“HOW TO” GUIDE FOR STORMWATER AND URBAN WATERSHED MANAGEMENT

Considerations for Stormwater and Urban Watershed Management: Developing a Program for Complying with Stormwater Phase II MS4 Permit Requirements and Beyond

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"... Storm water is water from rain or snow that runs off of city streets, parking lots, construction sites and residential yards. It can carry sediment, oil, grease, toxics, pesticides, pathogens and other pollutants into nearby storm drains. Once this polluted runoff enters the sewer system, it is discharged -- usually untreated -- into local streams and waterways.

A leading public health and environmental threat, storm water runoff can contaminate drinking and recreational waters. It also remains a major source of beach and shellfish bed closures. Storm water runoff washes sediment from construction sites at a rate of 20 to 150 tons per acre each year. Sediment has been identified as the single largest cause of impaired water quality in rivers and the third largest cause of impaired water quality in lakes.

The new storm water Phase II rule is expected to make approximately 3,000 more river miles safe for boating and protect up to 500,000 people a year from illness due to swimming in contaminated waters. It will prevent beach closures, make fish and seafood safer to eat, and reduce costs of drinking water treatment. Under the expanded program, sediment discharges from approximately 97.5 percent of the acreage under development across the country will be controlled through permits. ... "

Source: U.S. EPA Press Release, December 8, 1999

PURPOSE OF THIS DOCUMENT

The purpose of this document is to serve as a roadmap for individuals and communities that are in the process of developing plans and programs for urban watershed management. Although funding for this project specifically targeted Phase II stormwater communities or areas, this manual is designed to assist any community that seeks to develop planning strategies, education or other tools or local programs for urban watershed management. Hopefully more and more communities will recognize that urban watershed management addresses much more than just the water quality concerns that the U.S. Environmental Protection Agency and the Alabama Department of Environmental Management are required to address by implementing the Phase II MS4 program. Proactive urban watershed management that employs planning, design and best management practices will simultaneously address many quality of life issues in a community.

This document is not meant to be an encyclopedia of urban watershed and stormwater management information. Rather, as a roadmap, it is designed to present an outline and suggestions on how to address the subject and at the same time reference some of the better sources of information, training and assistance.

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DISCLAIMER

The opinions and suggestions presented in this manual are those of the author and are thus not necessarily endorsed or supported by the Alabama Department of Environmental Management the U.S. Environmental Protection Agency or Troy State University..

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WHY STORMWATER MANAGEMENT?

Even for communities where there is no Municipal Separate Storm Sewer (MS4) Phase II Stormwater Permit requirement pending, stormwater management makes sense. In recent locally-led water resource and nonpoint source water quality assessments conducted in all sixty-seven Alabama counties, flooding in and downstream of urban and urbanizing areas was one of the most frequently noted problems. Municipal engineers and public works departments spend a significant part of their time dealing with the effects of stormwater. A proactive approach can reduce problems and costs associated with stormwater management.

Also, one does not have to look very hard to see the impacts of urbanization upon both the stream habitats and upon water quality. Just a visual inspection of smaller streams and some not so small streams in urbanizing areas reveals problems with changes in stream morphology, sedimentation, organic and nutrient enrichment and trash and debris. Field observations and simple testing often reveals deficiencies in dissolved oxygen levels, elevated temperatures, degraded habitats, degraded biological communities and dry season low-flow problems in urban and urbanizing towns and cities.

Therefore, it should come as no surprise that many urban streams are significantly degraded and on the U.S. Environmental Protection Agencies (EPA's) list of impaired streams (the 303d list). Nor should it come as a surprise that EPA considers polluted stormwater runoff to be one of its remaining pieces of unfinished business. The effects of stormwater runoff are serious enough nationally to be regarded as the second largest water quality problem after agricultural runoff.

Most Communities Are Already Doing Some Aspects of Stormwater Management

Your community and most communities are doing and have been doing stormwater management or at least some aspects of it for years. However, past stormwater management efforts have usually been one-dimensional and have focused on getting the water to run off as fast as possible so as to avoid flooding. This approach works fairly well to address its intended purpose but creates many undesirable consequences. These include downstream flooding and streambank and channel erosion problems, not to mention the destruction of stream habitat that takes place when natural stream channels are cleared of natural woody debris, straightened or replaced with concrete conveyances. In addition to destroying stream habitat and altering water temperature, concrete conveyances increase flooding and stream degradation wherever they end. Clearly the approach used in the past as well as at the present time in many communities is seriously flawed from an ecological viewpoint. Better approaches to stormwater flow management are available and will be discussed in this document. These more ecologically sound approaches to managing stormwater flow also reduce pollutant loadings as will be noted later in this guide.

Stormwater Management Can Prevent Or At Least Minimize Flooding

One goal of stormwater management is to avoid significant changes in peak runoff from storm events. Many communities are beginning to address peak runoff and are employing strategies to try to keep post-development peak flow at or very near the pre-development peak flows.

Typically this is being done through ordinances that require detention or retention structures or other design features adequate to prevent any significant increase in peak flows. There are other means for accomplishing this goal that give superior water quality results and which may cost less than relying almost totally on detention structures. These means involve rethinking a variety of design features of our communities and are addressed in this document.

Good Stormwater Management Practices Can Save Money

The typical reaction to new federally mandated environmental programs usually is something like, "What, another *@#!!!&*+ unfunded federal mandate?" That reaction may be warranted in some cases, but stormwater management probably should not in fairness receive such a reaction. To say that there are not some costs associated with starting and operating a stormwater management program would be dishonest. However, the avoided costs or savings that can be gained from implementing stormwater or urban watershed management may exceed the costs of the program. Proactive stormwater management programs that employ a variety of techniques that begin with design and go all the way to stormwater pollution treatment practices can save substantial resources. A good storm-water program can save resources in a number of ways. Costs can be reduced through the lower costs for infrastructure for "green" subdivisions, lower costs for parking lot and street designs, reducing the incidence and losses associated with flooding as well as other cost reductions. Cost reductions occur in two ways. One way is that "green" or environmental friendly subdivision designs often cost less to implement yet provide the same or even higher market prices than traditional design. Also, addressing the runoff problem proactively through design may save communities substantial costs by avoiding the need for expense channel alterations including concrete water conveyances.

Some information on proactive measures for stormwater management, particularly design methods for developing and redeveloping areas will be presented in this document. Additional information and consultation with planners and other professionals is available through the Alabama NEMO (Nonpoint Education for Municipal Officials) initiative. See Appendix B for information on Alabama NEMO and other resources for urban watershed and stormwater management.

It Can Make Your Community A More Attractive and Healthier Place to Live

Urban watershed or stormwater management is not a cure for all your community's problems but if done well they can do some things to make your community a more attractive place. Urban watershed management can help to create a community that is more attractive to people choos-ing a place to live and even make the community a healthier place to live for its citizens. Visualize for a minute a natural stream with an intact streamside area complete with hardwood trees and song birds running through

Stream-Friendly Designs Utilize Vegetation and Preservation of Pervious Surfaces to Slow and Reduce Runoff Volume — and to Beautify a Community

your neighborhood. Then visualize a large concrete ditch running through your neighborhood. If you had a choice which would you prefer - a traditional subdivision design with square lots all on a rectangular street grid or a subdivision with smaller lots and shared open space for walking trails or bike trails through the woods and along the creek and perhaps a neighborhood park or picnic area? While it isn't for everyone, subdivision designs which allow for retention of green spaces are preferred by an increasing number of people. Also, some people would welcome a return to the concept of community in which neighborhood markets and neighborhood schools allow adults and children to walk or ride a bicycle for many if not most of their daily trips. Believe it or not, the design of new subdivisions or redeveloping areas in your community could address public interest in green space and a return to a neighborhood concept and at the same time address the design elements needed to proactively manage urban watersheds and stormwater runoff.

For Some Communities Stormwater Management Is Mandated By Law or Soon Will Be

Some communities will be required by law to develop plans to reduce the impacts of stormwater runoff under the U.S Environmental Protection Agency Phase II MS4 regulations. These regulations, which were first published in the Federal Register on December 8, 1999, will require communities with a population of 50,000 or more or that fall within certain additional criteria to make application for a permit and meet the requirements of a Phase II permit on March 10, 2003. Also, the Alabama Department of Environmental Management (ADEM) is tasked with developing criteria and using those criteria to determine which communities of less than 50,000 population will be required to obtain a stormwater phase II permit or operate a stormwater program under the general permit. Small cities with as few as 10,000 population can fall under the stormwater program as can even smaller areas so long as the population density is 1000 or more per square mile.

WHAT ARE THE IMPACTS OF STORMWATER RUNOFF?

The impacts of stormwater runoff can be divided into two categories: hydrologic and hydraulic impacts or changes and water quality impacts. In many situations the hydrologic and hydraulic changes will be the main factor that results in environmental degradation. Although the U.S. EPA regulations do not directly address the hydrologic impacts by requiring flow control, they do require permit holders to show improvements or at least no further degradation in water quality. It is unlikely that permit holders in areas with any significant growth rate will be able to exhibit the degree of water quality protection or improvement sought by EPA without some successful strategy for minimizing increased runoff. The other category of stormwater runoff impact is the direct pollution of water via pollutants in the runoff. This is probably in some ways the easier of the two sets of stormwater impacts to deal with and in other ways the most difficult because it requires changing public attitudes and individual behavior.

Hydrologic Impacts of Stormwater Runoff

As a watershed begins to undergo urbanization the hydrology or water movement in the watershed begins to change. Water which once pooled on the surface and then filtered into the

ground more and more often falls upon hard, impervious surfaces like concrete and cannot infiltrate into the groundwater. Where about 50% of precipitation typically infiltrates into the soil and eventually into the groundwater system prior to development, up to about 55% runs off and only about 10% enters the groundwater system after development. This means that with standard patterns of development there is a lot more runoff generated from the same size rainfall event than was generated prior to development in the watershed. This increased runoff creates a number of problems including:

Hydrologic Changes Caused By Traditional Development Methods Often Lead To Stream Death

- More runoff is produced and it flows faster over impervious surfaces creating increased flooding
- Due to the increased discharge rates streams attempt to increase their capacity (either by widening downcutting or both)
- Less precipitation infiltrates into the shallow groundwater and thus groundwater discharge to streams is decreased resulting in smaller warm/dry season stream flows

These initial impacts produce a number of secondary impacts that often lead to a continuing worsening of the impacts. The increased flooding puts pressure on public works officials to concrete more runoff conveyances and thus worsens flooding and stream degradation somewhere downstream where the concrete ends. The stream morphology (shape or physical structure) changes destroying streambank habitats and trees along the bank as they are undercut. Loss of shading plus the widening of the stream results in more direct sunlight falling on the stream and thus higher temperatures and lower dissolved oxygen in the stream. Low infiltration rates mean lower flows and additional temperature increases and dissolved oxygen decreases in the warm/dry seasons. The reduction of flow is particularly stressful in streams that receive wastewater discharges or organic loading from other sources.

The changes in streams, widening and/or down cutting, degrades or destroys the habitat for the benthic (bottom-dwelling) macroinvertebrates upon which fish feed as well as the fish themselves. Or the increased runoff may lead to flood control measures like that pictured which destroy streams.

Water Quality Impacts of Stormwater Runoff

Many of the worst water quality changes are caused by the hydrologic modifications addressed in the last section. The changes in stream morphology and flow increase stream temperature by removing trees from the streambank and widening the stream. The higher temperatures also reduce the amount of dissolved oxygen that the water can hold. Other water quality stresses also are related to the changing urban environment. Most if not all of the impervious surfaces that runoff is generated by - pavement, rooftops, and compacted earth surfaces such as ball fields have surface temperatures higher than most surfaces that were found in the pre-development watershed. Therefore, runoff can be very warm in comparison to the natural temperature of

runoff. The replacement of vegetated surfaces with impervious pavement, rooftops and other manmade structures also reduces natural attenuation or treatment of pollutants in runoff through contact of the pollutants with biological and physical phenomena in the soil.

While the hydrologic changes are a source of much of the impact from stormwater runoff, pollutants in stormwater runoff can and do produce impacts upon water quality. The extent and magnitude of these impacts depends upon land uses within each catchment or watershed within the urban or suburban landscape, the presence or absence and condition of riparian buffers and buffers around potential pollution sources and public awareness and action to prevent pollution.

Typical pollutants of concern in urban stormwater runoff are:

- Solids
- Oxygen-demanding substances
- Nitrogen and phosphorus
- Pathogens
- Petroleum hydrocarbons
- Metals
- Synthetic organics

The concentrations of many if not most pollutants in urban stormwater runoff are often about the same to significantly higher than pollutant concentrations in domestic wastewater after secondary treatment. These pollutant loadings can have a significant impact on urban streams and watersheds particularly when combined with the impacts that urbanization can produce in hydrology and stream morphology.

In a number of studies, stormwater pollutant concentrations appear to be similar from most types of urban land uses. The most frequent exceptions to this general observation are sediments which can be one to several orders of magnitude higher in runoff from areas with significant construction or row-crop agriculture and indicators of bacteriological contamination (fecal coliform, E. coli etc.) which are very variable in urban stormwater runoff.

Some of these pollutants are easier to control than others because they can be effectively controlled via prevention. Prevention activities include both general community education and specialized education to address needed changes and pollution controls for certain activities. For instance, excessive rates of erosion from construction sites and delivery of sediment from these sites to waterways is one of the most destructive pollutants in urban streams. The problem can be addressed by education reinforced by a community erosion and sediment control ordinance and a local construction site inspection program. Leaving or restoring open space,

Education, and an Effective and an Enforced Erosion Control Ordinance Are Needed to Control Excessive Stream Sedimentation

trees and other vegetation, particularly in riparian areas (the areas bordering streams), can keep temperature increases in streams within acceptable levels and thus reduce urban impacts. Getting developers to employ “green-design” concepts will require a mix of education and regulation. When developers see the benefits both for the environment and for their bottom-lines many will adopt subdivision and commercial development strategies that reduce runoff volume and pollutant loads.

Some of the pollutants in urban stormwater runoff will be more difficult to control. Substances like copper from sources like the wear on automotive brake system components, zinc from corrosion of galvanized roofs or automobile bodies, fuels and oil and grease from automotive leaks and spills, organic products of combustion and bacteria from pets and other sources will be more difficult to control. Fortunately, the U.S. EPA does not expect communities to address all pollutants and all pollutant sources at the same time. Unless there are impaired 303d listed streams to be addressed, the U.S. EPA and ADEM will probably be satisfied if there is overall improvement or at least no decline in water quality and stream health.

Communities should manage stormwater impacts much like a physician would treat wounded soldiers at a field hospital, by addressing those things that can make the most difference first. Managing stormwater successfully without wasting scarce resources will require triage to address the stormwater impacts so as to make the most improvement possible with the limited resources that likely will be available. The remainder of this guide addresses the U.S. EPA Phase II permit requirements and suggests possible strategies for successfully fulfilling those requirements and more importantly developing an effective and efficient stormwater management program.

What Are The Minimum Stormwater Management Requirements Under Phase II?

The Phase II Stormwater regulations specify six program elements that must be addressed by permit holders. The regulations also imply that additional things will need to be done but the lack of specific requirements gives permit holders a great deal of flexibility if not a lot of guidance about what to do about some aspects of stormwater management, chiefly monitoring.

The six required stormwater program elements include:

1. Public Education and Outreach
2. Public Involvement and Participation
3. Illicit Discharge Detection and Elimination
4. Construction Site Runoff Control
5. Post-Construction Runoff Management
6. Pollution Prevention/Good Housekeeping Practices for All Municipal Operations

1. Public Education and Outreach

Since a number of pollutants come in large part due to an uninformed or careless public, public education is a critical component of any successful stormwater management effort. The best education efforts, those that make the most difference, target the entire community with a general message and specific components of the populace with the specific information and motivation that is most needed and appropriate.

The most effective education programs involve a good cross-section of the community throughout, from their inception to their conclusion. The most effective education programs are a mix of bottom-up and top-down initiatives. And, the most effective education programs connect people with the resource through hands-on activities that allow education to lead to structured outcomes that turn education into action. If individuals see how changes in behavior will make a difference and if that difference can be achieved fairly quickly people are more likely to take additional actions as success builds upon success.

In Alabama there are already quite a few existing organizations and programs that communities can work with cooperatively to address urban watershed management and reduction of stormwater runoff impacts from an educational approach. A few of these organizations include: the Alabama Extension System, the Alabama Water Watch Program and Alabama Water Watch Association, Legacy, Partners in Environmental Education, the PALS (People Against A Littered State) and numerous others (see Appendix B) for a list.

Despite all of these valuable resources for cooperative partnerships, ultimately success will be determined by local planning and involvement. The local organization responsible for meeting the requirements of the stormwater permit must place someone to be in charge of and ultimately responsible for public education. It must also and provide that person and the education

program cooperators with the authority to develop and operate an education program. That program will also require some level of financial support from the community or stormwater management program.

Public education efforts usually target adults, school-aged children, and groups (such as earthmoving activities associated with construction, developers etc.) whose activities either contribute to or reduce the stormwater program. A mix of activities from purely informational messages to hands-on activities to technical training may be required to meet all the education needs in a community. The precise needs are different from community to community and can best be determined only by the community.

2. Public Involvement and Participation

Public involvement is key to any successful effort to change how people act and how they conduct their business from day-to-day. Public involvement is also critical to obtaining public support for new initiatives. Explaining to citizens why it is necessary to change how they conduct their private and business activities will work much better if key groups and individuals in the community are involved in choosing the process for implementing and paying for the needed changes in a fair and equitable manner.

Communities should form a working group or advisory committee and utilize a planning and program development process in which the advisory group plays a major role. If the process excludes any group from meaningful involvement in the process of creating a stormwater management program it places the community at greater risk of legal action over program funding, ordinances or other aspects of stormwater management program implementation.

Forming an advisory group or panel does not mean that community leaders are giving away the responsibility for making decisions. The advisory group will simply add diversity to the discussion, help the community arrive at a consensus decision and more likely than not develop a more effective and efficient program. The advisory group should probably be an ongoing group that will function both to periodically review progress and to help with education and promotional activities. Membership of an advisory group should include key public employees and anyone from the community with an interest and ability to work with the group in a constructive manner.

3. Detection and Elimination of Illicit Discharges

Another requirement for Phase II stormwater permit holders will be to implement a program for detection and elimination of illicit or illegal stormwater sewer connections if no such program already exists or if the permit holder feels that the existing effort is not getting the job done. Some communities already have programs and procedures in place for detecting illicit connections. Other programs will start off far behind because they do not even have reliable maps of their stormwater and sewer systems. One requirement for stormwater phase II permit holders is that they develop and maintain maps of their stormwater and sewer systems. Some phase II communities have the capacity to utilize geographic information systems to develop such maps. Some communities will have to contract with private firms or develop agreements with other

governmental units in order to develop accurate system maps that can be easily maintained in the future.

Detection of illicit connections requires dry-weather sampling of storm sewer systems to detect contaminants that indicate a possible illegal connection and illicit discharge to the stormwater system. A variety of parameters can be utilized to detect sewer flow into storm drain systems. In many cases use of a simple parameter like conductivity and taking measurements at intervals along a storm drain conveyance can detect illicit discharges. Other substances such as detergents, optical brighteners used in detergents or even caffeine have been and are used to detect illicit discharges. The essential point is that some organized program and methods will need to be put into place to detect illicit discharges.

4. Construction Site Runoff Control

Perhaps one of the most damaging and preventable forms of pollution in rapidly growing urban areas is the excessive sediment loads that can be contributed to streams due to erosion and transport of sediments from construction sites. Communities must have in place measures to control polluted runoff from construction sites. The Phase II rule requires permitting of construction sites down to 1 acre. Even with the addition of new inspectors that ADEM is reportedly going to be able to add, there will likely be too few inspectors to routinely inspect construction sites in Alabama. A robust and effective program for erosion and sediment control from construction sites will require education and enforcement. ADEM is unlikely to have the manpower needed for inspecting construction sites without significantly increased state support. Since it is the permit holder that will be the most likely target of any clean water suits filed by local citizens or by environmental groups representing citizens who feel that enforcement is inadequate, permit holders should have their own program for enforcement. This means that the community or (in cases of a watershed authority with multiple jurisdictions), the authority, will need to have an erosion and sediment control ordinance and have trained inspectors to enforce the ordinance. Also, the community or authority will probably want to further address the problem by helping to provide training for local developers and construction personnel. In some communities it may be possible and desirable to cross-train building inspectors to do erosion and sediment control inspections. In other cases, the community may decide to either hire a service firm to perform inspections or decide to depend entirely upon ADEM for enforcement. In this latter case the permit holder may still elect to train personnel to detect problems but elect to report problems to ADEM rather than conduct local enforcement activities.

5. Post-Construction Runoff Management

The phase II minimum requirements also include management of runoff after the active construction period. These requirements assure that a responsible party will take care of maintaining BMPs until the site is stabilized for erosion control practices and that maintenance of detention, retention basins and other structural BMPs will be funded and taken care of in the future.

If the permit holder can through incentives (fee structures etc.) induce developers to utilize non-structural BMPs, the potential and actual future obligations of the permit holder or

community will be lessened. Even then, it is desirable to have some sort of bonding mechanism in place or some sort of recurring fee so that funds for maintenance will be available when needed.

The permit holder or community should research the positive and negative aspects of different mechanisms for post-construction maintenance before choosing an approach that it believes best suits the needs of the community or area. This can be researched by contacting some existing programs directly or via one or more discussion forums hosted by the U.S. EPA or others on the Internet. Some program information and listserver and website information is listed in Appendix B.

6. Pollution Prevention and Good Housekeeping for Municipal Operations

The final requirement for stormwater Phase II permit holders is for the municipality or municipalities regulated under the permit to develop and implement pollution reduction and good housekeeping procedures for prevention of pollution from stormwater runoff. This means that a program for prevention of stormwater impacts from city facilities and city operations will have to be developed or perhaps strengthened if such a program already exists.

Elements of such a program might include structural components or such things as fuel and materials storage and handling safeguard improvements, erosion and sediment control on municipal projects, protection or restoration of riparian corridors on municipal property, use of design elements to prevent stormwater runoff and pollution on new projects or redevelopment projects, flow and pollution control BMPs for municipal parking areas and other actions for prevention or reduction of polluted stormwater runoff. Since careless or thoughtless actions of individuals often contribute to stormwater pollution a pollution prevention and housekeeping improvement program should include an education component for appropriate city employees and contractors.

This public sector pollution prevention and housekeeping component of the stormwater management program can be important particularly so when a community or permit holder is going to implement voluntary or even regulatory programs for reducing stormwater pollution. The public pollution prevention and housekeeping improvements can be used to demonstrate improvements and thus serve as education activities for private sector businesses and industries in the community.

When Should a Community Do More Than the Minimum?

Clearly these six activities represent the minimum requirements for Phase II communities or permit holders. Every community is different and every community may have issues, concerns or problems a little different from those in other communities. For example, some communities may have concerns about streams or water bodies that are special, very high quality resources that the community places special value on or which have important economic value. A community may have a TMDL stream for which special additional actions are needed or required to restore water quality in order to avoid growth restrictions or other possible sanctions. A community might have a specific problem like bacteriological contamination from waterfowl that

threatens a public beach, flooding problems or something else that is a special concern in the community that causes it to desire to do more.

Communities should pursue everything that makes sense to do for which there is a public consensus and adequate funding to complete. However, permit holders ***should not*** list anything in their plan or permit (if they are applying for an individual permit) that they do not definitely plan and know that they can and will complete. EPA will hold permit holders to those things that they say they will do as part of the permit. *It is safer for permit holders to do more than they indicated they would do than to list something tenuous and not be able to accomplish it*.

Is There A Preferred Approach To Stormwater Management?

Probably no two communities will create identical stormwater management programs although many may be very similar. Each community may have a few local conditions or concerns that can best be addressed with a customized solution. However, there are some elements which probably will be common to successful, efficient and effective stormwater or urban watershed management efforts. Some of these elements include:

- early and continuous public involvement of citizen stakeholders
- an effective community education program
- a focus on stormwater quantity management
- a flow control ordinance
- pollutant detection
- pollutant reduction or elimination
- monitoring of stream and watershed health
- periodic reporting of watershed health and water quality trends (improvements) to the public and taxpayers

Public Involvement

It is absolutely vital to involve the public as early as possible in the design and implementation of the stormwater or urban watershed management program. A diverse cross-section of the community representing all the different stakeholder groups should be represented. This should include the regulated community (developers, builders, business owners or managers etc.), the taxpayers who will be paying the tab, the property owners who have been impacted by flooding in the past, environmental groups and environmental activists, landowners, educators, volunteer citizen monitors and others. These are the people who will pay the bills, work with you to reduce pollution from their activities (*or oppose you at every turn if they are not informed and do not buy into the program*), work with you to implement school and community education programs, work on cleanups and assist with monitoring as citizen monitoring.

The Phase II U.S. EPA requirements include public involvement and there is probably no better way to do this than to form a citizen advisory committee. This should not be a committee appointed from political insiders. It should be composed of stakeholders who come to the table and are interested enough to stay with the process and who are in basic agreement that the community or stormwater management area organization is responsible for and must develop a stormwater management program.

Truly open public involvement can avoid expensive and time-consuming controversies that often lead to legal actions. They can also reduce the potential of citizen lawsuits from groups or individuals critical of the progress toward addressing stormwater management. As parties involved from the beginning in designing, implementing and evaluating the program, it is likely that the concerns of all groups will be addressed sufficiently to avoid serious controversy that can be resolved only through legal remedies. Citizen groups and persons fully involved in a

meaningful way in the process will not probably not choose expensive legal action to resolve disputes.

Furthermore, most Phase II communities are not going to find it easy to fund stormwater management efforts. Volunteer involvement will probably be a critical component of many successful programs. Volunteers can contribute a lot, whether it is scout troops interested in helping with neighborhood education through activities like storm drain stenciling, educators willing to help design education materials, citizens interested in working to help via involvement in volunteer water monitoring or businesses willing to contribute to the support of these citizen efforts or other forms of volunteerism.

Community Education

Awareness of stormwater related environmental issues and problems is generally low. A variety of surveys suggest that public awareness that storm drains are usually not connected to the sewers or that individual actions around our homes causes significant environmental impact to urban streams is not high! Many citizens do not know that our urban streams and watersheds are being damaged by the effects of urbanization and by the pollutants found in urban environments.

Support for stormwater or urban watershed management will not be strong, particularly if new resources are needed, unless citizens are aware of the condition of urban watersheds and stream segments. In some Phase II communities the presence of 303d list streams (streams listed by ADEM and the U.S. EPA as impaired streams) and the TMDL (Total Maximum Daily Load) process for reducing pollution and restoring water quality in these streams may help to increase awareness. Nonetheless, a strong, well-designed and ongoing or at least periodic education program will be needed both to build support for the stormwater program and make citizens aware of changes they can and need to make to reduce unnecessary stormwater impacts.

A strong, effective community education program will include general public awareness education as well as more technical education that targets specific groups such as developers, construction contractors, landscapers, lawn care services, and a variety of small businesses. It is important to address specific sectors of the community due to special concerns about pollution or other impacts associated with that activity as well as general things that homeowners and property owners can do to address needless or avoidable pollution.

In many communities there may already be an educator or educators involved in environmental education in the classroom who would be happy to assist the community by developing a stormwater education unit for delivery at appropriate grade levels. Likewise, local scouting organizations and or student conservation organization would probably be willing to conduct education at the neighborhood using activities like the stream walk or storm drain activities provided in Appendix D of this guide. Finally, many communities in Alabama already have citizen volunteers in place monitoring water quality through the Alabama Water Watch Program (see Appendix B for information). *Hands-on activity and involvement is critical to learning at all ages. Stormwater programs should utilize these existing resources whenever possible.*

Finally, a very good education program, Alabama NEMO (Nonpoint Education for Municipal Officials) is in place in Alabama. This program focuses on reducing stormwater impacts by controlling the amount of impervious surfaces. Minimizing the amount of impervious surfaces reduces both the increases in runoff volume that development produces and preserves the natural pollutant removal that occurs via infiltration. The program provides trained speakers who can provide your community with a presentation designed for your need. See Appendix B for information. To arrange a presentation for an audience in your community contact the Office of Education and Outreach at the Alabama Department of Environmental Management by calling 1-800-533-2336.

Stormwater Quantity Management

In many if not most instances, the ecological impacts of the hydrologic changes due to urbanization probably exceed the impacts of pollutants. Over time, increased flows alter or destroy stream and stream bank habitats to the extent that the diversity of life in the stream and the health of the stream is seriously degraded. When flooding is the result of urbanization without management of runoff quantity streams are often destroyed by converting them into concrete-lined water conveyances.

Control of these impacts requires development in such a way as to keep the runoff or discharge produced by storm events at or near the pre-development discharge or requires retrofits in already developed areas to attempt the same end. There are essentially two ways to accomplish the goals of no net increase in flow. In newly developing areas or areas without significant development, the NEMO approach, minimizing runoff by retaining natural surfaces that allow infiltration and percolation as well as slow runoff and avoiding unnecessary impervious surfaces works well and should be the preferred approach. In areas where there is already a degree of urbanization that prevents the NEMO approach alone from being sufficient, detention and retention ponds can be utilized to slow runoff and keep stormwater discharges to pre-development levels. In areas with significant development neither approach may achieve the desired goal without some innovative and probably very expensive approaches.

When choosing between the NEMO approach or reliance on detention or retention structures, stormwater managers should be aware that the NEMO approach is more effective at reducing stormwater impacts associated with both flow quantity and pollutants than extensive reliance upon retention and detention structures. Detention and retention structures can produce impacts, particularly increases in water temperature.

Flow Control Ordinances

Your community or your stormwater authority (if you create an authority) will need to develop and put a stormwater ordinance into effect to be able to control runoff volume at pre-development levels. A number of model ordinances exist. A source for model ordinances is referenced in Appendix B.

In order to enforce the ordinance you will have to have a process and procedures for reviewing construction permits and your engineers will have to have the resources needed to be able to

evaluate construction permit applications and visit construction sites to verify that the approved designs are implemented as indicated in the plan and stabilized when construction is complete.

Pollution/Contaminant Detection and Control

Control of runoff pollution in an urban environment can be very difficult and very expensive. Implementing and conducting a sampling program for detection of runoff pollution can be very expensive even to the extent that resources that might be better used for pollution control are consumed. The issues of how much and what types of monitoring are appropriate are addressed later. It is sufficient to note at this time that some level of monitoring will be required to detect pollution hotspots and establish a water quality and stream health baseline and trends.

A reasonable approach for stormwater management is to apply a sort of triage to stormwater or urban watershed management. Only those things which make the biggest difference for watershed health should be done first and only those areas in which local action can really make a difference should be given a high priority. For example, increased runoff or discharge is very detrimental to stream health as it destroys or drastically alters the natural stream structure or morphology and even degrades the stream banks and riparian areas bordering the stream. Worrying about pollutant loading when the stream is being altered to the extent that habitats are severely damaged or destroyed by hydrologic changes is probably not justified unless the pollutants are toxic or persistent and at concentrations that will influence water quality downstream. Or at a different level, worrying too much about metal pollutants coming from wear on brake linings (the composition of which the community has no control) also would seem to be of little use as national legislation or regulation would be required to alter their composition.

Oversized Parking Lots Create A Lot of Unnecessary Impervious Surface

Therefore, a reasonable approach to stormwater management is probably to deal first with the hydrologic issues through a NEMO style design approach where possible and a retrofit approach when NEMO will not do the job. After that, those pollutants and pollutant sources that the community or management area can effectively reduce should be addressed. After implementation of NEMO strategies the pollution control measures specified by the Phase II regulations are a good place to start!

- **Reduction of Stormwater Impacts and Contamination Via Control of Impervious Surfaces**

  Natural Resource Based Planning
  Green Site Design
  Structural Best Management Practices and Remediation

  < — NEMO APPROACH

- **Elimination of Illicit/Illegal Discharges**

In some areas pollutants from illicit or illegal discharges may be a significant contribution to pollutant loadings. These may be intentional or unintentional. In older areas they may be discharges that were never rerouted to the sewer system as regulations for discharges were put in place. They may also be things like floor drains that were never properly connected to the sewer system.

The task facing permit holders is to develop strategies and methods for detecting these illicit/illegal discharges so that they can be eliminated. A strategy for addressing this problem should first employ education of business owners and operators and homeowners and involve the public in detecting and correcting these problems voluntarily. Addressing the problem will also require a monitoring strategy. Monitoring for illicit/illegal discharges should be kept as simple as possible given resource realities and should progress from simpler, cheaper methods to more complex and more expensive methods as needed. Some techniques for detecting these discharges include:

Which Pipes Are Storm Drains And Which Are Illicit or Illegal Discharges?

- visual inspection along water courses for pipes and unusual discharges (at the same time a check can be made for leaking or broken sewer pipes)
- visual inspections of business and industrial sites
- smoke or dye testing to detect or confirm suspected illicit/illegal connections
- dry weather sampling of suspicious discharges for substances indicative of domestic or industrial wastewater (detergent, optical brighteners, caffeine or high conductivity)
- inspection, visual or remote camera, inside stormwater conveyances
- reconnaissance sampling upstream of where contamination hot spots are found

- **Pollution Prevention Through Education Efforts**

A substantial portion of the pollutants in stormwater runoff come from the inappropriate use, storage or disposal of oil, fuels, chemicals or fertilizer. Educating businesses and homeowners and other landusers within the urban and suburban environment about how their actions can either be harmful or protective of the environment can reduce pollution.

Some of the more innovative and successful education programs have created guidelines or suggestions for homeowners and different types of businesses. Some create incentives by allowing businesses that voluntarily implement pollution prevention practices display bay friendly or river friendly logos in their windows and on their promotional materials. An example of an excellent pollution prevention education campaign is Bellevue, Washington's "Business Partners for Clean Water" program.

It would be a good investment of any community that is designing a stormwater program to visit the website for this program

(http://www.ci.bellevue.wa.us/ulities/surface/4buspart.htm) as well as their stormwater site (http://www.ci.bellevue.wa.us/ulities/surface/default.htm).

Site contents include a phone number that can be used to request copies of materials like a manual "Water Quality Protection for Bellevue Businesses", a 15-minute "Water Quality Assessment" for businesses and other items that would probably be useful in developing a stormwater management program. Sometime in the next year the manual and many of the other documents will likely be available as Adobe . portable document (.pdf) files. For now you can call the Business Partners program coordinator and order the manual. The number is (425)- 452-5216.

An Orderly, Clean Transformer Yard at a Municipal Facility

- **Stormwater Pollution Prevention Via Attention to Improvements in "Housekeeping"**

A Phase II permit requirement is for municipalities to clean up their own operations to reduce or prevent the generation of polluted runoff. All the activities of the municipality (or municipalities) should be examined to determine where improvements can be made to reduce or eliminate needless runoff pollution. City utility, road and other operations should assure that their erosion and sediment control practices are top notch, that they store and utilize materials in a safe manner, that they have no illicit or illegal connections and that they dispose of all wastes in a safe and legal manner. Municipal operations should be cleaned up and procedures put into place to assure that they remain as clean and nonpolluting as possible. Before the municipality asks businesses and homeowners to clean up their operations it must make its operation an example for the community. The Bellevue, Washington Business Partners program materials provide excellence guidance on this subject.

- **Prevention Via Voluntary Improvements in Business/Industry Housekeeping**

Auto Service Businesses Can Generate Significant Levels of Pollutants If Housekeeping Is Poor or Absent

A municipality that has done an assessment of its own operations and has implemented needed improvements in housekeeping is in a strong position for encouraging businesses and industry to clean up their operations.

As previously noted, excellent materials have been produced that can provide municipalities with an example of a successful voluntary effort to obtain voluntary involvement of businesses.

- **Control of Construction Site Runoff**

A very important required stormwater management activity, perhaps equally as important as flow control, involves controlling runoff from construction sites during the construction and after construction. Excessive rates of erosion and transport of eroded materials to watercourses and streams causes serious impacts upon biological resources and also increases flooding by reducing the capacity of stream channels. Furthermore, many of the pollutants in stormwater are attached to sediments. Stopping erosion and transport of sediments reduces the level of many contaminants in streams.

At the present time erosion and sediment control activities are generally very poorly done not just in Alabama but in the region and across the nation. Designers simply do not usually have the skills in engineering, hydrology, soils, botany, agronomy, geology, and common sense needed to do quality, effective erosion control. As a result, outdated techniques are employed, techniques are misused or, as it often appears from looking at sites, silt fences or hay bales (not recognized as a BMP by EPA or by most knowledgeable designers) seem to be used for "show and tell" (I'm doing erosion and sediment control, never mind that it is not effective).

Communities or authorities responsible for implementation of stormwater management programs need to give erosion and sediment control from construction projects a high priority. Stream sedimentation is not only a significant impact, it is a very visible impact. Environmental groups or individual citizens interested in water quality protection have a new tool in that the Phase II regulations and the stormwater permit program provides a new target for citizen suits. It will not be enough to have a program in place. If the program is not making progress toward reducing erosion and stream sedimentation from transport of eroded material, citizen groups or individuals have the right under the law and will in some cases almost undoubtedly file suits if they feel that actions are not sufficient to protect water quality. Even if environmental groups do not file suit they have equally powerful tools at their disposal as they can document excessive sedimentation and request that the Alabama Department of Environmental Management or the U.S. Environmental Protection Agency segments put stream segments on the impaired waterbodies or 303d list. If a stream is put on the list it will likely result in additional permit requirements or actions that must be taken on the part of the permit holder.

Therefore it is very important for the community or authority that holds the stormwater permit to develop an effective erosion and sediment control program. Some suggestions for doing this include:

- adopt and implement a strong erosion and sediment control ordinance
- provide education and training for municipal personnel who are involved in municipal construction projects from supervisors to equipment operators (see Appendix B for a list of organizations that may be of assistance for training)
- encourage erosion and sediment control training for construction contractors and homebuilders or if possible work with others to provide training locally
- require that at least one appropriate individual (an engineer, landscaper, engineering technician etc.) become certified as a Certified Professional in Erosion and Sediment Control Specialist and assist that person with the costs associated with certification

- create a process for review and approval of construction site erosion and sediment control plans and provide for review of significant projects by the CPESC
- cross-train building inspectors to do initial inspections of construction sites
- as necessary have the CPESC conduct more detailed inspections
- determine whether you wish to develop a local enforcement program or simply refer problem sites to the Alabama Department of Environmental Management (*It is highly recommended that you develop your own plan review and inspection procedures and train inspectors even if you elect not to do enforcement locally. Furthermore, you may wish to create some limited enforcement authority including being able to issue a "stop work" order locally. The threat of a "stop work" order may be needed to get the actions required to get measures in place promptly when needed on a problem site.)*

Having an effective erosion and sediment control ordinance and program is a critical part of an effective stormwater management program. An effective erosion and sediment control program coupled with effective public involvement in the stormwater program provides insurance against costly legal actions.

- **Devices for Runoff Pollution Control**

A large and growing number of devices for controlling pollutant runoff in stormwater are being designed and marketed. Without a doubt some of these devices do a reasonable or better job provided they are maintained as needed at the proper interval. The problem at the present time is that few of these devices have been independently evaluated for their effectiveness. Work is underway to do such evaluations and such information will likely be posted to the U.S. EPA Stormwater site as it is reviewed and becomes available.

While little independent information is available on the numerous commercial structural BMP devices, the U.S. EPA has published fact sheets describing a number of structural and nonstructural BMPS. The URL for the page containing this information is:

http://www.epa.gov/OWM/mtbfact.htm

A National Stormwater Best Management Practices (BMP) Database that includes results of 70 BMP studies over the past 15 years in a standardized format. The URL for the database is:

http://www.bmpdatabase.org/

A CD-ROM version of the database can also be obtained through contacts listed at the site.

An excellent article on stormwater BMPs that was originally printed in "Stormwater" can be found at the following URL:

http://www.forester.net/sw_0011_right.html

The article evaluates and makes suggestions for use of a variety of BMPs. Professionals in the

stormwater field can also register for a free subscription to the trade journal "Stormwater" at the site.

Remember that while some of the commercial "package" devices may have appropriate applications, that the most effective measures usually involve planning, design and vegetative approaches. Structural BMPs are not a substitute for design approaches that prevent or reduce both excessive runoff volume.

Monitoring

The Phase II Stormwater Regulations do not specify requirements for monitoring. There is no absolute requirement for monitoring but some level of monitoring will be required both to attempt to detect and identify illicit or illegal discharges and to establish a water quality base-line and trends. Permit holders will have to have some data to show whether water quality and habitats are getting better, worse or staying the same over each permit cycle.

Extensive sampling of storm events is not required by the Phase II regulations. The nature of runoff from different urban and suburban landscapes is similar across the nation. Data collected for storm events in Dothan (see Appendix E) is in line with what one would expect based upon an examination of existing national data.

Monitoring for Phase II stormwater programs (at least during the first permit cycle) should focus on monitoring required as part of efforts to detect and identify illicit or illegal discharges and on monitoring to identify baseline or initial water quality and habitat conditions. A variety of data might be collected but some suggestions are:

- Stream habitat conditions: - this might be photographic or descriptive or both or it might include assessments of stream stability
- Basic stream quality parameters: - this might include temperature, pH, conductivity, dissolved oxygen, turbidity, total suspended solids, nutrients, stream flow and perhaps E. coli or fecal coliform at strategic sites in the permit area (a metal or metals such as copper or zinc might be added to this list if some landuses are significant including large parking lots or industrial areas with lots of galvanized buildings)
- Basic stream biological condition: - stream bioassessments should probably be done at a small number of sites using at least the U.S. EPA family level protocol. In some cases where there are sensitive fisheries in the urban watershed or immediately downstream a more complete assessment may be appropriate utilizing the Index of Biotic Integrity or IBI metric.
- In situations where problems with specific contaminants and sources are known or suspected or when rapid stream assessment methods suggest a possible problem with toxicity, monitoring for additional parameters or toxicity testing might be necessary.

The above monitoring, other than the photographic documentation, should be performed by professionals at the beginning and near the end of the permit cycle. The chemical monitoring should at a minimum be performed several times during the time of greatest stress in the stream

systems (low flows, high temperatures and low dissolved oxygen). This typically would be from sometime in late May through September or October depending upon the weather in any given year. Monthly sampling over a 12-month period is preferred if resources permit. Sample sites should be selected to reflect landuse differences and potential sources in subwatersheds within the permit area.

Habitat and biological assessments once at the beginning and once near the end of the permit cycle should be sufficient provided that care is taken to assure that samples are collected at appropriate times under appropriate stream conditions.

In addition to the data collected by professionals, volunteer data collected at more frequent intervals can supplement the professionally collected data and at the same time complement the stormwater education and public involvement programs that are required by the Phase II permit. The Alabama Water Watch program has established EPA approved methods and QA/QC protocols. The AWW program and the AWW Association would be pleased to cooperate with any interested community either to link up existing monitors with local stormwater programs or to assist with training of interested citizens. See Appendix B for details.

Volunteers can also help to assess stream conditions and possible illicit or illegal discharges by doing visual stream inspections. Instructions for a "Streamwalk" activity are provided in Appendix D along with instructions for community education via "Storm Drain Stenciling".

What Resources Are Available That My Community Might Find Useful for Developing a Stormwater Management Program?

In addition to the materials already mentioned or included in the Appendices, communities should be aware that legislation was passed earlier that provides for the formation of "stormwater management authorities". The formation of a watershed authority is particularly useful when a number of municipalities in an area decide to work together to manage stormwater. Formation of an authority may also be useful or even necessary when unincorporated areas are included in stormwater management permit areas.

The Storm Water Management Authority in Jefferson County has gone through the tedious, difficult and time-consuming process of forming an Authority and developing a funding mechanism. The experience of the Authority staff or Board members may be useful to you and they are willing to provide information and advice. See Appendix B for contact information. The Authority maintains a website, the URL is:

http://www.swma.com

The site contains information on the program, information and links for its education program and an Erosion and Sediment Control Ordinance.

There is also a U.S. EPA webpage with model ordinances. The URL is:

http://www.epa.gov/owow/nps/ordinance/

Appendix A

Designated Stormwater Phase II Communities/Areas in Alabama

Designated Phase II Communities/Areas in Alabama

Phase II Communities Designated By Being Listed in the Legislation

Anniston
Attalla
Auburn
Autauga County
Blue Mountain
Calhoun County
Colbert County
Dale County
Decatur
Dothan
Etowah County
Lee County
Madison County
Midland City
Montgomery County
Morgan County
Muscle Shoals
Napier Field
Northport
Opelika
Oxford
Phenix City
Flint City
Florence
Gadsden
Glencoe
Grimes
Hartselle
Hobson City
Hokes Bluff
Houston County
Kinsey
Lauderdale Co.
Prattville
Priceville
Rainbow City
Russell County
Sheffield
Southside
Sylvan Springs
Talladega County
Tuscaloosa
Tuscaloosa Co.
Tuscumbia
Weaver

Phase II Communities Based Upon the 1990 Census

Anniston
Auburn—Opelika
Birmingham
Columbus, GA—AL
Decatur
Dothan
Florence
Gadsden
Huntsville
Mobile
Montgomery
Tuscaloosa

Note: Five of these cities/areas, Birmingham, Montgomery, Huntsville, Mobile and Shelby County are covered by a Phase I stormwater permit.

Potentially Designated Cities

Jacksonville and Selma

Population increases from the 2000 census could cause additional areas to be designated.

Additional communities down to a population of 10,000 or areas with 1,000 people per square mile may be designated by ADEM based upon local water quality conditions or concerns.

Appendix B

Resources for Developing a Stormwater Management Program:

Programs
Publications
Websites/Webpages

Resources

Alabama Department of Environmental Management

- Stormwater Program: Contact: Dennis Harrison, 334-271-7700
- Alabama NEMO: Contact Gavin Adams, 334-394-4353
- Educational Materials: Contact Patti Hurley, 334-394-4350
- Contact Mike Mullen, 334-670-3624

Erosion and Sediment Control Training

- Ala. Chap. Soil and Water Conservation Committee: Contact Earl Norton, 334-821-0230
- Assoc. of Gen. Contractors of America, Ala. Chapter, Contact: T.W. Pugh, 205-252-8021
- Homebuilders Association of Alabama, Contact Sean Stricker, 334-834-3006
- Troy State University: Contact Mike Mullen, 334-670-3624
- International Erosion Control Association (Training Coursesand CPESC Program), 970-879-3010—http://ieca.org
- Soil and Water Conservation Society (Publications, Training, CPESC Materials): 515-289-2331

Stormwater Programs/Stormwater Program Websites

- SWMA (Jefferson County, Alabama) (Advice from Experiences, Perhaps Technical Assistance): Contacts: Zhaleh McCullers, Fred Guarino, 205-325-1440— http://www.swma.org (Ordinances)
- Bellevue, Washington, http://www.ci.bellevue.wa.us/ulities/surface/default.htm
- Ft. Worth Worth, Texas, http://www.ci.fort-worth.tx.us/dem/stormpg.htm

U.S. EPA and Related Websites/Pages

- http://www.epa.gov/OWM/mtbfact.htm (BMP Fact Sheets)
- http://www.bmpdatabase.org/ (SearchableBMP Database)
- http://www.epa.gov/owow/nps/ordinance/ (Model Ordinances)
- Http://www.epa.gov/owm/sw/phase2 (Phase II Rule and More)

Other Sites

- http://www.nrdc.org/water/pollution/storm/stoinx.asp (NRDC Report: Stormwater Strategies: Community Responses to Runoff Pollution (Useful Case Studies)

Stream Habitat and Biological Assessments

- Fisheries Department, Auburn University, Contact Dr. Cliff Webber, 334-844-9124
- Geological Survey of Alabama, Contact Dr. Pat O'Neil, 205-349-2852

Volunteer Water Quality Monitoring

- Alabama Water Watch Program, Contact AWW Program Office, 1-888-844-4785
  Website: http://www.auburn.edu/aww

Other Volunteer Citizen Groups

- Legacy (Potential Funding Source for Education/Educational Materials), 800-240-5115
- PALS (Stream/Roadside Litter Cleanups), 334-263-7737

Appendix C

Partial Bibliography

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U.S. EPA, 2000. Storm Water Phase II Compliance Assistance Guide. EPA-833-R-00-002. March 2000.

Note: This is a partial bibliography. Other materials are listed in the resources section of Appendix B.

Appendix D

Hands-on Activities for Students and Other Citizen Volunteers

ALABAMA WATER WATCH STREAMWALK ACTIVITY

WHAT IS THE STREAMWALK ACTIVITY?

StreamWalk is a simple, visual stream inspection activity.

WHY DO PEOPLE ORGANIZE STREAMWALK ACTIVITIES?

- To determine the condition of a stream and the surrounding riparian area
- To educate about watersheds, water quality and pollution prevention
- To detect specific pollution problems so that they can be prioritized and corrected
- To identify sites for water quality monitoring

WHO SHOULD I INVOLVE IN A STREAMWALK ACTIVITY?

- School classes, clubs, scout troops and other young people
- Recreational stream users
- Environmental group members
- Landowners and other watershed stakeholders
- Community leaders, politicians and the media

HOW LONG SHOULD A STREAMWALK ACTIVITY BE?

StreamWalk activities are conducted for a wide range of purposes. Therefore, StreamWalk activities can vary significantly. A StreamWalk activity for some groups such as younger school children might be as short as a few hundred yards. A StreamWalk activity sponsored by a watershed management group or stormwater project might involve a number of different streams and observations taken multiple times over the course of a StreamWalk several miles long. The length of the StreamWalk should match its purpose and the interest and physical abilities of participants.

WHAT ARE SOME PRECAUTIONS FOR CONDUCTING A STREAMWALK ACTIVITY?

- Obtain permission from landowners to cross their property
- Make sure the activity is appropriate for ages and abilities of participants
- Secure enough adult participants to supervise youthful participants
- Scout out the route of the StreamWalk in advance of the event
- Avoid severe conditions such as high water or severe cold or heat
- Know how to identify poisonous plants and prepare participants in advance of event
- Caution participants to watch out for broken glass and other sharp objects
- Remind participants to watch where they place their hands and feet in order to avoid snakebite
- Take a first-aid kit

WHAT MATERIALS ARE NEEDED FOR A STREAMWALK ACTIVITY?

- A current map area of the StreamWalk, preferably a U.S.G.S. map (a county map can be used)
- Clipboards, paper, writing instruments and a camera (a disposable waterproof camera works well)
- Suitable clothing, shoes, waders, boots, hat, insect repellant, sunscreen etc. as appropriate
- StreamWalk reporting forms (copy as many as are needed from this original)
- Water and snacks as desired (OPTIONAL)
- A first aid kit
- A backpack for carrying everything
- A walking stick (OPTIONAL)

SHOULD A STREAMWALK ACTIVITY BE PUBLICIZED? SHOULD IT BE PUBLIC?

The target audience for a StreamWalk activity depends upon the goals of the organizer. If the organizer's main purpose is to increase public awareness of the condition of a local stream or streams, the event should be conducted to involve as many citizens as can participate without damaging the stream or nearby riparian areas. If the major purpose of the StreamWalk is to collect information about the stream or streams, it may be best to conduct the StreamWalk in cooperation with water watch volunteers or to wait until you can plan, organize and conduct some training for citizens who wish to participate. In any event, when a StreamWalk is organized, each group that goes to the stream should have at least one person with previous streamwalk, monitoring or related experience present.

WHAT SHOULD BE DONE AFTER THE STREAMWALK?

- As soon as possible after the StreamWalk (while observations are still fresh in participants' minds) each group should review the field notes and complete the StreamWalk Reporting Form and map, adding tidbits of information that were omitted in the field. If necessary for readability or clarity, complete a new copy of the data form and a new map at this time.
- Report any serious problems or possible violations as soon as possible. For example, livestock in the water or riparian zone or a broken sewer pipe just above a site used for swimming could be a public health threat.
- Report all water quality problems or concerns observed (whether they represent a violation or health threat or not). If you live in a rural area, report problems to your county Soil and Water Conservation District (SWCD). If you live in a metropolitan area, report your findings to the stormwater program, the utility department and the SWCD.
- If problems observed during the StreamWalk are caused by the actions of persons that members of the group know and can communicate with personally, inform those persons of the impacts of their actions. Some polluters are not aware that their actions cause water quality impacts.
- If there are problems in the stream or streams that require increased public awareness or education, such as illegal trash or garbage dumping, contact a local newspaper reporter and see if you can get them to do a story on the problems and your StreamWalk findings. If you have good quality pictures from the StreamWalk event the reporter may utilize them. Hopefully a reporter will attend the event and have their own pictures.
- Make a copy of your StreamWalk report and send it to:
  Michael Mullen, Ala. NPS Education Coordinator, CERS, Troy State University, Troy, AL 36082
- If you do not know if your stream or streams are being monitored by a local Alabama Water Watch group (i.e. there was not an AWW volunteer involved in your StreamWalk) you can find out if there is a local Alabama Water Watch group that might test the water in your stream. Better yet, you can find out how you and members of your group can be trained to be citizen monitors. Call the Alabama Water Watch Office at 334-844-4785 or 888-844-4785 or send e-mail to <aww@acesag.auburn.edu>.
- If your group is interested in finding local support for correction of water quality problems or assistance (funds for test kits, kit refills etc.) contact appropriate local agencies with responsibility for or interest in protecting water quality. Examples include the Natural Resources Conservation Service and your local SWCD. Other organizations which have helped in some areas include county commissions, city councils, stormwater programs, environmental groups, watershed projects, universities and civic clubs.

HOW DO I REPORT PROBLEMS OBSERVED DURING A STREAMWALK ACTIVITY?

Normally problems should be reported to local agencies first. A broken sewer pipe should be reported to the local utility department. Agricultural problems should be reported to the local SWCD or NRCS county office. Erosion and sedimentation problems should be reported to the local stormwater office or the Alabama Department of Environmental Management's Field Operations staff. Problems from state highway projects should be reported to the nearest Alabama Department of Transportation District Office or a county road problem to the county engineer. Problems not corrected after a reasonable time should be reported to ADEM. To obtain the appropriate ADEM number, call the ADEM Ombudsman at 1-800-533-2336.

ANY EMERGENCY SITUATION SUCH AS A HAZARDOUS WASTE SPILL SHOULD BE REPORTED IMMEDIATELY TO A HAZARDOUS MATERIALS RESPONSE TEAM (CALL 911 OR YOUR LOCAL POLICE DEPARTMENT).

STREAMWALK DATA FORM

GROUP/SPONSOR INFORMATION

Group/Sponsor Name: _____

Contact Name: _____ Daytime Phone Number _____

Mailing Address: _____

Main Purpose For StreamWalk Event: _____

Date(s) StreamWalk Was Conducted: _____ Number Participating _____

STREAM INFORMATION - Use One Or More Forms For Each Stream (One For Each Significantly Different Segment That You Examine) - Make Copies From The Original As Needed

Stream Name: _____

Location of Observations For This Data Sheet: _____

_____

(Attach a copy of a map with the section of the stream that you examined clearly marked along with any notation of observations or problems that you observed).

VISUAL ASSESSMENT

Weather conditions at time of StreamWalk: (check one) ___ clear ___ cloudy ___ rainy ___ other

What color is the water? (check all that apply)
__ clear __ oily __ black
__ foamy __ green __ other
__ muddy __ brown

How does the water smell?
__ no odor __ rotten egg __ gasoline or oil
__ chemical __ chlorine __ sewage
__ rotting __ fishy

What is the composition of the stream bottom? (check all the types of material that you see)
__ sand __ gravel __ boulders __ limestone marl __ silt _ other

What materials form most of the stream bottom? (In the blanks write 1 for the most common bottom material, 2 for the second most common etc.)
__ sand __ gravel __ boulders __ bedrock __ silt __ other

How fast is the water in the stream moving? __ very fast __ fast __ slow __ not at all

Are algae present? (Algae are a variety of aquatic photosynthetic organisms). Check all that you see.
__ not present __ present in spots __ attached to rocks
__ everywhere __ floating __ matted on the streambed

If present, what color are the algae? (Check all you see). __ light green __ dark green __ brown
__ red __ orange

Do you see any fish in the stream? __ absent __ moderately abundant __ abundant

How many different types of fish do you see? __ one __ two to three __ more than three

Did you see any amphibians or reptiles? __ yes __ no

If the sun was directly above the stream how much of the stream would be shaded? (This question refers to an estimate of the average amount of tree cover over the stream).

__ fully exposed (0-25% of the stream is shaded from the sun)
__ partially exposed (25-50% of the stream is shaded)
__ partially shaded (50-75% of the stream is shaded)
__ fully shaded (75-100% of the stream is shaded)

Facing upstream, how much of the stream bank is covered by plants, rocks and logs?
Stream edge to 25 feet back from stream:

Left Bank:	Right Bank:
__ 70-100% covered	__ 70-100% covered
__ 30-70% covered	__ 30-70% covered
__ less than 30% covered	__ less than 30% covered

25 to 100 feet back from stream:

Left Bank:	Right Bank:
__ 70-100% covered	__ 70-100% covered
__ 30-70% covered	__ 30-70% covered
__ less than 30% covered	__ less than 30% covered

What are the land uses in the watershed in the areas adjacent to and immediately upstream from your sampling site? (check all uses observed).

__ farming/crops __ forest __ residential
__ pasture/grazing __ stores/malls __ mining
__ construction __ factories __ logging
__ poultry/swine

What are the three most common land uses in the watershed (of the stream segment surveyed) in terms of acreage involved?

1. _____ 2. _____ 3. _____

What are the local uses of the stream?

__ drinking water supply __ recreation
__ industrial water supply __ swimming
__ agriculture __ fishing
__ irrigation __ other
__ livestock watering

Are there any pipes emptying directly into or near the stream?

__ Yes __ No If yes, is there a discharge? __ Yes __ No

Are there barriers in the stream? __ dams __ bridges __ woody debris __ waterfalls

Is there any trash in or immediately adjacent to the stream?

__ absent __ moderately abundant __ abundant

Sketch the portion of the stream that was inspected on a separate sheet of paper and/or a copy of a map or section of a map. Clearly indicate the stream location on the sketch and/or map. Return a copy of the form, sketches and/or map as instructed previously in the StreamWalk activity instructions.

PUBLICATION OF THIS STREAMWALK ACTIVITY WAS MADE POSSIBLE BY A U.S. EPA SECTION 319 NONPOINT POINT SOURCE GRANT.

STORM DRAIN STENCILING ACTIVITY

WHAT IS A STORM DRAIN STENCILING ACTIVITY?

Storm drain stenciling is a neighborhood or community awareness and education tool.

The actual storm drain stenciling activity is but one part of a larger education campaign. A successful storm drain stenciling activity typically includes door-to-door neighborhood education and/or a media campaign. The education campaign lets the citizens of a community know why young people are stenciling storm drains. It makes them aware that the drains connect with surface or ground water and that dumping of oil, antifreeze, fuels, paint, leaves, grass clippings or other materials in storm drains causes damage to surface and groundwater.

Citizens need to know that:

- Huge quantities of pollutants come from our everyday activities through runoff or nonpoint source pollution
- Most storm drains, contrary to popular belief, are **NOT** attached to treatment systems and drain to streams, lakes or groundwater
- Other activities such as overutilization of fertilizer or chemicals and dumping waste fluids, leaves or grass clippings in the gutter also causes needless pollution

Educators Learn How To Stencil Storm Drains During 1997 Nonpoint Source Institute

WHY DO PEOPLE ORGANIZE STORM DRAIN STENCILING ACTIVITIES?

- To educate a neighborhood or community on the water quality impacts and other hazards of putting waste materials into storm drains
- To involve young people in an educational community service project
- To meet the educational requirement in the U.S. Environmental Protection Agency mandated Stormwater Permit Program
- To help to solve an illegal dumping problem that has been detected in a neighborhood or community

WHO IS TYPICALLY INVOLVED IN STORM DRAIN STENCILING ACTIVITIES?

- Students: school classes, school clubs
- Scouts or other youth groups
- Citizen volunteer monitoring groups and watershed improvement groups
- Stormwater programs and public utilities

WHAT IS INVOLVED IN ORGANIZING A STORM WATER STENCILING ACTIVITY?

- Defining who the active participants will be
- Obtaining permission for applying stenciling from your public works department
- Identifying and contacting sources of support (printing, door hangers, stencils, paint, safety vests, adult sponsors and traffic watchers)
- Obtaining from the local public works department the names or types of water bodies (streams, rivers, lakes, bays, wetlands, groundwater etc.) into which storm drains flow in different parts of the community
- Obtaining information on the impacts of stormwater runoff for use in educational materials (this could be a class assignment for students involved in the stenciling project)
- Designing a community education plan (door-to-door, newspapers, radio, TV etc.)

- Writing, layout and reproduction of printed materials
- Obtaining materials for stenciling
- Conducting the pre-stenciling education activity
- Conducting pre-stenciling safety training for adults and young people
- Arranging for placement of traffic cones or men-working signs by the local public works department when appropriate for safety

WHAT ITEMS ARE NEEDED FOR STORM DRAIN STENCILING?

- A map or maps of the neighborhood or community
- Stencils
- Paint (a CFC free aerosol can of traffic-zone latex paint, one can will do about 20 stencils)
- Broom or whisk broom
- Wire brush
- Safety vests
- Traffic cones, traffic flag
- Cardboard box (for overspray shield)
- Cleanup rags and bags

CHECKLIST FOR THE WEEK PRIOR TO THE EVENT:

__ Have flyers or door hangers been distributed in the neighborhood(s) or are they ready for distribution?
__ Has written permission been received?
__ Have sufficient adult safety volunteers (traffic watchers) been trained and assigned?
__ Are all supplies on hand and organized for the groups that will participate?
__ Have local media sources been contacted and invited to cover the event?
__ Have participants teams of 4 to 6 (each with an adult traffic watcher) been organized?
__ Is there a plan for postponing the event if the weather is unsuitable (a phone tree, meeting place etc.)?

TIPS FOR STENCILING DAY

WATCH THE WEATHER

If the pavement is not dry, if rain is likely, if it is very windy or if the air temperature is not above 50 degrees, reschedule. Also, if it is very windy, reschedule. The purpose of stenciling is not to have paint running into the storm drains or to spray nearby cars due to drift. If there is any wind at all, avoid painting near parked vehicles and utilize a large box (2 to 3 feet tall) folded flat as a shield to avoid overspray.

WORK IN TEAMS

Teams of 4 to 6 work well for storm drain stenciling. Two persons can prepare the area to be painted, two to four can secure the stencil while one applies the paint and one can be the traffic lookout. These jobs can be rotated periodically for maximum enjoyment.

TIPS FOR APPLYING STENCILS

- Remind stencilers beforehand to wear old clothes. They might also want to wear rubber gloves, plastic bags over shoes, and protective eyewear.
- Scrub the area briskly with a wire brush and remove loose dirt with a broom or whisk broom.
- Lay the stencil on the sidewalk, street or manhole cover.
- One or two people can hold the stencil flat or bricks or rocks work well as weights on the corners.
- When using spray paint, shake the can for one full minute. Hold the can 6 to 8 inches from the stencil and use a series of back and forth motions to spray one line at a time until the letters are uniformly covered. **DON'T USE TOO MUCH PAINT** - it will run underneath and blur the letters. (Paint rollers can be utilized but are much more difficult to use. Excess paint must be frequently struck from rollers. Paint rollers should only be used by adults).

- When the paint application is finished, carefully lift the stencil up off the surface. If the stencil is not clearly readable do not attempt to wipe it off and try again! That will only make a bigger mess. Learn from your small mistakes - simply try to use less paint the next time. Your purpose is to get the message out not to create a work of art.
- After all stenciling is finished, lay stencils out flat to dry in a warm, dry place for a day or so.When the paint is completely dry Mylar stencils can be gently rolled to chip off excess paint. This works best if the paint does not build up too thick between cleanings.

The primary purpose for storm drain stenciling is to create public awareness of the street to waterbody and street to groundwater connections. Your distribution of flyers, the storm drain stencils and media coverage of your project should have increased public awareness of the connection. Once that connection has been made and the citizens in a community realize the impacts of their activities, the increased level of public awareness can and hopefully will create a ripple effect. That ripple effect might include formation of local groups that do stream cleanups, streambank or wetlands restoration. Increased awareness might lead to formation of a new Alabama Water Watch group in the community.

For both classroom and informal educators, stenciling is an effective community service project that combines learning with environmental studies, civics, and language arts, especially if students research the subject and create their own flyers. Some cities have involved young people in youth-at-risk programs in storm drain stenciling. Action projects empower young people!

FOLLOW UP

REPORT YOUR ACTIVITIES

The Alabama Nonpoint Source Education Program Coordinator is interested in knowing what successes you have with storm drain stenciling in your neighborhood or community. The NPS Education Program wants to recognize outstanding education and pollution reduction efforts. The NPS Education Program can also benefit by capturing volunteer time for part of the match required by U.S. EPA Section 319 NPS grants.

RELATED WATER QUALITY ACTIVITIES FOR CITIZENS WHO WANT TO DO MORE

There are a number of activities available for citizens who want to do more to improve and protect water quality in the community. These activities include:

- StreamWalk, a visual stream assessment activity. Contact Mike Mullen at 334-670-3624 or e-mail him at mmullen@trojan.troyst.edu to request a copy.
- Adopt-A-Stream, a stream crossing clean up program of Alabama PALS (People Against A Littered State). Contact Alabama PALS at 334-263-7737 for information.
- Alabama Water Watch Program, Alabama's citizen volunteer monitoring program. Contact Alabama Water Watch at 334-844-4785 or 888-844-4785 for information about upcoming training workshops.
- Alabama Water Watch Association, the Association is the citizen arm of the Alabama Water Watch Program. Citizens do not have to be monitors to support the Association although many members are monitors.
- Soil Watch, a program that prepares citizens to recognize and report erosion and sedimentation problems, is being designed at the present time and will be available in the future.
- In areas with Stormwater Management Permit Programs there are excellent opportunities for citizen involvement. All of these stormwater programs are required to have an education component. These programs should be interested in involving citizens in water quality education and monitoring efforts.

SOURCES FOR STENCILS

Storm drain stencils can be made locally or they can be purchased from a commercial source. Stencils can be made from cardboard or Mylar. Mylar stencils can be used over and over again if care is taken to clean and store them after use. Cardboard stencils are less durable. One commercial source for storm drain stencils is Earthwater Stencils, 4425 140th Avenue SW, Rochester, WA 98579-9703. Phone 360-956-3774; Fax 360-956-7133. Generic Drains To Stream, Drains To Lake, Drains To Ground Water stencils are available. Custom stencils with your organization's name can also be supplied.

STORM DRAIN STENCILING REPORTING FORM

Please find time to complete and send the following form along with a copy of your education materials with photocopies of any newspaper articles or other information you would like to include. Please send to: Michael William Mullen, Alabama NPS Education Coordinator, CERS, Troy State University, Troy, AL 36082.

Person Reporting: _____

Organization: _____

Address: _____

Phone Number: _____ FAX Number _____

Date Stenciling Took Place: _____

Estimated Number of Storm Drains Stenciled: _____

Number of Adults Participating: _____

Number of Young People Participating: _____

Local Organizations Contributing To The Project _____

_____

Were Any Signs Of Dumping Of Wastes Into Storm Drains Observed During The Activity? __ Yes __ No

If So, Were These Reported To The Local Utility Department? __ Yes __ No

In Your Opinion Has The Storm Drain Stenciling Activity Created Awareness That Will Lead To Other Community Water Resource Protection Activities? __ Yes __ No

THANK YOU FOR YOUR EFFORTS TO KEEP ALABAMA'S STREAMS, RIVERS, LAKES, ESTUARIES AND GROUNDWATER CLEAN!

PUBLICATION OF THIS STORM DRAIN STENCILING ACTIVITY WAS MADE POSSIBLE BY A U.S. EPA SECTION 319 NPS GRANT.

Appendix E

Dothan Stormwater Data

Dothan Storm Water Project Sampling Sites

Site Characteristics	Site Name	Site Location
Agriculture – Row Crop	Lonsdale	Field, Lonsdale Road Inside City Limits
Light Industrial Site	Kraft Road	Storm Drain Serving Light Industry
Residential Site	Chapelwood Subdivision	Subdivision Around 15 Years Old
Low-Traffic Commercial Parking Lot	Winn-Dixie	New Winn Dixie Strip Mall Parking Lot Drain
Moderate to High Traffic Parking Lot	Wiregrass Commons Mall	Large Shopping Mall Parking Lot

Grab samples were collected from these sites as soon as possible after the onset of precipitation and initiation of runoff from these sites. Employees of the City of Dothan Public Works Department collected storm water samples. These employees work locations were at two nearby wastewater treatment facilities. The employees involved were trained to collect samples in their everyday roles as wastewater treatment facility plant workers.

Data From the Lonsdale Storm Water Sampling Site

	10/24/97	11/12/97	1/22/98	3/5/98	8/1/98	9/21/98	Average	Min.	Max.
TSS (mg/L)	3676	214	726	1960	910	44	1255	44	3676
TDS (mg/L)	37	204	64	97	30	81	85.5	30	204
BOD (mg/L)	18.9	2.86	6.79	17.8	7.9	6.79	10.173	2.9	18.9
pH (S.U.)	6.95	9.04	7.1	7.01	6.42	6.42	7.1567	6.42	9.04
TKN (mg/L)	6.92	0.69	1.44	3.75	1.8	0.95	2.5917	0.69	6.92
Total Phosphorus (mg/L)	0.91	0.41	0.69	1.34	0.45	0.13	0.655	0.13	1.34
Ortho Phosphorus (mg/L)	0.79	0.12	0.16	0.49	0.07	0.04	0.2783	0.04	0.79
Total Nitrogen	7.12	0.77	1.69	4.08	4.05	2.21	3.32	0.77	7.12
Nitrate + Nitrite (mg/L)	0.2	0.08	0.25	0.33	2.25	1.26	0.7283	0.08	2.25
COD (mg/L)	445	7.01	78.1	115	51.4	149	140.92	7.01	445
Lead (mg/L)	0.26	0.15	<0.12	0.12	<0.15	<0.18	0.0883	<0.12	0.26
Cadmium (mg/L)	0.02	<0.01	<0.01	0.01	0.03	<0.02	0.01	<0.01	0.03
Chromium (mg/L)	0.18	<0.12	<0.13	<0.11	<0.13	<0.18	0.03	<.11	0.18
Iron (mg/L)	118	4.13	31.6	4.7	12.9	2.02	28.892	2.02	118
Oil & Grease (mg/L)	<1.0	<1	<1	<1	<1	<1	0	<1	<1
Cyanide (mg/L)	<0.02	<0.02	0.01	<0.01	<0.02	<0.02	0.0017	<0.01	0.01
Fecal Coli. (N/100ML)	48000	500	470	850	328000	29000	67803	470	328000
Rainfall for month (in)	4.75	8.8	7.1	7.5					
Rainfall for day of event (in)	0.75	3.1	1.1	0.9					

Data From the Kraft Road Storm Water Sampling Site

	10/24/97	11/12/97	12/3/97	1/22/98	3/5/98	6/6/98	6/23/98	8/16/98	9/21/98	12/8/99	Average	Min.	Max.
TSS (mg/L)	14.4	7	7.5	48	156	22	7.5	15.5	34	49	36.09	7	156
TDS (mg/L)	77	37	73	36	100	67	435	2135	35	50	304.5	35	2135
BOD (mg/L)	38	9.89	3.62	23.7	62.2	6.67	9.75	6.62	<2	12.7	17.315	<2	62.2
pH (S.U.)	6.24	6.4	6.75	6.84	7.44	4.76	7.16	7.95	6.97	7	6.751	4.76	7.95
TKN (mg/L)	3.95	1.61	0.33	1.99	2.13	1.06	4.22	0.83	0.59	2.23	1.894	0.33	4.22
Total Phosphorus (mg/L)	0.36	0.1	0.012	0.52	0.35	0.22	0.06	0.34	0.07	0.29	0.2322	0.01	0.52
Ortho Phosphorus (mg/L)	0.2	0.03	0.04	0.22	0.2	0.19	0.01	0.2	<0.02	0.18	0.127	0.01	0.22
Total Nitrogen	5.67	2.96	0.45	2.87	3.07			2.35	1.56	3.05	2.198	0.45	5.67
nitrate + nitrite (mg/L)	1.72	1.35	0.12	0.88	0.94	2.94	17.4	1.52	0.97	0.82	2.866	0.12	17.4
COD (mg/L)	194	36.5	36.5	113	222	185	184	53	149	74.7	124.77	36.5	222
Lead (mg/L)	< 0.10	0.15	0.1	< 0.12	0.15	0.12	0.13	0.1	<0.18	0.16	0.091	<0.10	0.16
Cadmium (mg/L)	< 0.01	0.01	0.01	< 0.01	0.01	0.01	<0.01	0.01	<0.02	0.01	0.006	<0.01	0.01
Chromium (mg/L)	< 0.14	< 0.12	0.5	< 0.13	< 0.11	<0.15	<0.2	<0.05	<0.18	<0.04	0.05	<0.04	0.5
Iron (mg/L)	13.3	2.31	0.42	0.85	6.7	0.47	0.72	0.81	0.64	1.27	2.749	0.4	13.3
Oil & Grease (mg/L)	50.4	2.36	3.44	1.54	26.5	2.41	<1	1.5	<1	6.63	9.478	<1	50.4
Cyanide (mg/L)	< 0.02	< 0.02	< 0.010	0.01	< 0.01	<0.02	<0.02	<0.02	<0.02	<0.02	0.001	<0.01	0.01
Fecal Coli. (N/100ML)	3700	2700	170	8000	43	10000	0	700	16000	5400	4671.3	0	16000
Rainfall for month (in)	4.75	8.8	8.6	7.1	7.5								
Rainfall for day of event (in)	0.75	3.1		1.1	0.9								

Data From the Chapelwood Subdivision Storm Water Sampling Site

1	0/24/97	11/12/97	12/3/97	1/22/98	3/5/98	6/5/98	6/25/98	7/16/98	8/16/98	9/21/98	Average	Min.	Max.
TSS (mg/L)	23	20	16	116	182	19	86	126	112	28	72.8	16	182
TDS (mg/L)	181	90	72	37	56	170	124	29	49	35	84.3	29	181
BOD (mg/L)	24	9.8	10.1	13	8.4	28.6	25.3	13	12.1	3.4	14.77	3.4	28.6
pH (S.U.)	8.3	6.24	7.1	7.65	5.85	6.24	7.04	7.2	6.74	6.79	6.915	5.85	8.3
TKN (mg/L)	1.71	1.6	0.98	2.19	1.51	5.25	3.84	3.93	1.6	0.59	2.32	0.59	5.25
Total Phosphorus (mg/L)	0.25	0.24	0.19	0.18	0.26	0.44	0.25	0.46	0.21	0.03	0.251	0.03	0.46
Ortho Phosphorus (mg/L)	0.19	0.12	0.05	0.05	0.06	0.41	0.17	0.17	0.1	<0.02	0.132	<0.02	0.41
Total Nitrogen	2.99	2.51	2.07	3.49	2.24	9.51	6.84	6.27	3.61	1.77	4.13	1.77	9.51
Nitrate + Nitrite (mg/L)	1.28	0.91	1.09	1.3	0.73	4.26	3	2.34	2.01	1.18	1.81	0.73	4.26
COD (mg/L)	175	46.1	82.4	153	295	214	235	118	83.2	167	156.87	46.1	295
Lead (mg/L)	<0.1	0.11	0.1	<0.12	0.11	0.13	0.14	<0.12	0.1	0.18	0.087	<0.01	0.18
Cadmium (mg/L)	0.01	<0.01	0.006	<0.13	<0.01	<0.01	<0.01	0.01	0.01	<0.02	0.0036	<0.006	0.01
Chromium (mg/L)	<0.14	<0.12	1.4	<0.13	<0.11	<0.15	<0.18	<0.18	<0.05	<0.18	0.14	<0.05	0.14
Iron (mg/L)	0.21	0.24	0.45	1.01	0.9	0.44	0.93	1.08	1	0.43	0.669	0.21	1.08
Oil & Grease (mg/L)	4.81	1.06	1.31	1.6	1.92	1.05	2.94	<1	<1	<1	1.469	<1	4.81
Cyanide (mg/L)	<0.02	0.03	<0.01	0.011	<0.01	<0.02	<0.02	0.02	<0.02	<0.02	0.0061	<0.01	0.03
Fecal Coli. (N/100ML)	290	90	290	170	200	10040	1000	1000	12800	1000	2688	90	10040
Rainfall for month (in)	4.75	8.8	8.6	7.1	7.5								
Rainfall for day of event (in)	0.75	3.1		1.1	0.9								

Data From the Winn Dixie Storm Water Sampling Site

	10/24/97	11/12/97	12/3/97	1/22/98	3/5/98	6/5/98	6/25/98	7/16/98	8/16/98	9/21/98	Average	Min.	Max.
TSS (mg/L)	84	94	44	7	22	29	11	17	24	40	37.2	7	94
TDS (mg/L)	190	52	131	29	92	478	392	33	78	1	147.6	1	478
BOD (mg/L)	68	7.5	5.47	3.5	<2	51.9	12.3	4.65	9.05	3.24	16.561	<2	68
pH (S.U.)	5.5	7.42	7.6	7.79	7.7	7.24	6.37	7.3	7.18	7.48	7.158	5.5	7.79
TKN (mg/L)	4.05	0.81	1.02	0.66	0.13	4.5	2.87	0.74	0.34	0.7	1.582	0.13	4.5
Total Phosphorus (mg/L)	0.74	0.12	0.16	0.05	0.04	0.24	0.18	0.09	0.1	0.09	0.181	0.04	0.74
Ortho Phosphorus (mg/L)	0.42	0.03	0.03	<0.02	<0.02	0.19	0.08	0.02	0.05	<0.02	0.082	<0.02	0.42
Total Nitrogen	5.73	1.29	2.15	1.05	0.2	9.59	5.89	2.4	2.45	2.32	3.307	0.2	9.59
Nitrate + Nitrite (mg/L)	1.68	0.48	1.13	0.39	0.07	5.09	3.02	1.66	2.11	1.62	1.725	0.07	5.09
COD (mg/L)	324	69.9	117	45.2	7.19	651	66.5	44.4	85.6	176	158.68	7.19	651
Lead (mg/L)	0.11	0.12	0.14	<0.12	0.12	0.14	<0.14	0.12	0.11	<0.18	0.086	<0.12	0.14
Cadmium (mg/L)	<0.01	<0.01	0.006	<0.01	0.01	<0.01	<0.01	0.02	0.01	<0.02	0.0046	<0.01	0.02
Chromium (mg/L)	<0.14	<0.12	1.39	<0.13	<0.11	<0.15	<0.18	<0.18	<0.05	<0.18	0.139	<0.01	1.39
Iron (mg/L)	0.72	0.83	1.04	0.2	0.19	0.64	0.22	0.17	0.71	0.49	0.521	0.17	1.04
Oil & Grease (mg/L)	1.52	3.53	3.23	<1	<1	3.78	<1	2.48	<1	<1	1.454	<1	3.78
Cyanide (mg/L)	<0.02	<0.02	<0.010	0.051	<0.01	<0.02	<0.02	<0.02	<0.02	<0.02	0.0051	<0.01	0.051
Fecal Coli. (N/100ML)	6600	120	920	270	0	650	170	300	1200	22000	3223	0	22000
Rainfall for month (in)	4.75	8.8	8.6	7.1	7.5								
Rainfall for day of event (in)	0.75	3.1		1.1	0.9								

Data From the Wiregrass Commons Mall Storm Water Sampling Site

	10/24/97	11/12/97	12/3/97	1/22/98	3/5/98	6/6/98	7/16/98	9/21/98	2/17/99	3/9/99	Average	Min.	Max.
TSS (mg/L)	13	30	3.5	3	62	20.5	18	16	25	2	19.3	2	62
TDS (mg/L)	170	64	121	47	54	41	39	33	85	4	65.8	4	170
BOD (mg/L)	25	7.33	10.8	2.12	8.46	4	7.7	2.06	7.99	2.38	7.784	2.1	25
pH (S.U.)	7.4	5.74	6.32	5.4	6.13	6.26	7.3	7.02	7.16	6.95	6.568	5.4	7.4
TKN (mg/L)	2.98	1.94	1.2	0.84	0.34	1.42	1.73	0.93	2.03	0.37	1.378	0.34	2.98
Total Phosphorus (mg/L)	0.13	0.16	0.13	0.05	0.09	0.21	0.12	0.07	0.13	0.03	0.112	0.03	0.21
Ortho Phosphorus (mg/L)	0.1	0.08	0.05	<0.02	0.03	0.14	0.06	<0.02	0.06	0.02	0.054	<0.02	0.14
Total Nitrogen	5.04	3.26	2.41	1.92	2.08	3.81	5.21	3.3	3.78	1.02	3.183	1.02	5.21
Nitrate + Nitrite (mg/L)	2.06	1.32	1.21	1.08	1.74	2.39	3.48	2.37	1.75	0.65	1.805	0.65	3.48
COD (mg/L)	139	59.9	50.5	37.9	80.4	160	56.5	147	45.4	13.7	79.03	13.5	160
Lead (mg/L)	<0.10	0.16	0.11	<0.12	0.13	0.12	0.12	<0.18	3.14	<0.08	0.378	<0.08	3.14
Cadmium (mg/L)	<0.01	0.01	0.006	<0.01	0.01	0.01	0.01	<0.02	0.03	0.01	0.0086	0.006	0.03
Chromium (mg/L)	<0.14	<0.12	0.73	<0.13	<0.11	<0.15	<0.18	<0.18	<0.04	<0.06	0.073	<0.04	0.73
Iron (mg/L)	0.21	0.63	0.17	0.15	0.42	0.1	0.21	1.08	1.42	0.14	0.453	0.1	1.42
Oil & Grease (mg/L)	0.43	1.64	1.09	<1.0	<1.0	<1	<1	<1	<1	<1	0.316	<1	1.64
Cyanide (mg/L)	<0.02	0.02	0.031	<0.01	<0.01	<0.02	<0.02	<0.02	<0.02	<0.02	0.0051		
Fecal Coli. (N/100ML)	5000	360	270	8	0	5080	4000	5000	20	35	1977.3		
Rainfall for month (in)	4.75	8.8	8.6	7.1	7.5								
Rainfall for day of event (in)	0.75	3.1		1.1	0.9								