*i*SWM Resource Guide:

STORM WATER RETROFITTING

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SECTION 1 – Introduction

Ideally, as land is developed structural controls are implemented to control present and future storm water runoff impacts. However, controlling storm water from new development and redevelopment alone will not solve existing problems. Retrofitting by definition is the process by which structural controls are constructed to serve and reduce the water quantity and quality impacts from *existing* developed areas.

Due to the fact that they are intended to serve existing problem areas, retrofits are typically the responsibility of the local government which must mitigate property flooding, reduce streambank erosion, or comply with TMDL or other water quality regulatory requirements.

Retrofits must be integrated with existing and often diverse urban development, and they assume a wider range of issues than structural controls installed during new development. These issues may include space constraints, construction costs, acquisition of easements, safety precautions, economic vitality, and property rights.

SECTION 2 – Storm Water Retrofitting Process

Storm water retrofitting is ideally performed as a part of an overall watershed planning and implementation effort. When applied along with other available water restoration strategies such as pollutant reduction, habitat restoration, and channel stabilization, retrofitting can be most effective. The following eight steps detail a "how-to" approach to retrofitting.

Step 1: Watershed Retrofit Inventory

The first step to putting a retrofit in place is identifying a feasible and appropriate locations for a proposed facility. This involves a process of identifying as many potential sites as possible. The best retrofit sites fit easily into the existing landscape, are located at or near major drainage or storm water control facilities, and are easily accessible. Usually the first step is completed in the office using available topographic mapping, low altitude aerial photographs (where available), storm drain master plans, and land use maps (zoning or tax maps are generally acceptable).

Before venturing into the field, there are two tasks that should be performed. First, the drainage areas should be delineated, and second, the potential surface area of the facility measured. The drainage area is used to compute a capture ratio. This is the percentage of the overall watershed that is being managed by the retrofit project(s). The surface area is used to compute a preliminary storage volume of the proposed facility. These two bits of information can be used as a quick screening tool. In general, an effective retrofitting strategy must capture at least 50% of the drainage area, and the minimum target storage volume for each retrofit is approximately 0.5 inch per impervious acre.

Step 2: Field Verification of Candidate Sites

Candidate retrofit sites from Step 1 are field investigated to verify that they are indeed feasible candidate sites. This field investigation involves a careful assessment of site specific information such as:

- Presence of sensitive environmental features
- Location of existing utilities
- Type of adjacent land uses
- Condition of receiving waters
- Construction and maintenance access opportunities, and most importantly,
- Evaluation of retrofit suitability

Usually a conceptual sketch is prepared and photographs are taken. During field verification, utilities should be located and an assessment made as to potential conflicts. Avoidance should be stressed due to cost considerations. It may also be appropriate to contact the appropriate utility to verify field observations and to discuss the potential facility. This may alleviate potential conflicts later.

Existing natural resources such as wetlands, streams, and forests should be evaluated as to their sensitivity. Avoidance and /or minimization of impacts, where feasible, should be considered. Finally, identify, review, and assess adjacent land uses for consideration of structural controls that are compatible with nearby properties.

Step 3: Prioritize Sites for Implementation

Once sites have been located and determined to be feasible and practical, the next step is to set up a plan for future implementation. It is prudent to have an implementation strategy based on a predetermined set of objectives. For example, in some watersheds, implementation may be based on a strategy of reducing pollutant loads to receiving waters where the priority of retrofitting might be to go after the highest polluting land uses first. Whereas if the strategy is oriented more towards restoring stream channel morphology, priority retrofits are targeted to capture the largest drainage areas and provide the most storage. Whatever the restoration focus, it is useful to provide a scoring system that can be used to rank each retrofit site based on a uniform criteria. A typical scoring system might include a score for the following items:

- Pollutant removal capability
- Stream channel protection capability
- Flood protection control capability
- Cost of facility (design, construction and maintenance costs)
- Ability to implement the project (land ownership, construction access, permits)
- Potential for public benefit (education, location within a priority watershed, visible amenity, supports other pubic involvement initiatives)
- Ability to maintain the facility
- Ability to coordinate with other work in the area, such as street repair

Step 4: Public Involvement Process

This aspect of the process is critical if a project is to be constructed. A successful project must involve the immediate neighbors who will be affected by the changed conditions. Nearly all retrofits require modifications to the existing environment. For example, a dry detention pond may be very desirable for some residents in the community. It can function as a community space which would only be unusable during and immediately following major storm events. A storm water pond or wetland retrofit, on the other hand, may have large expanses of water and may have highly variable water fluctuations. Adjacent owners may resist these changes. In order to gain citizen acceptance of retrofits, they must be involved in the process from the start and throughout the planning, design, and implementation process. Citizens who are informed about the need for, and benefits of, retrofitting are more likely to accept such projects.

Still, some citizens and citizen organizations will never support a particular project. This is why it is mandatory that there be an overall planning process which identifies projects early in the selection process and allows citizen input before costly field surveys and engineering designs are performed. Project sites and retrofit techniques that simply cannot satisfy citizen concerns may need to be dropped from further consideration.

A good retrofit program must also incorporate a good public relations plan. Slide shows or field trips to existing projects can be powerful persuasions to skeptical citizens. Every site that goes forward to final design and permitting should be presented at least once to the public through a public hearing or “town hall” type meeting.

Step 5: Retrofit Design

In the design process, the concept is converted to an engineering design and construction plan. Design of retrofit projects should incorporate the same elements as any other structural control design including, but not limited to:

- Adequate hydrologic and hydraulic modeling

- Detailed topographic mapping
- Property line establishment
- Site grading
- Structural design
- Geotechnical investigations
- Erosion and sediment control design
- Construction phasing and staging
- Maintenance access

Structural control design usually follows a prescribed set of design criteria (i.e., control of the 25-year storm or sizing for a specified water quality volume). Retrofit designers must work backwards from existing site constraints to arrive at an obtainable and acceptable storm water control. This process may yield facilities that are too small or ineffective, and, therefore, not practical for further consideration. Designers should look for opportunities to combine projects, such as stream stabilization or habitat restoration with the overall structural control design in a complementary manner.

The key to successful retrofit design is the ability to balance the desire to maximize pollutant removal, channel erosion protection and flood control while limiting the impacts to adjacent infrastructure, residents or other properties. Designers must consider issues like avoiding relocations of existing utilities, minimizing existing wetland and forest impacts, maintaining existing floodplain elevations, complying with dam safety and dam hazard classification criteria, avoiding maintenance nuisance situations, and providing adequate construction and maintenance access to the site.

Retrofits can vary widely as to cost from a few thousand dollars to several hundred thousand dollars. A preliminary cost estimate should be a part of the design phase.

<u>Step 6: Permitting</u>

Perhaps the most difficult permitting issues for retrofit projects involve impacts to wetlands, forests and floodplain alterations. Many of these impacts are either unavoidable or necessary to achieve reasonable storage targets. The primary issues that permitting agencies are looking for is to ensure that the impacts have been minimized to the maximum extent practicable and that the benefits of the proposed project are clearly recognizable. In some instances, mitigation may also be required in order to satisfy permitting. If so, additional costs may be involved.

<u>Step 7: Construction and Inspections</u>

Like any design project, proper construction, inspection, and administration are integral to a successful facility. Retrofitting often involves construction of unique or unusual elements, such as flow splitters, underground sand filters, or stream diversions. Many of these practices may be unfamiliar to many contractors. Most publicly funded projects are awarded to the low bidder who may be qualified to do the work, but may never have constructed projects of this nature. Therefore, it is almost a necessity to retain the retrofit designer of record or other qualified professional to answer contractor questions, approve shop drawings, conduct regular inspections, hold regular progress meetings, conduct construction testing, and maintain construction records. As-built drawings should also be a part of the construction process. These drawings are used for maintenance purposes.

<u>Step 8: Maintenance Plan</u>

Always the last element and often the least practiced component of a storm water management program, maintenance is doubly important in retrofit situations. The reasons are simple: most retrofits are undersized when compared to their new development counterparts and space is at a premium in urban areas where many maintenance provisions such as access roads, stockpiling, or staging areas are either absent or woefully undersized.

SECTION 3 – Types of Retrofitting Techniques

Retrofitting techniques can be applied to many different situations depending on the end result required and space available. Retrofitting techniques include:

Source Retrofit – Use of techniques that attenuate runoff and/or pollutant generation before it enters a storm drain system, i.e., reducing impervious areas, using pollution prevention practices, etc. These are used in areas where build-out prevents the establishment of a significant number of new facilities, and where redevelopment will not have a significant impact on water quality.

Redevelopment – Redevelopment will result in retrofit by means of new structural control facilities required by local storm water management standards. Projected redevelopment trends, while not within the direct control of local government, are useful in predicting areas of existing development that may be mitigated in the future.

Existing Structural Control Retrofit – The retrofit of an existing structural control to improve its pollutant removal efficiency or storage capacity, or both.

Installation of Additional Storm Water Controls – Additional storm water controls can be added for existing development or redevelopment. Consideration should be given to regional controls, rather than site-specific applications.

Conversion of Existing Storm water Facilities to Water Quality Functions – Existing flood control facilities built to serve previous development may be modified to act as a water quality structural control on a regional or site-specific basis.

Open Channel Retrofit – Open channel retrofits are constructed within an open channel below a storm drain outfall, e.g., extended detention shallow marsh pond system.

Natural Channel Retrofit – Depending on the size of the channel and the area of the floodplain, a natural channel may provide several retrofit options.

Off-line Retrofit – Involves the use of a flow-splitter to divert the first flush of runoff to a lower open area for treatment in areas where land constraints are not present.

In-line Retrofit – Used where space constraints do not allow the use of diversions to treatment areas.

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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