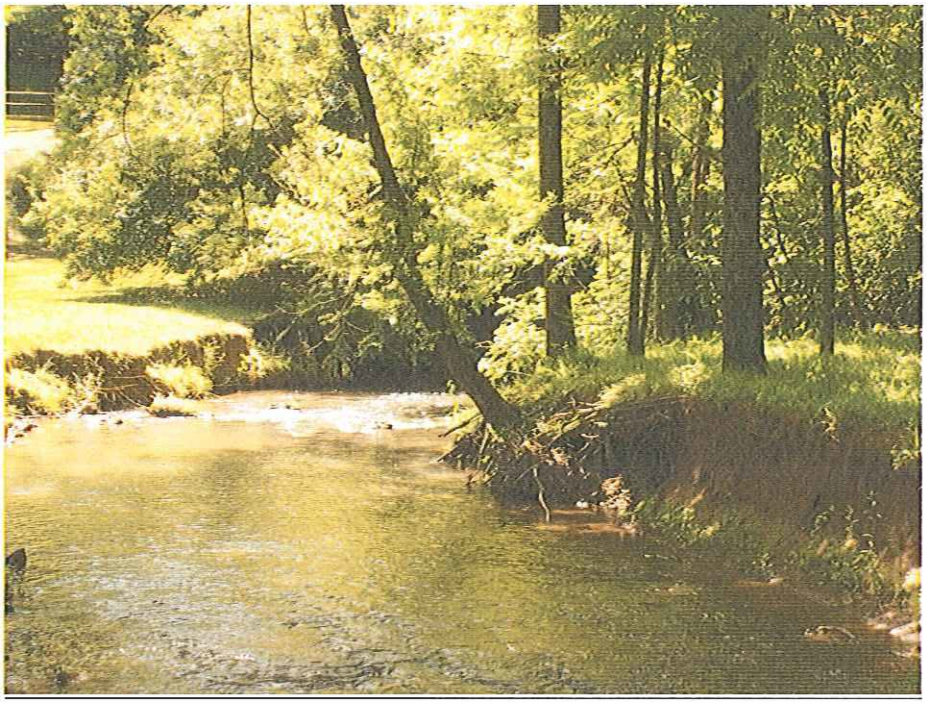

Photo 1. Third Creek Upstream Site at the Lower Section

Photo 2. Third Creek Upstream Site Showing Riffles

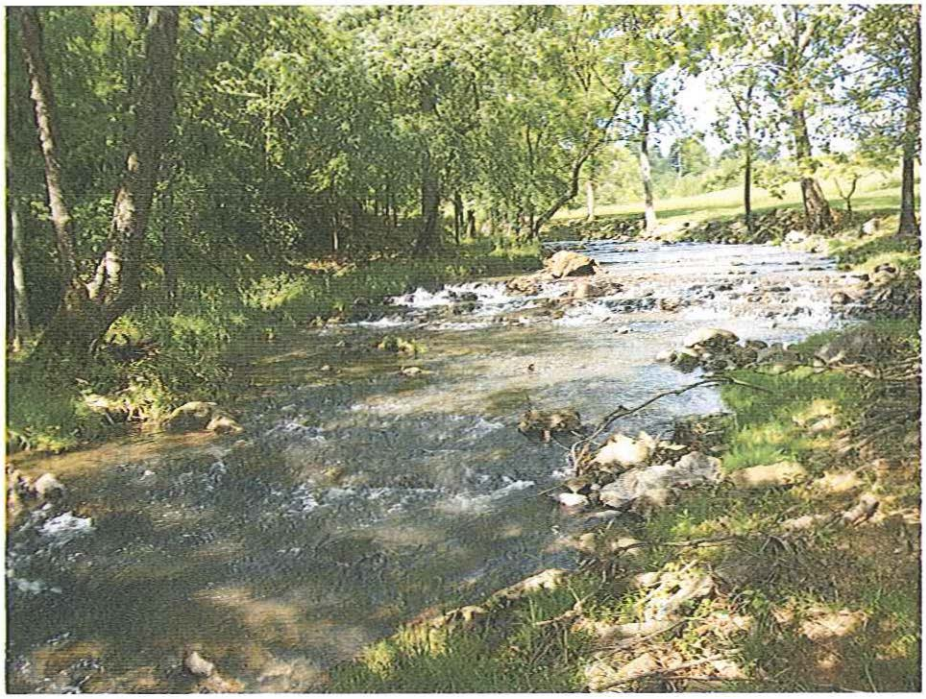

Photo 3. Third Creek Upstream Site

Photo 4. Third Creek Downstream Site

Photo 5. Third Creek Downstream Site Left Bank

Photo 6. Third Creek Downstream Site Stream Bed

APPENDIX B: PHOTOS OF FOURTH CREEK

Photo 7. Fourth Creek Upstream Site Stream Bed

Photo 8. Fourth Creek Upstream Site Riparian Canopy

Photo 9. Fourth Creek IBI-F Downstream Site

Photo 10. Fourth Creek IBI-F Downstream Site Location

Photo 11. Fourth Creek IBI-F Downstream Site Upstream Point

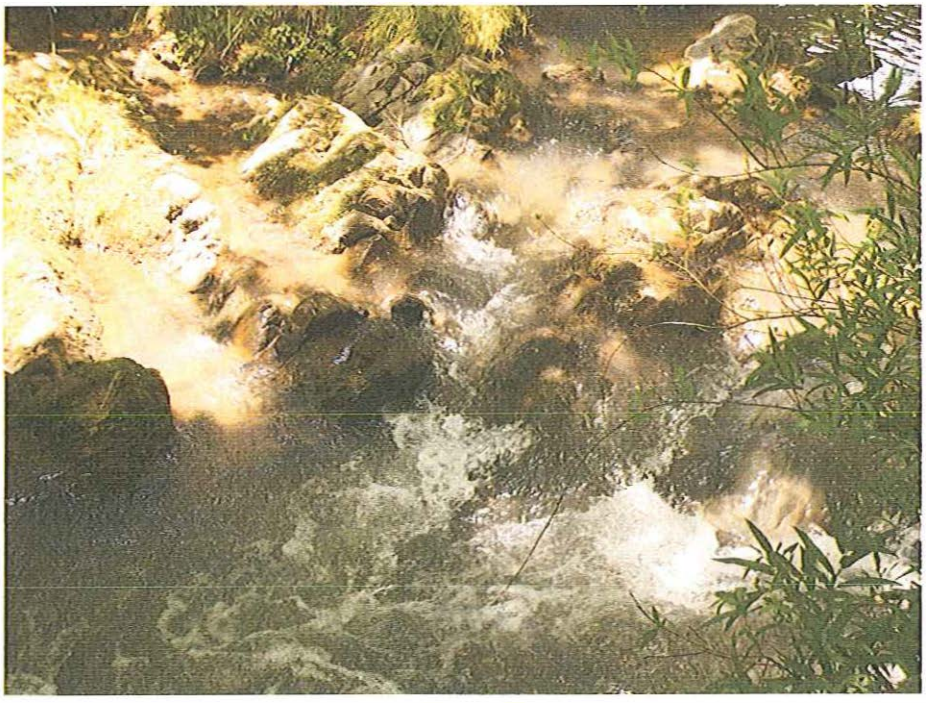

Photo 12. Fourth Creek Downstream IBI-M Site

Photo 13. Fourth Creek IBI-M Downstream Site

Photo 14. Fourth Creek IBI-M Downstream Site Left Bank

APPENDIX D

Summary Report for RBP III Studies

RAPID BIOASSESSMENT PROTOCOL (III) ON GOOSE CREEK AND SECOND CREEK IN THE CITY OF KNOXVILLE FINAL DATA REPORT

MAY – JULY, 2009

CITY OF KNOXVILLE CONTRACT C-08-0185

CONDUCTED BY:

FORT LOUDOUN LAKE ASSOCIATION

REPORT PREPARED BY:
Michael S. Gaugler, Stormwater Services Program Director

RBP DATA PROVIDED BY:
Michael S. Gaugler

MACROINVERTEBRATE DATA PROVIDED BY:
Michael S. Gaugler

RAPID BIOASSESSMENT PROTOCOL (III) ON GOOSE CREEK AND SECOND CREEK IN THE CITY OF KNOXVILLE FINAL DATA REPORT MAY – JULY, 2009

INTRODUCTION

This document represents data collected from two streams located in Knoxville, TN by the Fort Loudoun Lake Association (FLLA) for the City of Knoxville. Goose Creek and Second Creek were the two streams surveyed for the Rapid Bioassessment Protocol III (RBP III) in May-July, 2009. In this document we will state our plan, describe the study areas, explain methodology, and discuss results.

OBJECTIVES

1. Perform a macroinvertebrate study.
2. Perform a water quality test.
3. Perform a habitat analysis on each stream.
4. Provide photographic evidence of current conditions and pressures at each site. See Appendix A and B.
5. Score the RBP and deliver write-up to the city of Knoxville.

STUDY AREAS

FLLA assessed two sites along Goose Creek. The upstream site was located behind the Vestal Boys and Girls Club at 522 Maryville Pike upstream from the Mary Vestal Park (see Figure 1). The downstream site was located within the Mary Vestal Park (see Figure 2). This creek flows through South Knoxville and drains into the Tennessee River at river mile 646.8. Goose Creek flows westward through downtown Knoxville and the surrounding land uses include residential areas, roadways, and some businesses. The survey was approximately 1.1 river miles from the confluence of Fort Loudoun Lake.

FLLA assessed two sites along Second Creek. The upstream site was located above World's Fair Park and continued upstream approximately 100 meters (see Figure 3). This survey was conducted at approximately 0.7 miles up stream from the confluence with Fort Loudoun Lake. The approximate drainage area was 3.20 square miles. The downstream site was at Neland Drive near Volunteer Landing and continued upstream to the parking lot of the University of Tennessee on Kingston Pike near the World's Fair Park (see Figure 4). This survey was conducted at approximately 0.1 mile upstream from the confluence with Fort Loudoun Lake.

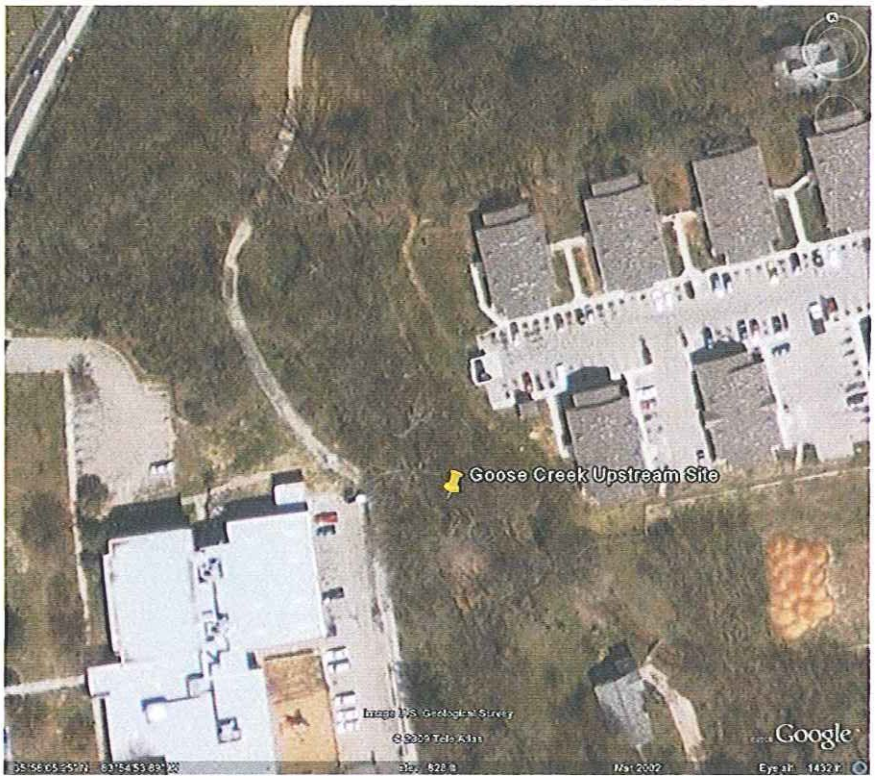

Figure 1. Location of upstream site on Goose Creek

Figure 2. Location of downstream site on Goose Creek

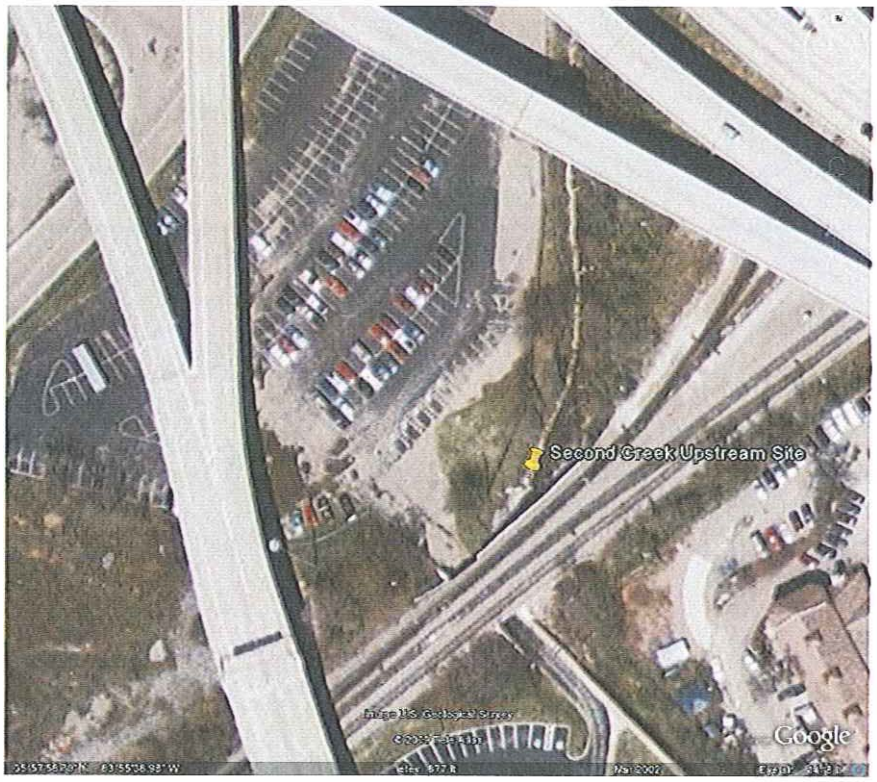

Figure 3. Upstream site on Second Creek

Figure 4. Downstream site on Second Creek

METHODS

FLLA used the United States Environmental Protection Agency (US EPA) Methodology for Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish (Barbour et al. 1999) for macroinvertebrate sampling using the multi-habitat approach, habitat assessment, and water quality sampling. This methodology is in compliance with the Tennessee Department of Environment and Conservation (TDEC), Division of Water Pollution Control Standard Operating Procedures for Stream Surveys (Arnwine 2006). Sampling sites were chosen based upon geographic location (within the City of Knoxville), the presence of suitable habitat, and easy of access. The biological conditions of Goose Creek and Second Creek were assessed by collection and identification of the benthic macroinvertebrates to lowest taxon possible usually to the species level. The physical environment was assessed looking at the instream and out-of-stream (riparian) habitat parameters and water quality parameters.

IBI-M

FLLA utilized the Tennessee Department of Environment and Conservation's (TDEC) Quality System Standard Operating Procedure for Macroinvertebrate Stream Surveys (Arnwine 2006) for sampling procedures of collecting biological samples in multiple habitats. The biological conditions of Goose Creek and Second Creek were assessed by collecting and identifying the benthic macroinvertebrates (IBI-M) present at two sites per creek.

The method is based upon the design recommendations of the Mid-Atlantic Coastal Streams Workgroup for use in variable habitat structure (US EPA 1997) and has been used for state stream bioassessment programs in Florida (DEP 1996) and Massachusetts (DEP 1995). The method utilizes a multiple habitat approach in order to sample major habitats in proportional representation within a sampling reach. The benthic macroinvertebrates are collected systematically from the instream habitats by kicking the substrate or jabbing with a D-frame dip net.

At each location a 100 m representative reach was sampled for benthic macroinvertebrates. Before sampling the Physical and Chemical field sheet was completed to document site description, weather conditions and land use. Photographs were taken to further describe the area. Based upon habitats present and their approximate proportion, the number of jabs per habitat type was determined. Working from downstream to upstream a total of 20 jabs or kicks were taken at each site. After two sampling attempts all material in the net was washed into a 500 micrometer bucket sieve and recorded as a single wash on the data sheet. Therefore, five marks on the sheet equaled 10 sampling efforts. The least number of sampling efforts per habitat was two. After sampling the entire sample was washed and any remaining sediment was washed into a 1-L plastic bottle. Any macroinvertebrates remaining in the bucket were removed by forceps and placed into the bottle. The sample was preserved in 70% isopropyl alcohol. The bottle was labeled with location, date, and preservative information. The Benthic Macroinvertebrate Field Data Sheet (Appendix A-3, Form 1 Barbour et al. 1999) and the Physical Habitat Sheets (Appendix A-1, Form 3 Barbour et al. 1999) were completed after the sampling.

In the laboratory, samples were washed onto a 500 micrometer mesh sieve and washed with water to remove additional sediment and residual alcohol. Each sample was processed completely and all macroinvertebrates were removed and stored in a second container for identification purposes. The processed sample was returned to the original container and stored.

All macroinvertebrates were identified using a Fisher Scientific microscope and Brigham et al. (1982) along with recent corrections to this edition. Taxa counts were recorded and specimens were identified to species level when possible.

A macroinvertebrate index using seven biometric values was created based upon semi-quantitative macroinvertebrate surveys (Arnwine and Denton 2001). The index is based upon ecoregional reference data and calibrated by bioregion. The seven biometrics are:

EPT(Ephemeroptera, Plecoptera, and Trichoptera Richness)
TR (Taxa richness)
% EPT (EPT abundance)
%OC (% oligochaetes and chrinomids)
NCBI (North Carolina Biotic Index)
% NUTOL (% nutrient tolerant organisms)
% Clingers

After calculating the seven biometric values, the data were equalized and assigned a score of 0, 2, 4, or 6 based upon the reference database of the bioregion. The seven scores are totaled and the biological condition is determined. There are three categories of the index score:

Non-impaired (supporting) is equal to or greater than 32.
Slightly impaired (partially supporting) is 21 – 31.
Moderately impaired (partially supporting) is equal to or less than 20.

Water Quality

Water parameters recorded included dissolved oxygen, pH, temperature and conductivity. Parameters were recorded using YSI meters. The YSI 100 meter recorded temperature and pH and the YSI 85 was used to compare temperature and to measure DO and conductivity. Before each field day the meters were calibrated per the manufacturer's directions and tested for reading drift at the end of each sampling day.

Habitat Analysis

A visual habitat assessment was conducted at each of the sampling sites following Barbour et al (1999) methodology to evaluate the integrity of the habitat at each sampling site. The Physical Characterization and Water Quality Field Data Sheet (Appendix A-1, Form 1 of Barbour et al. 1999) and the Habitat Assessment Field Data Sheet (Appendix A-1, Form 2 of Barbour et al. 1999) were used. Because samples were collected in Ecoregion 67f, the High Gradient Stream assessment sheet was used to evaluate habitats. In all ten parameters were evaluated:

Epifaunal substrate/available cover
Embeddedness
Velocity/Depth combinations

Sediment deposition
Channel flow status
Channel alteration
Frequency of riffles or bends
Bank stability
Bank vegetative protection
Riparian vegetative zone width

Each parameter was individually scored 0 to 20 with 20 being the highest attainable score. A maximum of 200 points per site was possible. The scores were divided into four categories (Optimal, Suboptimal, Marginal and Poor) with a range of five points per category. After totaling the scores, the final score was compared with the Habitat Assessment Guidelines for Ecoregion 67f from Tennessee's Department of Environment and Conservation Quality System Standard Operating Procedure for Macroinvertebrate Stream Surveys (Arnwine 2006) to determine if the habitat is capable of supporting a healthy macroinvertebrate community. Scores for the Habitat Assessment are:

Scores greater than or equal to 130 indicate the habitat is not impaired.
Scores 103 – 129 indicate the habitat is moderately impaired.
Scores less than or equal to 102 indicate the habitat is severely impaired.

RESULTS

Table 1. Summary of IBI-M, and habitat assessment scores on Goose Creek and Second Creek May 14, 2009.

	Goose Creek		Second Creek	
	Upstream Site	Downstream Site	Upstream Site	Downstream Site
IBI-M score	28	24	24	24
Rating	Slightly impaired	Slightly impaired	Slightly impaired	Slightly impaired
Habitat score	86	116	123	127
Rating	Severely impaired	Moderately impaired	Moderately impaired	Moderately impaired

Table 2. Densities of Macroinvertebrates Collected on Goose Creek and Second Creek, May 14, 2009.

TAXA				
	GOOSE CREEK		SECOND CEEK	
	Upstream	Downstream	Upstream	Downstream
OLIGOCHAETA (aquatic worms)				
Haplotaxidae				
Haplotaxis gordioides	6	13	31	26
EPHEMEROPTERA (mayflies)				
Oligoneuriidae				
Isonychia sp.	3	2		
TRICHOPTERA (Caddisflies)				
Hydropsychidae				
Certatopsyche sparna	56	50	23	1
Hydropsyche demora	18	13	17	20
Hydropsyche venularis	3			
COLEOPTERA (beetles)				
Elmidae				
Stenelmis sp. (adult)		8	6	
Stenelmis sp. (juv.)	23	16	18	13
Haliplidae				
Peltodytes sp.		1		
Psephenidae				
Psephenus herricki		3		

	GOOSE CREEK		SECOND CEEK	
	Upstream	**Downstream**	**Upstream**	**Downstream**
DIPTERA (Flies)				
Chironomidae				
Cricotopus bicinctus			11	
Polypedilum sp.	36	51	26	52
Rheotanytarsus exiguus	40	14	13	
Tanytarsus sp.	3	1		3
Ephydridae				
Ephydra macellaria				2
Psychodidae				
Telmatoscopus albipunctatus	1			
Tabanidae				
Tabanus sp.		3		
Tipulidae				
Antocha sp.	11	16	16	44
Dicranota sp.				2
Hexatoma sp.		2		
Tipula abdominalis	2	7	1	
Tipula Yamatotipula sp.	1			
Sciomyzidae				
Sepedon sp.				1
Simuliidae				
Simulium snowi	24	13	18	
PLECOPTERA (Stoneflies)				
Capnidae				
Allocapnia sp.	1			
TUBIFICIDA				
Naididae				
Nais sp.		2		5
AMPHIPODA				
Crangonyctidae				
Crangonyx sp.		21		15
TOTALS	228	236	180	184

A total of 828 specimens were collected among the four sampling sites. The Mary Vestal Park site on Goose Creek had the highest collection with 236 individuals. The caddisfly, *C. sparna*, and the midge, *Polypedilum* sp., dominated the community. On Second Creek, the community was similar however *Antocha* sp. dominated the downstream site near Neland Stadium.

Table 3. Summary Table for Macroinvertebrate Index of Four Sampling Sites on Goose Creek and Second Creek, May 14, 2009.

		METRIC							
Site		**Taxa Richness**	**EPT Richness**	**% EPT**	**% OC**	**NCBI**	**% Clingers**	**% NUTROL**	**Index Score**
Goose Creek, Upstream	Value	13	4	35.53	37.28	4.48	77.19	40.79	
	Score	2	2	4	4	6	6	4	**28**
Goose Creek, Downstream	Value	17	3	27.54	33.47	4.85	56.36	28.39	
	Score	2	0	2	4	4	6	6	**24**
Second Creek, Upstream	Value	10	2	22.22	45.00	3.90	67.78	53.89	
	Score	2	0	2	4	6	6	4	**24**
Second Creek, Downstream	Value	12	2	11.41	45.11	4.52	42.39	21.20	
		Taxa Richness	**EPT Richness**	**% EPT**	**% OC**	**NCBI**	**% Clingers**	**% NUTROL**	**Index Score**
	Score	2	0	0	4	6	4	6	**22**

	INDEX SCORE	INDEX SCORE RATING
SITE		
Goose Cr., Upstream	28	Slightly Impaired
Goose Cr., Downstream	24	Slightly Impaired
Second Cr., Upstream	24	Slightly Impaired
Second Cr., Downstream	24	Slightly Impaired

Scores ranged from 24 to 28. Each sampling location was classified as slightly impaired according to the macroinvertebrate index scores.

Table 4. Summary of water quality analysis taken on Goose Creek and Second Creek, May 14, 2009.

	WATER QUALITY PARAMETERS			
Site **LOCATION**	Temperature (°C)	DO (mg/L)	pH	Conductivity (um/hos)
Goose Cr., Upstream	16.8	8.21	7.75	431.1
Goose Cr., Downstream	17.2	8.24	7.81	402.8
Second Cr., Upstream	16.9	8.11	7.99	426.0
Second Cr., Downstream	16.9	8.49	8.13	456.3

Temperatures ranged 16.8 to 17.2 °C on Goose Creek and 16.9 °C at both Second Creek sites. Dissolved oxygen ranged from 8.21 to 8.24 mg/L on Goose Creek and 8.11 to 8.49 mg/L on Second Creek. On Goose Creek pH ranged 7.75 to 7.81 and 7.99 to 8.13 on Second Creek. Conductivity ranged from 402.8 to 431.1 (um/hos) on Goose Creek and 426.0 to 456.3 on Second Creek.

Table 5. Summary for Habitat Assessment on Goose Creek and Second Creek, May 14, 2009.

	SAMPLING SITE			
Habitat Parameter	Goose Creek, Upstream	Goose Creek, Downstream	Second Creek, Upstream	Second Creek, Downstream
Latitude	35°56.215'	35°56.215'	35°57.937'	35°57.416'
Longitude	083°54.920'	083°54.920'	083°55.632'	083°55.361'
Epifaunal Cover	8	14	13	12
Embeddedness	9	14	14	12
Velocity/Depth Regime	10	11	13	15
Sediment Deposition	7	11	13	12
Channel Flow	11	13	12	13
Channel Alteration	10	13	9	13
Riffle Frequency	9	12	15	15
Bank stability (left/right)	4/4	6/6	5/5	8/8
Vegetative Protection (left/right)	4/4	6/6	7/7	5/6
Riparian Zone Width (left/right)	3/3	2/2	5/5	4/4
Total (200 max.)	**86**	**116**	**123**	**127**

	TOTAL SCORE	TOTAL SCORE RATING
SITE		
Goose Cr., Upstream	86	Severely impaired
Goose Cr., Downstream	116	Moderately impaired
Second Cr., Upstream	123	Moderately impaired
Second Cr., Downstream	127	Moderately impaired

The upstream site on Goose Creek was scored as severely impaired and the downstream site scored moderately impaired. At both sites on Second Creek the rating was moderately impaired.

At the Vestal Boys and Girls Club location nine of the parameters scored in the marginal category. There were severe issues with sedimentation throughout the sampling site and very little exposed gravel substrate. The remaining areas looked like sand bars throughout. The riparian zone provided a good canopy layer thus the lowest temperature recorded during the survey but there were areas throughout that showed issues with bank stability and several areas were disturbed as well as the presence of eroded banks on both sides of the stream. The Goose Creek downstream location at the Mary Vestal Park scored higher than the upstream location but was still classified as "moderately impaired". This site was scored higher because flows were higher with better in-stream habitat due to less embeddedness and sediment deposition. Riffles were also longer than

at the upstream location therefore more streambed was suitable for colonization. This site was also further downstream from the construction occurring upstream of the Vestal location.

The sites at Second Creek scored higher than the Goose Creek sites. Both scored high in the moderately impaired category. This was the only site classified as moderately impaired. The downstream site scored a 92 and was classified as severely impaired. Though scores were low, the scores were higher than the 2008 IBI habitat scores at the same locations (49 and 65 respectfully). It is believed that the additional rains have increased the flows throughout Second Creek thus improving instream habitat availability and has helped to alleviate some of the sedimentation issues in this area. The issues with the riparian zone still remained and will do so for a period of time. Like the upstream location, the additional waterflow has helped improve the current habitat conditions. There was an increase in riffle availability and the areas of deposition were beginning to scour. There are still issues with the riparian zone such as bank stability, zone width, and the protective area. These issues will continue to remain because of the parking lots surrounding the sampling site.

DISCUSSION

Both creeks in the current study are listed in the draft version of the 2008, 303 d list for the state of Tennessee (TDEC 2008). Goose Creek's 4.9 impaired miles are listed due to loss of biological integrity due to siltation, other another anthropogenic habitat alterations, PCBs, and *Echerichia coli* from collection system failure, discharges from MS4 area, and RCRA hazardous waste. Second Creek's 12.8 impaired miles are due to loss of biological integrity, other anthropogenic habitat alterations, nitrates and *Echerichia coli* from discharges from MS4 area, urbanized high density area and collection system failure.

Both Goose Creek sites failed to meet the TDEC Target TMI of 32 for the macroinvertebrate sampling. They were scored as slightly impaired at both locations with scores of 28 and 24. At the upper site 13 taxa were identified with four EPT taxa while the downstream site had 17 taxa and three EPT taxa collected and identified.

At the Goose Creek sites, the habitat was classified as severely impaired at the upstream location and moderately impaired at the downstream location. At the upstream location there were environmental pressures due to construction upstream of the sampling site. These pressures were evident by the water turbidity as well as the amount of embeddedness present resulting in loss of instream habitat availability. There were few riffles present and habitats were mainly slow flowing runs or deeper pools. Also there were issues with bank failure and several eroded areas present at this site. The downstream site showed some of the same issues but the severity of those impacts were decreased. There was less embeddedness present and a decrease in sediment deposition. Bank stability was greater but several areas still suffered from potential bank failure. Also because of its location within the park, issues with impervious surfaces such as the roadway and parking lot and general maintenance of the grounds within the park added to the environmental pressures.

The sites on Second Creek were both classified as slightly impaired according to the macroinvertebrate data. Each site's index score was 24. At the upstream location, 10 taxa and only two EPT taxa were present. The downstream location was similar with 12 taxa and two EPT taxa present.

Both Second Creek sites were rated as moderately impaired and scored higher than Goose Creek. These sites were evaluated in 2008 by FLLA and both received a higher score from the 2009 habitat analysis. It is believed that due to the increased rain events during Spring 2009 that the additional flows assisted in scouring the streambed and providing additional instream habitat. There were still issues concerning the riparian zone such as the zone width and the amount of protective layer.

Overall both streams are suffering due to anthropogenic forces throughout their stream lengths. It is believed that these pressures will continue and that the biological community and the physical habitat will continue to suffer as well. Please refer to Appendix A photos for current conditions and pressures on Goose Creek and Appendix B photos for current conditions on Second Creek.

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APPENDIX A: PHOTOS OF GOOSE CREEK

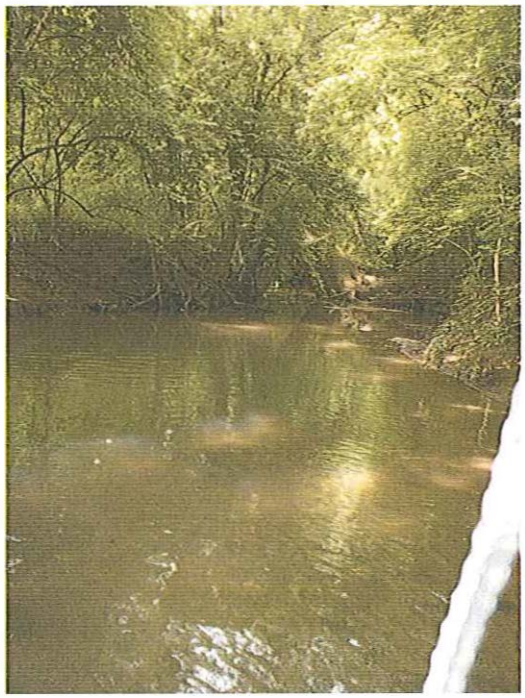


Photo 1. Goose Creek Upstream Site Upper Section

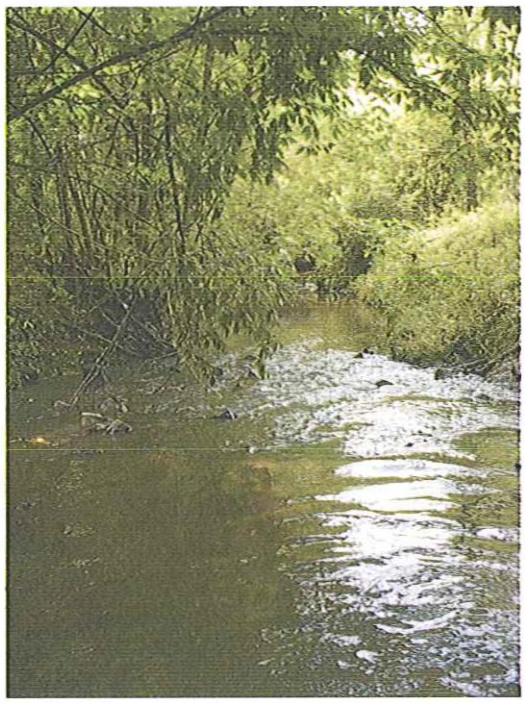


Photo 2. Goose Creek Downstream Site Riffles

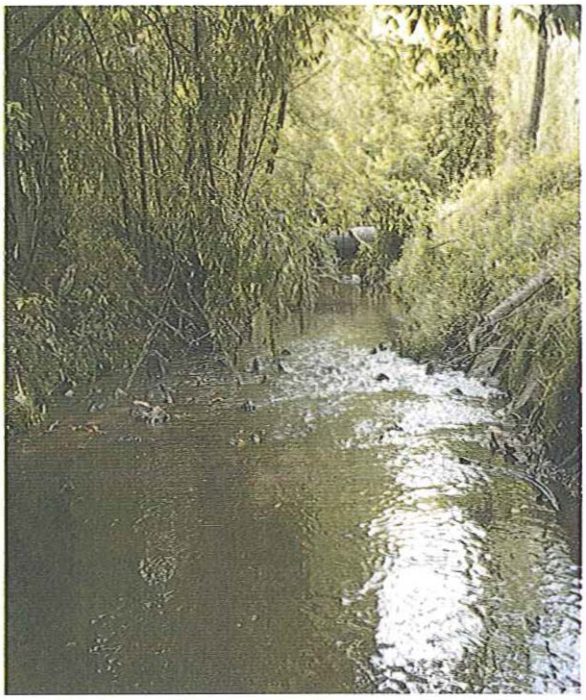


Photo 3. Goose Creek Downstream Site

APPENDIX B: PHOTOS OF SECOND CREEK

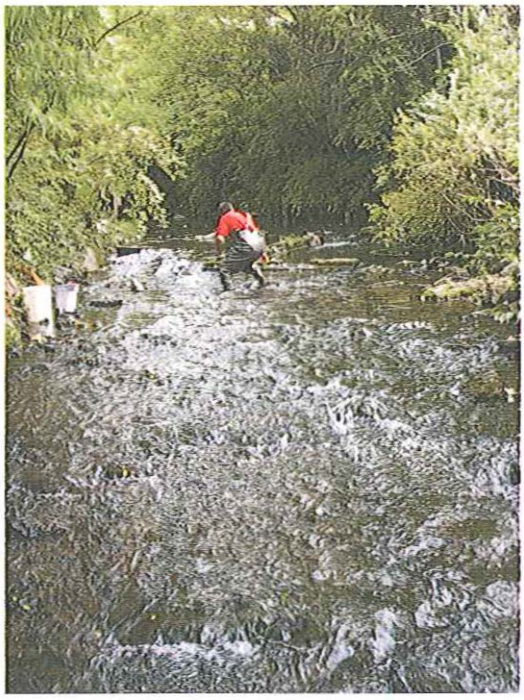


Photo 4. Second Creek Upstream Site Fast Riffles

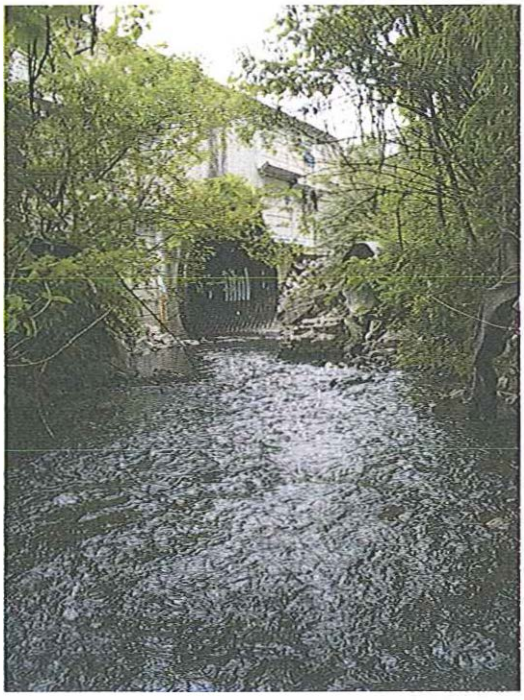


Photo 5. Second Creek Upstream Site Slow Riffles

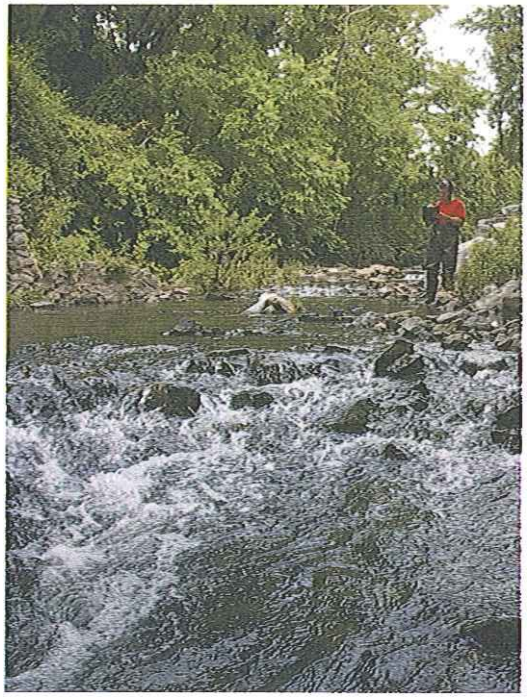


Photo 6. Second Creek Downstream Site Fast Riffles

Photo 7. Second Creek Downstream Site Slow Riffles

APPENDIX E

Stream Restoration/Weir Removal Contract Report

2009 Weir Removal Program

Work Conducted by:
Chase McCord, Jake Hudson and Scott Wilson

Fort Loudoun Lake Association
956 Volunteer Landing Lane Box 12
Knoxville, TN 37915

Weir Survey and Removal

Abstract:

The Weir survey and removal program has been very successful to date. The program entailed a ground survey of urban creeks throughout Knoxville where-in weirs were located, documented, and assessed as to whether they were necessary for removal. Project plans were then composed and the weirs removed.

Weirs Removed:

First Creek Weir- 01

N 36° 01.672' W 083° 55.749'

FLLA staff members Jake Hudson and Scott Wilson removed this blockage on December 9th, 2008. Tree limbs had grown downward into the creek and collected large amounts of woody debris, leaves, and trash. The majority of the creek was blocked and the stream flow was diverted to the northeast bank. Workers cut and removed the limbs. The woody debris and leaves were removed as well as one bag of trash. Flow regime was restored.

First Creek Weir – 02

N 36° 00.489' W 083° 55.460'

This weir was also removed on December 9th, 2008. Large pieces of a tree trunk along with trash and woody debris were pinned against the Rocks protruding from the creek. Seventy percent of the creek was blocked. One bag of trash was collected and removed from site. Using a mattock, the larger pieces of wood were pried up, and workers lifted them. The smaller debris was removed and the flow regime was restored.

William's Creek Weir – 01

N 35°58.868' W 083°53.248'

Staff members Scott Wilson and Jake Hudson removed this weir on February 11, 2009. The blockage consisted of fallen trees, woody debris, trash and a small table. Workers cut and removed the large trees and woody debris. One bag of trash and the small table were removed from site.

Williams Creek Weir – 02

N 35°58.797' W 083°53.248

This weir was removed on February 25, 2009. A tree had fallen and wedged itself in the forks of another tree. The blockage collected a lot of woody debris and some trash. All of this was entangled in large and small vines. Using a chainsaw, machete, mattock and rake, workers cut and removed the tree and many of the vines. The woody debris was removed from the creek and one bag of trash was collected and removed.

Williams Creek Weir – 03

N 35°58.805' W 083°53.239'

Staff members removed this blockage on February 25, 2009. A tree had fallen across the creek and collected a few large logs and some smaller woody debris. Workers were able to remove the smaller logs by hand. The larger logs were cut with a chainsaw and removed.

Knob Creek Weir – 01

N 35°53.494' W 083°57.287'

This blockage was removed on April 15th, 2009 at the request of the City of Knoxville Public Service Dept. A large two trunk Tulip tree had fallen and completely blocked access to the public boat ramp at Knob Creek. Using a 20' jon boat, chain saw, axe and ropes, this tree was cut and removed. We cut the tree to just above the water line and wrapped it in caution tape so that it would be easily visible to boaters. FLLA plans to return when the water level drops to winter pool and cut it back to the shoreline.

Third Creek Weir – 01

N 35° 57.041' W 085° 58.095'

This weir was removed on April 22nd at the request of John Shubzda with the City of Knoxville Dept. of Engineering. A large tree had fallen and it's canopy was in the creek and collecting debris. Using a chainsaw, FLLA staff members Scott Wilson and Jake Hudson cut and removed the tree.

Third Creek Weir – 02

N 35°57.005' W 083°58.071'

This blockage was located just downstream from the previous weir and was also removed at the request of Mr. Shubzda. A large two trunk tree had fallen into the creek and collected a large amount of trash and debris. Workers removed the trash which included a folding chair, two buckets, a bundle of rope and a bag full of trash. A lot of vines were tangled within the tree and the debris. They were cut and removed with a machete. The tree was cut up with a chainsaw and removed from the creek.

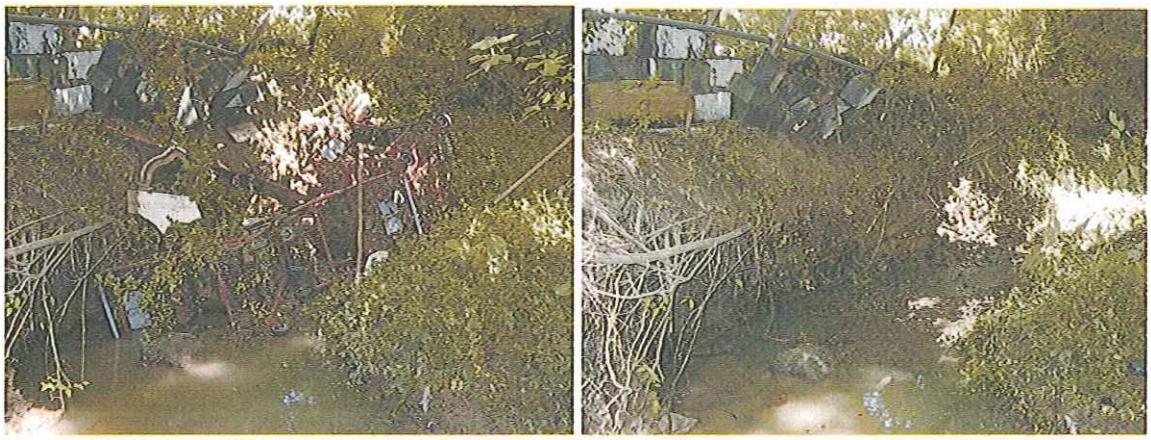
Holston River Weir – 01

N 35°58.796' W 083°51.529'

This weir was located on the inside of Boyd's Island, at Holston River Park. A very large tree had fallen causing 100% blockage. On June 15th, 2009, FLLA staff members Jake Hudson and Scott Wilson removed this blockage using a work boat, chainsaw, mattock, rake and ropes. Trash and small woody debris was removed by hand. As the tree was cut, workers would place the logs on the boat or tie them to the boat. Approximately 60% of blockage was removed providing safe boat passage. What remained of the weir was under the water line and could not be removed. FLLA plans to return to the site when TVA drops the water level and remove the rest.

Tecoma Drive Weir -01

N 36°00.743' W 083°54.863'



This blockage was located in a tributary to First Creek and was removed on July 14th, 2009 by FLLA staff members Chase McCord and Scott Wilson. Four grocery carts had been dumped into the trib and had accumulated a lot of trash and debris. Workers removed one bag of garbage, a small amount of woody debris and the carts. The carts were placed on the side of Tecoma Dr. and were removed by the City of Knoxville Dept. of Public Services.

Tecoma Drive Weir – 02

N 36°00.734' W 083°54.858'

This weir was removed on July14th, 2009 by staff members Chase McCord and Scott Wilson. The blockage consisted of one grocery cart, a bundle of wire mesh and a small amount of trash and debris. The trash and debris was removed first. Then workers removed the cart and the mesh and placed them on the side of Tecoma Dr. for the Public Services Dept. to pick up.

Tecoma Drive Weir – 03

N 36°00.769' W 083°54.843'

FLLA staff members Chase McCord and Scott Wilson removed this weir on July 14th, 2009. The weir consisted of a low hanging vine that broke the surface of the water. Trash and debris had been snagged by the vine causing approximately 70% blockage of the trib. Workers removed the trash and debris and cut away the vine.

Tecoma Drive Weir – 04

N 36°00.761' W 083°54.846'

This weir consisted of a large wooden spool, one grocery cart and a lot of trash and woody debris. Approximately 80% of the tributary was blocked. The blockage was removed on July 14th, 2009. Staff members Chase McCord and Scott Wilson removed the woody debris and bagged all of the trash. Then the Cart and spool were moved to the side of Tecoma Drive for the Public Services Dept. to pick up.

Tecoma Drive Weir – 05

N 36°00.722' W 083°54.845'

The Fort Loudoun Lake Association was notified of this weir by the City of Knoxville Department of Engineering. It consisted of one very large tree, a large wooden spool and a small amount of trash and debris. FLLA staff members Chase McCord and Scott Wilson removed the trash and debris. The spool was taken to the Side of Tecoma Dr. for pick up by the Public Services Dept. Workers cut the tree using Chainsaws, splitting axes and a timber jack.

Baker Creek Weir – 01

N 35°57.120' W 083°53.676'

This weir consisted of a large log the stretched from one shore to the other, and a couple of smaller logs that had wedged against it. On July 23rd, 2009 FLLA workers Chase McCord and Scott Wilson removed the smaller logs by hand and using a chainsaw cut and removed the large log.

Baker Creek Weir – 02

N 35°57.128' W 083°53.674'

This blockage was removed July 23rd, 2009 by staff members Chase McCord and Scott Wilson. The blockage was made up of many logs, trash, small woody debris and cuttings from a willow tree. A chainsaw was used to cut the entangled willow cuttings and some of the larger logs. One bag of trash was collected and removed from site.

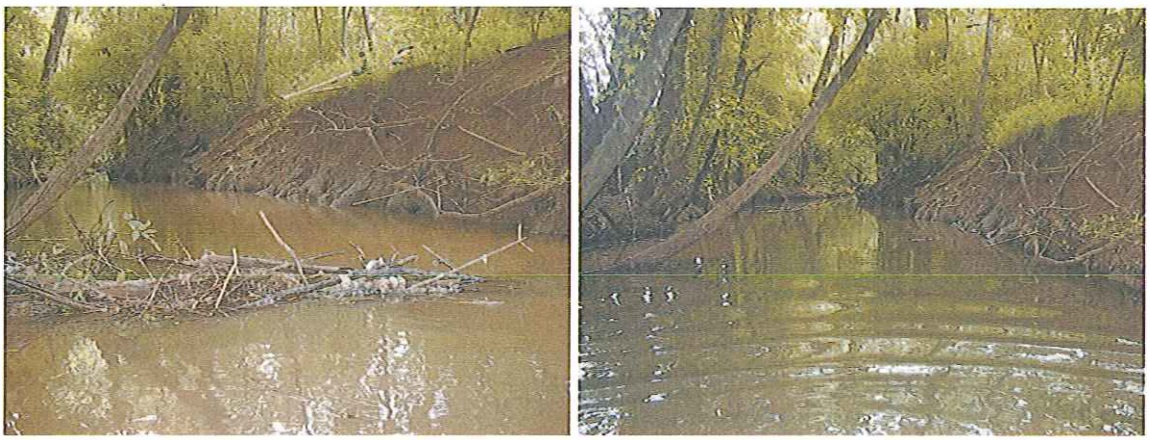
Baker Creek Weir – 03

N 35°57.139' W 083°53.673'

Staff members Chase McCord and Scott Wilson removed this weir on July 23rd, 2009. This weir was made up of large logs, small woody debris, large sheets of plastic and a small amount of trash. The larger logs were cut with a chain saw and removed along with the woody debris. The plastic sheets and trash were bagged and removed from site.

Baker Creek Weir – 04

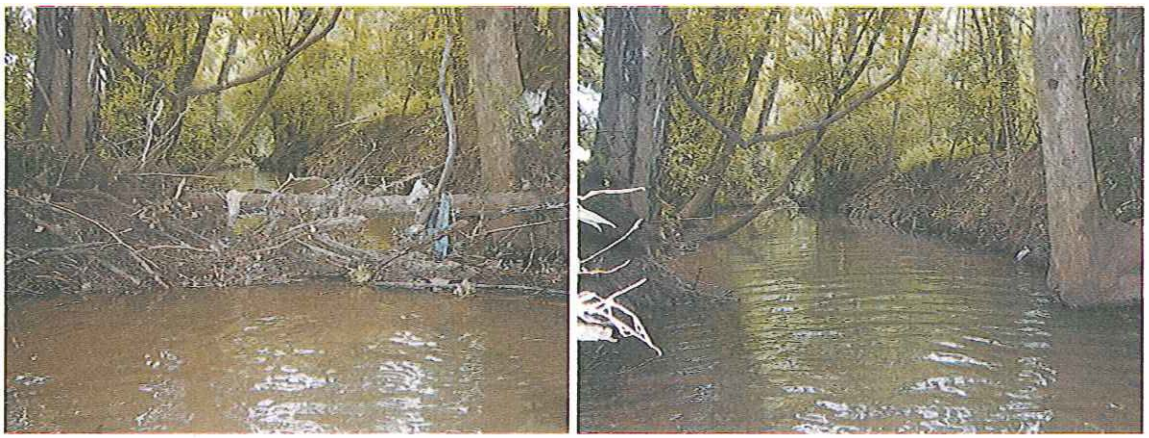
N 35°57.066' W 083°53.700'



This weir was removed on July 23rd, 2009 by FLLA staff members Chase McCord and Scott Wilson. The weir consisted of one large log, several smaller logs, trash and woody debris. Approximately 70% of the creek was blocked. Smaller logs and woody debris were removed by hand. Trash was bagged and removed from site. The larger log was cut with a chainsaw and removed.

Baker Creek Weir – 05

N 35°57.060' W 083°53.755'



This weir was removed on July 23rd, 2009 by staff members Chase McCord and Scott Wilson. This blockage consisted of a fallen tree that bridged the two banks. The tree collected several logs, trash and woody debris. A chainsaw was used to cut the fallen tree and some of the larger logs. The smaller logs and woody debris was removed by hand. The trash was collected and removed from site.

Baker Creek Weir – 06

N 35°56.980' W 083°53.755'

This weir was removed on July 23rd, 2009 by FLLA staff members Chase McCord and Scott Wilson. The weir was made up of a large piece of PVC, woody debris and trash. The woody debris was removed by hand. The trash was bagged and removed from site along with the PVC.

Conclusion:

As urban runoff has increased within watersheds in the Knoxville area, stream bank scouring and stream widening has increased the frequency of weirs in surrounding urban creeks. Said weirs are a problem in that they can create additional stream bank scouring/erosion, trash and debris buildup, urban flooding, stream-bed sedimentation, Oxygen depletion, biota passage obstruction, mosquito and other pest breeding, and can be a human safety issue causing underpinning and drowning if a person is caught in the stream during a high water event. The removal of these obstructions can help further degradation to the creek, both visually and biologically.

APPENDIX F

Table of SPAP Facilities Inspections

Commerical and Industrial Facilities Inspected During 2008-2009

Permit Number	Project Name	Address	Street Name	Inspection Date	Inspector	Water Quality Device
03-002	Ft. Sanders Park West Med. Cnt.	9352	Park West Blvd	07/10/2008	Jeffery Askew-CrystalSteam	Crystal Stream-Oil and grit seperator
07-013	Waffle House	6230	Papermill Dr.	08/07/2008	J Shubzda	Suntree Tech Grate Inlet Skimmer Box
08-008	Taco Bell	4413	Western Ave.	08/19/2008	J. Shubzda	Managerial controls
05-017	McDonalds	7030	Kingston Pike	09/18/2008	J. Shubzda	3 Suntree Catch Basin Inserts
06-019	Lexus of Knoxville	10315	Parkside Drive	09/18/2008	J. Shubzda	5 Suntree Catch Basin Inserts
07-016	Toyota of Knoxville-Service Bay Addition	10415	Parkside Drive	09/18/2008	J. Shubzda	AquaGuardian Catch Basin insertAG-18
08-006	Mercedes of Knoxville	10131	Parkside Drive	09/18/2008	J. Shubzda	Kristar Enterprises, FloGard CB inserts
05-011	Home Depot	140	Green Rd	10/16/2008	J. Shubzda	Suntree Nutrient Separating Baffle Box
06-020	Pilot Food Mart #119	2518	N. Broadway	10/24/2008	Dynamis In.	2 Suntree Catch Basin Inserts
01-005	Pilot Food Mart	4603	Chapman Hwy.	10/30/2008	Dynamis Inc.	catch basin inserts
05-020	Pilot Food Mart #217	4800	N. Broadway & Adair Drie	10/30/2008	Dynamis Inc.	media filtration inserts
06-004	Pilot Foodmart # 215	410	Merchants Drive	10/30/2008	Dynamis Inc.	Flow Guard-Plus Filtration insrts
01-010	Pilot Food Mart-158	405	Lovell Rd	10/31/2008	Dynamis Inc.	Fossil Filter Flo Guard
02-001	Pilot Food Mart-105	206	Walker Springs Rd	10/31/2008	Dynamis Inc.	Fossil Filter Flo Guard
05-027	Pilot Food Mart #138	136	N. Northshore Dr.	10/31/2008	Dynamis Inc.	Flow Guard-Plus/filtrtn inserts
06-014	Titan Truck Equipment and Repair, Inc.	1901	Sutherland Ave	10/31/2008	J. Shubzda	Managerial controls
07-007	Sonic-Walker Springs	8475	Kingston Pike	10/31/2008	J. Shubzda	Suntree Catch Basin Insert
03-006-Closed	Liquidy Split, formally Cosmic Clean Car Wash	8525	Walbrook Dr	11/06/2008	J. Shubzda	Suntree grate inlet skimmer box-Closed
01-008	Lowes of East Knoxville	4927	Millertown Pk	11/19/2008	J. Shubzda	CDS PMSU30_28 X (2)
05-014	Stowers Rental & Supply	10616	Lexington Drive	12/01/2008	David Russel	Suntree Nutrient Separating Baffle Box
06-005	Ruby Tuesday (Wokhay)	120	Merchants Dr. & Central	12/08/2008	J. Shubzda	Sun Tree
08-004	Joe Neubert Collision Center	5086	Clinton Hwy	12/10/2008	J. Shubzda	Suntree
07-008	Onsite Environmental	403	Bernard Ave	01/05/2009	J. Shubzda	managerial controls
04-005	Outback Steakhouse Strawberry Plains	7400	Sawyer Ln	01/09/2009	J. Shubzda	4 catch basin inserts
04-028	Zaxby's Restaurant	607	East Emory Road	01/09/2009	J. Shubzda	4 Suntree Catch Basin & 2 Grease Guards
05-013	Ryder Truck Rental	7509	Stawberry Plains Pike	01/09/2009	J. Shubzda	11 catch basin inserts, no work= no inserts
06-009	Tennessee RV	7450	Sawyer Lane	01/09/2009	J. Shubzda	3 Catch Basin Inserts
07-019	Emerald Building #1, Quick Lube	7420	Saddlerack St.	01/09/2009	J. Shubzda	2 catch basin inserts
08-035	Kwik Fuel 398	7405	Strawberry Plains Pike	01/09/2009	J. Shubzda	4000 gl Concrete Oil/Water Separator-already exist
08-042	Lowe's East of Knoxville	3100	South Mall Rd	02/09/2009	S&ME	CDS PMSU30-28
02-003	Finish Line Exxon	5706	Ashville Hwy	02/11/2009	J. Shubzda	CDS PMSU30_30
04-012	Ruby Tuesday Restaurant	508	East Emory Road	02/23/2009	Jeffery Askew-CrystalStream	Crystal Stream
06-031	Harvest Park Shopping Center	5515	Washington Pike	02/23/2009	Storm System Services	Suntree Vault
05-016	KFC	4200	Chapman Highway	03/17/2009	J. Shubzda	Insert and Stormceptor
06-015	Kentucky Fried Chicken chpmn hwy	4200	Chapman Hwy	03/17/2009	J. Shubzda/L. Marcum	catch basin insert/storm septor
04-010	Pepsi Bottling Group Warehouse Expansion	3501	Middlebrook Pike	03/25/2009	J. Shubzda	Grate Inlet Skimmer Box
06-012	Trinity Hills Senior Living Community	4611	Asheville Highway	04/18/2009	J. Shubzda	catch basin inserts
00-002	Lexus of Knoxville	10315	Parkside Dr	04/21/2009	J. Shubzda	Catch Basin Inserts
00-003	Toyota of Knoxville	10415	Parkside Dr	04/21/2009	J. Shubzda	Catch Basin Inserts
01-014	Budget Transmission	3000	Sutherland Ave	04/21/2009	J. Shubzda/L. Marcum	sand filter
03-014	Ridgeway Service Center	5410	Western Avenue	04/21/2009	J. Shubzda	grass swale
05-019	Wal-Mart Knoxville East	3051	Kinzel Way	04/22/2009	J. Askew	Suntree Nutrient Separating Baffle Box
01-009	Kroger Store U-558 Fuel Center	4414	Ashville Hwy	04/28/2009	J. Shubzda/L. Marcum	Downstream Defender
03-001	Park West Church of God	7635	Middlebrook Pk	04/28/2009	J. Shubzda/L. Marcum	First flush filter and skimmer plate
07-011	Taco Bell	5322	Millertown Pike	04/28/2009	J. Shubzda/L. Marcum	Suntree Catch Basin Insert
09-030	Park West Church of God	7635	Middlebrook Pike	04/28/2009	J. Shubzda/L. Marcum	First flush filter and skimmer plate
08-005	El Mezcal Mexican Restaurant	118	N. Forest Park Blvd	04/30/2009	J. Shubzda	Suntree Curb Inlet Basket
02-011	Kroger Fuel Facility -U525	9501	S. Northshore Dr	05/18/2009	J. Shubzda	Aqua-Swirl AS-4
03-008	Knoxville/Knox Co. - Animal Cnt.	3201	Division St	05/18/2009	J. Shubzda	Suntree grate inlet skimmer box
06-033	Woodlands of Knoxville II	1045	Cherokee Trail	05/18/2009	J. Shubzda/L. Marcum	Kristar Catch Basin Inserts

Commerical and Industrial Facilities Inspected During 2008-2009 cont.

Permit Number	Project Name	Address	Street Name	Inspection Date	Inspector	Water Quality Device
07-015	Fox Pizza	7660	S. Northshore Dr.	05/18/2009	J. Shubzda	Management Controls
08-031	Parkway Farms	9411	S Northshore Dr	05/18/2009	J. Shubzda	Kristar FloGard, Model FGP-2024F
01-004	Frito-Lay Distr. Cnt.	4744	South Middlebrook Pk.	05/28/2009	J. Shubzda/L. Marcum	Suntree grate inlet skimmer box
06-023	Division Street Business Center	501	Cary Street	05/28/2009	J. Shubzda/L. Marcum	Suntree Technologies fiberglass insert-NOT BUILT
06-025	Long John Silvers	2816	E. Magnolia Ave	05/28/2009	J. Shubzda/L. Marcum	Enviropod
06-036	Marathon	2601	Knott Road	05/28/2009	J. Shubzda/L. Marcum	Closed System, Oil/water Separtor
07-025	Cummins terminals, Inc.	4715	N. Middlebrook Pk	05/28/2009	J. Shubzda/L. Marcum	Aqua Swirl AS-3
08-001	Rita's Bakery	3023	Tazewell Pike	05/28/2009	J. Shubzda/L. Marcum	Managerial Controls
08-007	Greenbrier Ridge Apts	1505	Greenbrier Ridge Way	05/28/2009	J. Shubzda/L. Marcum	Suntree Catch Basin Inserts
09-007	Downtown Island Airport	2701	Spence Place	05/30/2009	J. Shubzda	Oil Water Seperators
04-017	Clayton Motors-CC Used Cars	4316	Clinton Highway	06/03/2009	J. Shubzda/L. Marcum	Suntree Catch Basin Inserts
04-022	Food City	4805	N. Broadway	06/03/2009	J. Shubzda/ L. Marcum	3 Hancor Flow-Guard Plus catch basin inserts
07-010	Superior Ice Company	2729	Middlebrook Pike	06/03/2009	J. Shubzda/L. Marcum	Suntree Catch Basin Insert
08-003	Sequatchie Concrete Service	2145	Sutherland Ave	06/03/2009	J. Shubzda/L. Marcum	Infiltration Pond
09-004	Kitt's Café	4620	Greenway Dr	06/03/2009	J. Shubzda/L. Marcum	Suntree CB Inserts
02-006	Chapman Hwy Car Wash	4605	Chapman Hwy	06/05/2009	J. Shubzda/L. Marcum	sand filter
02-013	Kroger Fuel Facility U-531	4409	Chapman Hwy	06/05/2009	J. Shubzda/L. Marcum	Crystal Stream 645
04-019	Knox Used Car Lot	2321	Chapman Highway	06/05/2009	J. Shubzda/L. Marcum	Sump with sock
06-021	Building 400, The Village at Northshore Town Cent	2099	Thunderhead Rd, STE TBD	06/05/2009	J. Shubzda/ L.Marcum	Kristar Flogard
06-029	StarBucks Coffe-Montvue Center Way	7803	Montvue Center Way	06/05/2009	J. Shubzda/L. Marcum	infiltration
07-017	Jason's Deli	133	N. Peters Rd	06/05/2009	J. Shubzda/L. Marcum	Managerial Controls
08-018	The Supershine Express	9423	S. Northshore Dr.	06/05/2009	J. Shubzda/ L. Marcum	Suntree
08-025	East TN Healthcare Development	1451	Old Weisgarber Rd.	06/05/2009	J. Shubzda/ L. Marcum	Contech CDS56_53,CDS40_45
08-039	Dunkin Donuts	7114	Kingston Pike	06/05/2009	J. Shubzda/ L. Marcum	Infiltration Trench
07-006	Sysco Food Services	900	Tennessee Ave	06/09/2009	J. Shubzda/L. Marcum	Large Suntree
07-027	KUB Hoskins Operation Center	4505	Middlebrook Pike	06/09/2009	J. Shubzda/L. Marcum	Suntree Inserts
08-013	South Grove, Gondoliers	7644	Mountain Grove Dr.	06/22/2009	J. Shubzda	Catch Basin Inserts
08-020	Food City Gas-N-Go Southgrove	7644	Mountain Grove Dr.	06/22/2009	J. Shubzda	Suntree GISB 32-32-24-SB 2 ea. N. end of Prop
04-004	Pilot Food Mart-187	100	Merchant Drive	06/23/2009	Dynamis Inc.	Catch Basin Inserts
05-009	Starbucks Coffee Company	116	Merchant Drive	06/23/2009	J. Shubzda	4 Suntree catch basin inserts
09-009	All in One Automotive/Carwash	1926	Callahan Drive	06/23/2009	J. Shubzda/L. Marcum	Suntree GISP-A-24-37-25

APPENDIX G

City of Knoxville Solid Waste Office 2008 Annual Report

Solid Waste Section
2008 Annual Report

CITY OF KNOXVILLE
BILL HASLAM, MAYOR

Department of Public Works
Steven King, Director

Public Service Division
David Brace, Deputy Director

Printed on Recycled Paper

INTRODUCTION

In 2008, we continued to show positive progress in the development of our solid waste programs. We continued active enforcement of the solid waste ordinances and completed our eleventh full year of operations at the Household Hazardous Waste Collection Center. The Public Service Division is in its seventh year of garbage collection service and recycling in the Central Business District at a cost savings of $30,000 per year. All of these programs have been successful and reflect the continued interest in and growth of our comprehensive solid waste management program.

The following pages summarize our activities for the calendar year 2008.

The last page is a residential waste stream analysis of data such as:

* The total waste stream increased by 5855.43.95 tons from 2007
* The diversion rate increased to 61.74% from 59.50% in 2007
* The recycling rate increased to 30.72% from 25.83% in 2007

The total waste stream shows an increase for the first time in three years. This increase is largely attributed to yard was collection. Diversion and recycling rates have remained level over the last five years, varying a few points up or down each year.

I. RECYCLING

A total of 5895.08 tons of recyclables was collected at the City's eleven drop-off recycling centers in 2008. This number is level with recyclables from 2005 to 2007, up by 186 tons. The increase comes from the extended operation at the Parkvillage Rd. center. All commodities showed an increased while news paper showed a decrease.

Goodwill Industries is in the 2nd year of three 1 year extensions of a contract to assist in on-site operation of the recycling centers. For 2008 new contracts were signed with Advanced Polymer Recycling to handle recycling of all of the materials collected at the centers and pay the City current market value for material collected. A contract was signed with Waste Connections to haul the materials from the centers to Advanced Polymer Recycling.

In 2008, the City extended a pilot project to collect cardboard brought to the Market Street Garage by downtown businesses. A local recycling non profit organization was asked to assist in collection, processing and weighting and of the material. During the 2008 over 79 tons of material was collected from the down town area.

II. MUNICIPAL SOLID WASTE (MSW)

A total of 47,554.45 of garbage was collected from Knoxville homes in 2008 as part of the weekly garbage collection service the City offers via its contractor, Waste Connections. This number reflects a less than1% decrease from the previous year. The City is currently in a five year contract with Waste Connections that expires in 2011. Current collection costs per this contract are:

Curbside Collection	$6.40 / house/month	41,411 residents
Backdoor Collection	$8.00 / house/month	14,584 residents

All garbage is disposed of at the Chestnut Ridge Landfill operated by Waste Management of Knoxville. The City is currently in a 10 year contract with Waste Management that expires in 2010. Contract prices change in October of each year. Disposal costs for 2008 were as follows:

Oct. '07 - Jun. '08	$25.14 / ton
Jul. '08 - Sep. '08	$25.82 / ton
Oct. '08 - Jun. '09	$27.04 / ton

III. YARD WASTE COLLECTION / MULCHING

A total of 36,683.24 tons of yard waste was collected by City crews in 2008. This number is up by 8,628.06 tons from last year. The Solid Waste Department sees this increase based on extremely dry weather conditions during the entire year of 2008 and increase in the amount of leaves collected. All yard waste is taken to Shamrock Organic Products where it is turned into mulch products. The City is currently in a 5 year contract with Shamrock that expires in 2011. Costs for disposal in 2007 at Shamrock were:

Oct. 07 - Sept. 08	$27.95 / ton
Oct. 08 - Sept. 09	$28.93 / ton

IV. SOLID WASTE MANAGEMENT FACILITY

Transfer Station

The design of the Transfer Station encourages separation of Construction and Demolition waste (C&D) from Municipal Solid Waste. This allows us to save money by sending C&D waste to a Class III landfill and also enable us to comply with the State mandate calling for a reduction in the volume of waste placed in Class I landfills. In 2008, we diverted 28,932 tons of C&D waste to a Class III landfill. This was 82% of the waste received at the Transfer Station. The total number of vehicles using the facility in 2008 was just over 57,430 down 2,570 from 2007 including City of Knoxville vehicles. Total revenue from charge and cash customers was $599,860.34 up $20,266.43 from 2007 549,860.34

Household Hazardous Waste (HHW) Collection Center

Staffed by City Solid Waste personnel, the HHW Facility is operated jointly by the City and County for all residents. Based on approximately 50/50 usage by City and County residents, the County contributes 50% of the operating and disposal cost. In 2008, this facility was visited by 4,668 vehicles, slightly up by 25 from 2008, and processed 132 tons of HHW, 70% of which was latex paint.

V. EDUCATION

The Solid Waste Office engaged in many activities and special programs throughout 2008 to educate Knoxvillians about waste reduction, recycling, composting, and other solid waste issues.

America Recycles Day - The City of Knoxville, along with several other local organizations, participated in the tenth annual America Recycles Day, a national education campaign aimed at increasing citizens' commitment to recycling and buying recycled goods.

Telephone Book Recycling - Once again this year the Solid Waste Office coordinated the Knoxville/Knox County schools telephone book recycling program. Thirty eight Knox County schools competed for cash prizes donated by the City and County. Over 76 tons of old phone books were collected from the schools and from eight City of Knoxville drop-off centers.

Earth Day - The Solid Waste Office was a part of a city-wide steering committee that developed EarthFest 2008 which celebrated the 35th anniversary of Earth Day at Pellissippi State Tech. Comm. College. Over 9,000 people attended the event which had 100 + exhibitors from the environmental community.

One-Day Computer Collection Events - One-day computer collection events were held in January with ten sponsors contributing to the success of the event. Approximately 1400 residents participated in the events with just over 68 tons of electronic materials collected. The material was recycled at 5R Processors in Clinton, TN.

Used Residential Thermometer Exchange - The Solid Waste Office started an ongoing mercury thermometer exchange program in 2005. The exchanges, conducted in cooperation with the Tennessee Department of Environment and Conservation, the City of Knoxville Public Service Division, and the Safe Kids Coalition of the Greater Knox Area, collected over 545 mercury thermometers from City and County residents, containing a total of close to just over 1 pound of mercury in 2008. New digital thermometers were given out for each used mercury thermometer that was turned in.

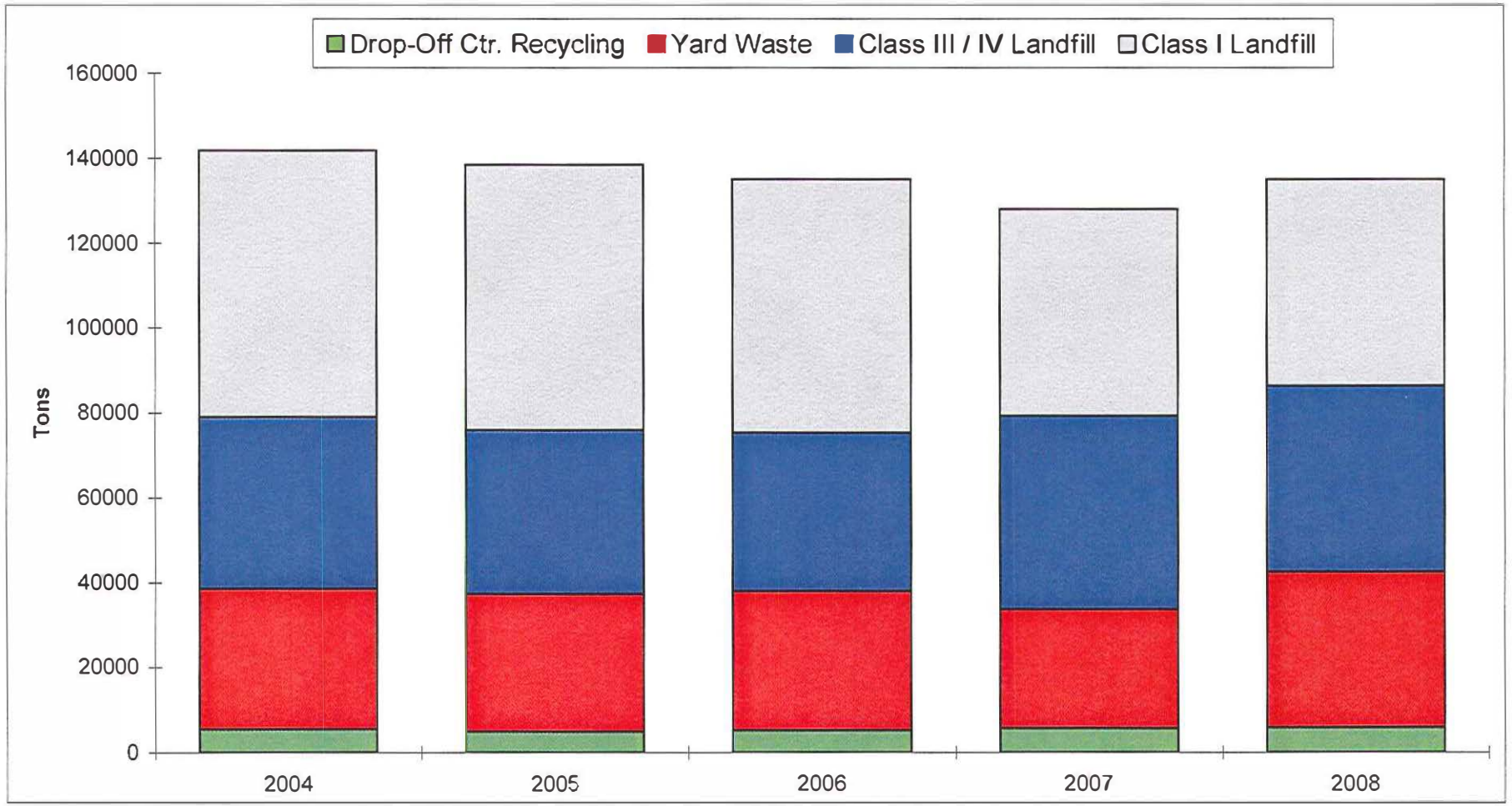
Unwanted Medicines Collection Event

The City Solid Waste Coordinated a unwanted medicines collection event in cooperation with the City of Knoxville Police Department, Knox County Solid Waste Office and Health Department and UT Student Pharmacy Association. Over 92 pounds of medications were collected at the first event and properly disposed of by the KPD. Other collection events are in the planning stages for 2009.

Curbside Recycling – The City's contractor for the collection of residential solid waste, Waste Connections, began a subscription curbside recycling program in the city. The program started in November of 2004 and Waste Connections provided statistics on participation rates to the Solid Waste Office throughout 2008. City of Knoxville residents can call Waste Connections to request the service. Materials collected for recycling are cardboard, glass, aluminum, newspaper, and plastics. 1200 tons was collected from 2500 residents signed up for the service in 2008.

Other - In 2008, the Solid Waste Office continued to produce and distribute educational brochures and promotional items. Staff of the Solid Waste Office participated in several educational events in 2008 using our exhibit booth display at events including the Dogwood Arts' House and Garden Show and America Recycles Day Events. Over 200 school children toured the SWMF and listened to a presentation at the HHW facility.

Destination of Knoxville's Residential Waste Stream, 2004 - 2008



	2004	2005	2006	2007	2008
Diversion Rate	59.26%	56.25%	56.26%	59.50%	61.74%
Recycling Rate	28.02%	27.61%	28.77%	25.83%	30.72%

Annual Report 2008 Drop Off Centers	Kroger 5003 N. Broadway	Goodwill Magnolia & Alice	Kroger 4818 Kingston Pk.	Kroger 2217 N. Broadway	Goodwill 225 Moody Av.	Kroger 4440 Western Av.	Goodwill 341 Parkvillage	Downtown 400 State St.	Food City 5941 Kingston Pk.	Food City 2939 Alcoa Hwy.	Goodwill 820 Metler	Totals
Aluminum	10280 lbs	3060 lbs	15880 lbs	11300 lbs	12680 lbs	6000 lbs	37840 lbs	3520 lbs	2540 lbs	2600 lbs	0 lbs	52.85 tons
Steel	34202 lbs	9020 lbs	53847 lbs	22987 lbs	25540 lbs	20853 lbs	70273 lbs	13980 lbs	0 lbs	0 lbs	0 lbs	125.35 tons
Plastics	126962 lbs	34100 lbs	180677 lbs	86417 lbs	95600 lbs	74913 lbs	274893 lbs	30910 lbs	3680 lbs	11840 lbs	2160 lbs	461.08 tons
Clear Glass	77961 lbs	17768 lbs	173733 lbs	68780 lbs	65474 lbs	43900 lbs	171433 lbs	36086 lbs	0 lbs	0 lbs	593 lbs	327.86 tons
Brown Glass	139699 lbs	34868 lbs	272186 lbs	98253 lbs	100994 lbs	74727 lbs	276300 lbs	42906 lbs	0 lbs	0 lbs	593 lbs	520.26 tons
Green Glass	90339 lbs	20448 lbs	191246 lbs	73733 lbs	71354 lbs	50947 lbs	197300 lbs	36166 lbs	0 lbs	0 lbs	593 lbs	366.06 tons
Newspaper	514040 lbs	194400 lbs	589020 lbs	287120 lbs	266760 lbs	313220 lbs	812460 lbs	69600 lbs	72593 lbs	57186 lbs	0 lbs	1,588.20 tons
Mixed Paper	594340 lbs	161600 lbs	967640 lbs	325320 lbs	352040 lbs	328900 lbs	1172440 lbs	153720 lbs	22160 lbs	57720 lbs	6340 lbs	2,071.11 tons
Cardboard	138940 lbs	37460 lbs	203930 lbs	93400 lbs	99220 lbs	99220 lbs	31920 lbs	31920 lbs	511 lbs	23760 lbs	4320 lbs	382.30 tons
Drop Off Center Totals	863.38 tons	256.36 tons	1,324.08 tons	533.66 tons	544.83 tons	506.34 tons	1,522.43 tons	209.40 tons	50.74 tons	76.55 tons	7.30 tons	5,895.08 tons

KPD / Lorain St.	11.20 tons
Cardboard / Paper	22.51 tons
Downtown Cardboard Recycling	79.17 tons
Phone Books	76.46tons

	Leaves	Brush	Total
Mulching Site	11,573.69 tons	25,109.55 tons	36,683.24 tons

	Scrap Metal	Cardboard	Rec. Tir.	HHW REC.	HHW Divert.
Transfer S ation	342.21 tons	0.00 tons	0.39 tons	19.04 tons	15.08 tons

	C&D	Compacted	Computers	Tires	Total
Transfer Station Cont.	28,932.11 tons	6,007.56 tons	94.28tons	108.12 tons	35,518.79 tons

	Household Trash	Misc. Trash	Total
Landfill Class I	47,554.45 tons	404.84tons	47,959.29 tons

	Transfer Station	Construction	Codes	Total
Landfill Class III	28,932.11 tons	8,277.08 tons	6,517.22 tons	43,726.41 tons

Total Waste Diverted, Class III & Rec.	87,073.18 tons
Total Waste Landfilled, Class I	53,966.85 tons
Total Wastestream	141,040.03 tons

Recycling	30.72%
Diversion	61.74%
** Recycling / Total WS*	7.17%
* Yard Waste Not Included w/just residential trash	11.03%

APPENDIX H

NPDES Permit Program Inventory Map

(Attached separately)

The entire inventory map is not reproduced as part of the online version of the Year 13 Annual Report. The entire map is approximately 66 inches by 32 inches (covering an area of approximately 33 miles by 16 miles) at a scale of 1-inch equals one-half mile.

To view the entire map, please contact the Stormwater Engineering Division at (865) 215-2148.