



***iSWM* Resource Guide:**

**STORM WATER SYSTEM
OPERATION & MAINTENANCE**

October 2007

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SECTION 1 – Local Storm Water Operations and Maintenance Programs

1.1 Introduction

An essential component of a comprehensive storm water management program is the ongoing operation and maintenance of the various components of storm water drainage, control, and conveyance systems. Failure to provide effective maintenance can reduce the hydraulic capacity and the pollutant removal efficiency of storm water controls and conveyance systems. A lack of maintenance can also lead to damage of other infrastructure elements such as roadways, water transmission lines and sanitary sewer systems.

The question is not whether storm water management system maintenance is necessary in a community. Rather, the question is how a community's maintenance programs will be budgeted, staffed, and administered; and who has responsibility for managing inspections, scheduling periodic required maintenance, and funding remedial work. Ideally, a local program should address operations and maintenance concerns proactively instead of reacting to problems that occur such as flooding, channel erosion, or water quality degradation.

Operations and maintenance activities can include cleaning and maintenance of catch basins, drainage swales, open channels, storm sewer pipes, storm water ponds, and other structural controls. Street sweeping and certain other pollution reduction activities such as illicit discharge identification and removal also fall under operations and maintenance activities. Storm water system operations and maintenance can also include the retrofitting of existing development to meet water quality and/or water quantity goals and streambank restoration.

A clear assignment of storm water inspection and maintenance responsibilities, whether they be accomplished by the local government, land owners, private concerns, or a combination of these, is essential to ensuring that storm water management systems function as they were intended. It is imperative that communities require the maintenance of private storm water systems and develop the necessary legal framework to ensure compliance.

1.2 Key Maintenance Program Components

Most people expect that storm water conveyance and control facilities will continue to function correctly as designed forever. However, it is inevitable that deterioration of the storm water infrastructure will occur once it becomes operational. On-going maintenance is a vital part of ensuring the operational success of storm water management facilities, and is critical to achieving an extended service life and continuous operation as designed.

There are three key components to adequately maintaining a community's storm water management infrastructure:

- Inventory of storm water system components;
- Periodic and scheduled inspections; and
- Scheduling and performance of maintenance

System Inventory

Without knowledge of the type and locations of storm water infrastructure components, no comprehensive maintenance plan can be developed. Necessary information to be included in a storm water management system inventory are facility and conveyance locations, dimensions of components, elevations, outfalls, contributing drainage, receiving drainage, control structures, material types, vegetative species, and any other pertinent information necessary to defining the kind of maintenance required for the facility or conveyance. This type of information can be incorporated into a GIS system database. Included in the database can be dates on previous inspections, inspection findings, maintenance dates, specific tasks performed, and digital photos of the structure or conveyance. The system inventory process is a costly and intensive effort. It is absolutely imperative, however, for any effective long-term and cost-effective maintenance program. See Appendix G, *Storm Water Computer Models and Information Tools*, in the iSWM Design Manual for Site Development for a more in-depth discussion of storm water system inventories and geographic information tools.

Inspections

It is clear that an inspection program is necessary to ensure a storm water facility or conveyance remains operational. Inspections should be performed on a regular basis and scheduled based on the storm water control type and characteristics. In addition, inspections should occur after major rainfall events for those components deemed to be critically affected by the resulting runoff. Not all inspections can be conducted by direct human observation. For subsurface systems video equipment may be required. There may be cases where other specialized equipment is necessary. The inspection program is tailored to address the operational characteristics of the system.

It is not mandatory that all inspectors be trained engineers, but they should have some knowledge or experience with storm water systems. Trained storm water engineers should, however, direct them. Inspections by licensed engineers should be performed where routine inspection has revealed a question of structural or hydraulic integrity affecting public safety.

The inspection process should document observations made in the field. Comments should be archived on structural conditions, hydraulic operational conditions, evidence of vandalism, condition of vegetation, occurrence of obstructions, unsafe conditions, and build-up of trash, sediments and pollutants. Water quality measurements required for monitoring programs could be taken during inspections and incorporated into the inspection history. The inspection data should be ideally incorporated into the GIS, if possible, as it allows spatial identification. Trends may be identified in this way and specific system components causing recurring problems can be identified.

Scheduling and Performance of Maintenance

Maintenance activities can be divided into two types: scheduled and corrective. Scheduled maintenance tasks are those that are typically accomplished on a regular basis and can generally be scheduled without referencing inspection reports. These items consist of such things as vegetation maintenance (such as grass mowing) and trash and debris removal. These tasks are required at well-defined time intervals and can be considered a given for most, if not all, storm water structural facilities. A permanent maintenance crew is typically put under a fixed scope of responsibility to address these items.

Corrective tasks consist of items such as sediment removal, stream bank stabilization, and outlet structure repairs that are done on an as-needed basis. These tasks are typically scheduled based on inspection results or in response to complaints. Corrective maintenance sometimes calls for more specialized expertise and equipment than for scheduled tasks. For example, a task such as sediment removal from a storm water pond requires specialized equipment that may not be in the jurisdiction's equipment inventory. Therefore, some maintenance tasks might be effectively handled on a contract basis with an outside entity specializing in that field. In addition, some corrective maintenance may also require a formal design and bid process to accomplish the work.

SECTION 2 – Implementing an Effective Operation and Maintenance Program

2.1 Maintenance Responsibility

Communities must make decisions concerning the construction, operation, and maintenance of the storm water management infrastructure. For which parts of the storm water system should the local government be responsible? What services should the local government provide to various parts of a storm water management system? How do we define exactly what makes up the storm water management system? And how do we transform our current maintenance policies to a newer definition of responsibility?

Unmaintained storm water facilities will eventually fail operationally. A major contributor to unmaintained facilities is a lack of clear ownership and definition of responsibility. In order for an inspection and maintenance program to be effective, the roles for each responsibility must be clearly defined prior to construction of a system. The lead role in determining what responsibilities belong to whom lies with the local government. Several different

approaches are possible and are briefly described below. A community must determine which approach best suits its capabilities, both physically and financially.

Limited local responsibility

The narrowest approach for communities to take is that they accept responsibility only for property owned by the community. This would include the right-of-way and any other publicly owned land such as local facilities and parks. With this approach, the community would not be involved with any storm water systems on private property, except for possible regulatory action.

While this approach may seem most easily defined, there are some drawbacks. Parties who have little knowledge or funding to maintain storm water systems, own many of the storm water system components that are on private land. For example, many residential subdivisions contain a storm water pond, frequently located on one of the less desirable lots. The property owners association is typically the owner of such a pond. These groups generally have little understanding of the purpose of the pond and how it operates, and have even less funding available to repair and maintain it. The storm water pond will typically fall into disrepair and become overgrown with vegetation and lose any viable functionality. Many light commercial storm water systems also fall into this same state for the same reasons.

If a community decides to use the approach of limited local responsibility, the local government will have to put forth some effort to prevent these drawbacks from occurring. It may be possible for the community to make this approach work with a proactive inspection program to review private systems, and a strong public education program to insure that owners understand their responsibility and perform their required duties. Private owners should also be made aware of the need to plan how they will fund their maintenance programs. For the residential example above, dues to the property owners association could be earmarked for maintenance.

Expanded local responsibility

In addition to maintaining and operating publicly owned storm water systems, the community may determine that it should maintain and operate some of the private portions of the system. This approach could be chosen in an attempt to eliminate the problems mentioned above.

The difficulty with expanding the responsibility of the local government is in determining where to end local responsibility and how to fund the extra responsibilities. These decisions must be made in a fair and equitable manner. One option for this approach would be for the community to accept operation and maintenance responsibilities for all residential storm water systems, but not for any commercial or industrial systems.

Comprehensive local responsibility

The opposite of a limited approach would be a comprehensive approach, where the community conducts all operation and maintenance activities for storm water systems within its jurisdictional boundaries. This type of approach may be deemed to be the best approach if the community has serious non-point source pollution issues, especially if there is a possibility of regulatory action by the federal or state government. This type of approach would also be well suited to the community that has a storm water utility in place and/or operates and maintains regional storm water management systems instead of a myriad of small on-site systems. Because of the inherent problems associated with private maintenance responsibilities, the most efficient organizational structure would be to give the jurisdiction ownership or easement access to the storm water system. This would place the responsibility for the overall storm water system with one entity. A comprehensive and cohesive program could be developed and implemented by the jurisdiction for inspection and maintenance.

The most difficult aspect of this approach may be how it would be funded. Options for funding could include a storm water utility fee based on the amount of storm water and pollution contributed by each site, or a tax that would pay for the facilities that serve the general public.

Of the above given approaches to local responsibility, each community must determine the amount of responsibility and effort it is willing to commit in order to provide adequate storm water management. A local government could choose one of the approaches described above, or could choose some point between.

Whichever approach is chosen, the decision must be carefully considered and open for change with time and experience. A storm water management system should have ownership and maintenance responsibilities clearly defined from the initial stages of design. It should be clear and unequivocal what entity has responsibility for each portion of the system.

2.2 Level of Service

In addition to determining the extent of responsibility that a community is willing to assume, a decision must be made about how the storm water system will serve the community. This decision determines the *level of service* (or LOS) that the system must achieve. The level of service is defined two ways: performance level of service and maintenance level of service.

The susceptibility of a community to flooding or water quality problems due to storm water can be measured by assessing the performance level of service available. For example, for flooding issues, a level of service can be expressed in terms of the degree of roadway flooding and/or the extent of first floor flooding for a given hypothetical storm event. For some communities, a level of roadway service may be defined as no less than one open lane on evacuation routes during the largest one-day rain event with a 25-year recurrence interval. LOS definitions vary considerably by community and are defined as a design frequency tied to a specified condition (e.g. the 10-year storm design frequency for culvert overtopping). Compared to a flooding LOS, the concept of a water quality level of service is fairly new. A water quality LOS system might promote land use controls, followed by structural treatment measures, and may penalize untreated discharge from urban areas.

A maintenance level of service is defined by the types of services a community will provide to different parts of the drainage system or by the specific condition of the system. For example, within the right-of-way and in critical areas highly susceptible to flood damages, the maintenance level of service might include periodic inspection, priority cleaning and the highest level of emergency response. In similar right-of-way areas not susceptible to flooding, the level of service for maintenance might be much lower. A community might perform maintenance for residential structural storm water controls, but only provide inspection and enforcement of maintenance agreements for structural controls located on non-residential parcels.

Maintenance levels of service can also be defined in terms of the condition of the system. Channel mowing may take place when the grass is about 8" high. Or culverts might be cleaned out when they are, on average, 20% blocked with sediment. In these cases, inspection of the systems drives work orders rather than flooding complaints.

The extent or responsibility and level of service combine to define the capital project (construction or land acquisition) and operation and maintenance programs. For example, it might be that on private land a local government is only willing, and only has the resources, to perform emergency response services and to give technical advice. But in the high priority public right-of-way areas, the local government may be willing to provide a much higher level of service. If a community chooses a low-level storm water maintenance program with minimal responsibilities, it should anticipate increasing complaints and an unknown but growing backlog of unmet capital construction and remedial maintenance needs. No storm water management system can function for long without adequate attention. Maintenance avoided is simply maintenance deferred.

2.3 Establishing Maintenance Responsibility and Level of Service Policies

A drainage system, starting from the headwaters and moving downstream toward the mouth, carries incrementally larger and larger flows. The extent of responsibility policy seeks to define the point in this system between local government and private responsibility. The basic components and limits of that responsibility are also defined in extent of service.

The extent of responsibility will almost certainly change over time, both in terms of the local government's policies and the application of those policies. For example, in terms of routine maintenance of the systems, the extent of responsibility may consistently be limited to those components within rights-of-way and easements which allow adequate access to the facilities, but rights-of-way and easements will be added over the years, so the practical extent of responsibility will expand even if the policy does not change.

The extent of responsibility for regulatory activities must go far beyond the rights-of-way and easements to meet the local government's storm water quantity and quality control responsibilities. Often the community must determine its regulatory extent of responsibility (through its authority for land use control) based on what must, or can, be done on private property in order to protect the general public health, safety, and welfare.

How far into the system should a local government provide service? All of the drainage system can be categorized according to location, conveyance, and legal standing:

- In or outside the public right-of-way;
- Does or does not contain significant public water, and
- Is or is not within a permanent dedicated drainage easement.

Thus, there are four “policy” categories of drainage system:

1. In the right-of-way;
2. Outside the right-of-way, carrying public water and within an easement;
3. Outside the right-of-way, carrying public water but not within an easement; and
4. Totally private systems.

Based on its definition of the system components, the community can determine how it will handle the various portions of the drainage system. Generally:

- The minimal extent of responsibility is within the public right-of-way. Every local government has a public health and safety responsibility to keep its traveled way open to traffic and free from dangerous amounts of standing water.
- Often communities also provide maintenance service, of some sort, within permanent drainage easements. This is especially the case when there is both public water and a public interest in keeping a certain drainageway functional.
- Some also have established the policy that they will provide some service to other parts of the drainage system that carry public water (e.g. downstream from the first public street). In other locations, only an inspection and enforcement service is provided outside the right-of-way and easements.
- Most communities will respond to any location whatsoever in an emergency situation.

When developing changes to a maintenance program it is helpful to remember these three basic steps:

1. Define Program

- Determine segment category definitions
- Determine level-of-service and policy definitions
- Determine resource demands and available budget
- Develop policies for each segment category

2. Define System

- Inventory and map storm water management system
- Identify “official” system (right-of-way & key outside ROW segments)
- Assign segments to system

3. Initiate Changes

- Begin changes in service
- Expand slowly as experience is gained

2.4 Maintenance Agreements

Whenever storm water structural control implementation is required, maintenance requirements must be explicitly stated and enforced. There should also be some type of compliance mechanism to assure that maintenance is actually performed on a regular or as-required basis.

One method for ensuring maintenance is the implementation of a storm water operating permit system and/or maintenance agreements. This kind of system would produce information for inclusion in a storm water inventory database thus adding to the efficiency of a local maintenance program as well as providing a funding mechanism through permit fees. Some key points for inclusion in permits or maintenance agreements are:

- Identification of who will perform inspection duties and how often.
- Listed duties that are to be performed by the owner, such as mowing, debris removal, and replanting of vegetation.
- Defined roles for the local government, possibly inspection, and/or modifications to the system such as resizing an orifice.
- Determination of action to be taken if the owner does not fulfill their obligations (i.e. repayment to the local government for activities that the owner did not perform).
- Development of a pollution prevention plan by the owner.
- Requirement of a report, possibly annually, that would serve to keep the owner involved and aware of their responsibilities.

For example, a permit or maintenance agreement could specify that the local government accept responsibility for inspecting and maintaining the storm water system's structural components, including the periodic removal of debris and accumulated sediments. However, vegetative and aesthetic maintenance would still rest with the private entity.

If a developer enters into a maintenance agreement he should do so as the legal representative of any property owners association, not as the developer. Also, agreements should be referenced on the development plats of the association properties plus language that make the properties jointly and severably liable for maintenance costs if the association ceases to exist.

An example maintenance agreement is included at the end of this resource guide.

2.5 Education

One of the most important ways to assure the regular inspection and maintenance of the storm water infrastructure is through education programs for both private owners and the general public. The public can be helpful or detrimental to the success of the community's storm water management program.

A good example of the need for public education is residents who use the ditch behind their house to dispose of grass clippings and vegetative debris. This debris can then block a pipe inlet and cause flooding or cover an infiltration trench and cause excessive runoff. Another common problem is individuals disposing of materials by discharging them into the storm water catch basins. Citizens need to be informed that sediment, vegetative material and harmful substances should not be dumped into catch basins but must be disposed of properly. In many cases, once the public is informed of the purpose of the system and the need to properly maintain the system, they are less likely to perform acts that inhibit the system or cause adverse impacts.

An additional benefit of an educated public is the opportunity to have many more "inspectors" who will alert system operators of potential problems prior to catastrophic failure. As part of an effective education component, the public should be informed of conditions that may indicate serious problems. If a citizen is told that the dry detention pond behind his house should not have standing water at all times or should not fill to the top of the dam after every rain event, he or she would then know to alert the proper authorities and could prevent possible damage to life or property.

In addition to public education for publicly owned or operated systems, education can be very important for privately owned systems. Once storm water structural controls are installed, the end-user or owner may not be aware of the necessity of the facilities or the consequences of a failed system. As part of the public education, it is vital that private owners be educated to understand and become proactive in the operation and maintenance of their system. It is in the best interest of the public to make the owners of private storm water systems aware of the responsibility that goes with ownership and the effect that failure could have on public health and safety. This information must also be made available to prospective and future owners so they are clearly aware of their responsibilities.

2.6 Periodic Review of Regulations and Procedures

Once a community's storm water management operation and maintenance program has been developed and implemented, it may become apparent that changes or modifications are necessary to make the program more effective. After the initial implementation of the operation and maintenance program, review of the program should be scheduled one to two years after implementation. After the initial review, additional reviews may be scheduled in three to five-year intervals. Reviews should include input from staff members who are performing the various activities.

Following are some examples of issues that may arise during the review:

- The system inventory may not be complete or up-to-date
- Inspection scheduling may need to be revised for more or less frequent inspections for all or only specific types of systems
- Inspection checklists may need modification
- Maintenance activities may need to be modified
- Some systems or system components allowed may need to be deleted based upon experiences
- Some systems or system components allowed may need to be added based on new techniques or developments
- Additional equipment may be necessary to perform duties adequately

EXAMPLE STORM WATER FACILITY MAINTENANCE AGREEMENT

THIS AGREEMENT, made and entered into this . day of _____, _____, by and between (Insert Full Name of owner) _____ hereinafter called the "Landowner", and the [Local Jurisdiction], hereinafter called the "[City/County]". WITNESSETH, that WHEREAS, the Landowner is the owner of certain real property described as (Tax Map/Parcel Identification Number) _____ as recorded by deed in the land records of [Local Jurisdiction], Texas, Deed Book _____ Page _____, hereinafter called the "Property".

WHEREAS, the Landowner is proceeding to build on and develop the property; and WHEREAS, the Site Plan/Subdivision Plan known as _____, (Name of Plan/Development) hereinafter called the "Plan", which is expressly made a part hereof, as approved or to be approved by the [City/County], provides for management of storm water within the confines of the property; and

WHEREAS, the [City/County] and the Landowner, its successors and assigns, including any property owners association, agree that the health, safety, and welfare of the residents of [Local Jurisdiction], Texas, require that on-site storm water management facilities be constructed and maintained on the Property; and

WHEREAS, the [City/County] requires that on-site storm water management facilities as shown on the Plan be constructed and adequately maintained by the Landowner, its successors and assigns, including any property owners association.

NOW, THEREFORE, in consideration of the foregoing premises, the mutual covenants contained herein, and the following terms and conditions, the parties hereto agree as follows:

1. The on-site storm water management facilities shall be constructed by the Landowner, its successors and assigns, in accordance with the plans and specifications identified in the Plan.
2. The Landowner, its successors and assigns, including any property owners association, shall adequately maintain the storm water management facilities in accordance with the operations and maintenance plan included in the Plan. This includes all pipes, channels or other conveyances built to convey storm water to the facility, as well as all structures, improvements, and vegetation provided to control the quantity and quality of the storm water. Adequate maintenance is herein defined as good working condition so that these facilities are performing their design functions. The Storm Water Structural Control Maintenance Checklists are to be used to establish what good working condition is acceptable to the [City/County].
3. The Landowner, its successors and assigns, shall inspect the storm water management facility and submit an inspection report annually. The purpose of the inspection is to assure safe and proper functioning of the facilities. The inspection shall cover the entire facilities, berms, outlet structure, pond areas, access roads, etc. Components of the facility which need maintenance or replacement to perform their design function shall be noted in the inspection report along with the corrective actions to be taken.
4. The Landowner, its successors and assigns, hereby grant permission to the [City/County], its authorized agents and employees, to enter upon the Property and to inspect the storm water management facilities whenever the [City/County] deems necessary. The purpose of inspection is to follow-up on reported deficiencies and/or to respond to citizen complaints. The [City/County] shall provide the Landowner, its successors and assigns, copies of the inspection findings and a directive to commence with the repairs if necessary.
5. In the event the Landowner, its successors and assigns, fails to maintain the storm water management facilities in good working condition acceptable to the [City/County], the [City/County], its authorized agents and employees, may enter upon the Property and take whatever steps necessary to correct deficiencies identified in the inspection report and to charge the costs of such repairs to the Landowner, its successors and assigns. This provision shall not be construed to allow the [City/County] to erect any structure of permanent nature on the land of the Landowner outside of the easement for the storm water

management facilities. It is expressly understood and agreed that the [City/County] is under no obligation to routinely maintain or repair said facilities, and in no event shall this Agreement be construed to impose any such obligation on the [City/County].

- 6. The Landowner, its successors and assigns, will perform the work necessary to keep these facilities in good working order as appropriate. In the event a maintenance schedule for the storm water management facilities (including sediment removal) is outlined on the approved plans, the schedule will be followed.
- 7. In the event the [City/County] pursuant to this Agreement, performs work of any nature, or expends any funds in performance of said work for labor, use of equipment, supplies, materials, and the like, the Landowner, its successors and assigns, shall reimburse the [City/County] upon demand, within thirty (30) days of receipt thereof for all actual costs incurred by the [City/County] hereunder.
- 8. This Agreement imposes no liability of any kind whatsoever on the [City/County] The Landowner agrees to hold the [City/County] harmless from any liability in the event the storm water management facilities fail to operate properly.
- 9. This Agreement shall be recorded among the land records of [Local Jurisdiction], Texas, and shall constitute a covenant running with the land, and shall be binding on the Landowner, its administrators, executors, assigns, heirs and any other successors in interests, including any property owners association.

WITNESS the following signatures and seals:

Company/Corporation/Partnership Name (Seal)

By: _____
(Type Name and Title)

The foregoing Agreement was acknowledged before me this ____ day of _____, 20____, by _____.

NOTARY PUBLIC
My Commission Expires: _____
COUNTY OF _____,

By: _____

(Type Name and Title)

The foregoing Agreement was acknowledged before me this ____ day of _____, 20____, by _____.

NOTARY PUBLIC
My Commission Expires: _____

Approved as to Form:

[City/County] Attorney Date

What is iSWM?

integrated Storm Water Management (iSWM) is a new way of managing storm water in North Central Texas by looking to mitigate the negative impacts of development by integrating the management of the quality and quantity of storm water, as well as integrating storm water considerations into the earliest stages of the development and site planning process. iSWM is an avenue to provide comprehensive and practical guidance oriented to implementation in everyday practice.

Why iSWM?

Comprehensive guidance is needed for the region in order to integrate the management of storm water quantity and quality throughout the planning, design, construction, operation, and maintenance of storm water infrastructure that will protect water quality, minimize streambank erosion and provide flood control both onsite and downstream. iSWM guidelines will greatly enhance the storm water management initiatives of North Central Texas area communities by improving and streamlining the development process for communities, developers, and consultants. The short-term and long-term impacts on the storm water quality and quantity improvements brought about by these guidelines will prove invaluable for the region.

What iSWM documents are available?

iSWM Design Manual for Construction – December 2003

Provides guidance on the control of sediment and other pollutants on during construction activities.

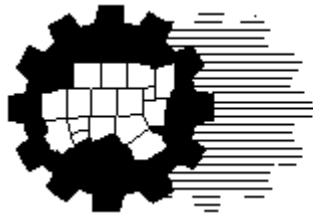
iSWM Design Manual for Site Development – January 2006

A detailed design document to guide developers, consultants, and government agencies on the preparation of an *integrated* Storm Water Management Site Plan to control and manage storm water quality and quantity for new developments and redevelopments.

iSWM Resource Guides – October 2007

Provide guidance for local jurisdictions and developers on various aspects of effective urban storm water management.

These documents can be found at <http://iswm.nctcog.org/>.



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