Chapter 6 Technical Guidelines for Areas of Special Considerations

For the City of Chattanooga's stormwater program to achieve success in restoring the health of the City's streams and water resources, it is imperative that better stormwater management techniques be widely implemented. Certain areas represent challenges to the stormwater management approach defined and described in this manual as a result of higher than normal pollutant concentrations in runoff, the possibility of material spills that could contaminate groundwater or surface water, or past contamination issues that could become more dispersed in stormwater.

These areas may include:

- Hot areas and/or brownfield sites
- Highways and roads
- Urban redevelopment sites and CSO districts

In many instances, better stormwater management can be achieved in these areas through careful consideration in design, with the simplest approach often being to prevent runoff from the areas of special consideration from "mixing" with cleaner runoff. Other techniques, such as housekeeping and spill prevention and control, are essential and will improve opportunities for better stormwater management.

6.1 Hot Areas/Brownfields

The City's MS4 Permit defines "hot area" to mean an area where land use or activities have the potential to generate highly contaminated runoff, with concentrations of pollutants in excess of those typically found in stormwater. Applicants must clearly identify all potential hot areas on project concept and plan drawings. A typical example is the fueling area at a gas station. Other examples include loading dock areas (depending on the nature and amount of material handled) and outdoor material storage areas (again, depending on the nature of the stored material). Areas with a high potential for material spills should also be considered hot areas.

It is important to identify hot areas when developing a stormwater plan because the runoff may require a higher level of treatment, or the runoff may not be suitable for infiltration or reuse. It may be possible or desirable to keep the runoff from these hot areas from mixing with other site runoff, or to implement systems that can prevent stormwater mixing in the event of a spill. Stormwater runoff from other portions of the site should **never** be directed to, through, or across a hot area.

Many hot areas have higher than average pollutant levels, but are suitable for pretreatment measures or housekeeping practices that will address the pollutant levels such that the hot area may be suitable for inclusion in the SOV measures incorporated at the site. Waste containment dumpsters are one example (see Figure 6-1). Certain areas that are subject to spills of hazardous material may be addressed by spill containment practices (see Figure 6-2). Potential recommendations for hot areas and areas with higher pollutant loads are indicated in Table 6-1.

Figure 6-1. Dumpsters and outdoor storage of materials are examples of hot areas that can be addressed through better housekeeping practices.

Figure 6-2. Incorporation of a debris and spill containment program at a truck stop "hot area" located atop karst topography with a subsurface infiltration bed. Incorporation of these measures allowed for successful stormwater management, including infiltration on karst.

Table 6-1. Pretreatment Options for Stormwater Hot Areas

	Stormwater Hotspots					
Minimum Pre-Treatment Options	Vehicle Fueling Areas	Dumpsters/ Outdoor Material Storage, Loading Docks	Vehicle Maintenance	Outdoor Storage of Liquids	Other Uses or Activities Designated by Appropriate Autority	High use Areas, i.e. Fast Food restaurants, convenience stores, etc.
Oil/ Water Separators/ Hydrodynamic Separators	x		x		x	
Sediment Traps/ Catch Basin Sumps		x			x	x
Trash/ Debris Collectors in Catch Basins		x			x	x
Water Quality Inserts for Inlets	x	x	x	x	x	x
Use of Drip Pans and/or Dry Sweep Material under Vehicles/ Equipment	x		x			
Use of Absorbent Devices to Reduce Liquid Releases	x		x	x		
Spill Prevention and Response Program	x	x	x	x	x	
Diversion of Stormwater away from Potential Contamination Areas	x	x	x	x	x	x
Vegetated Swales/ Filter Strips		x			x	x
Stormwater Filters (Sand, Peat, Compost, etc)					x	x
BMPs that are a part of Stormwater Pollution Prevention Plan (SWPPP) under a NPDES Permit	x		x	x	x	

One specific type of hot area found in the City is a brownfield. The term brownfield is defined by the City's NPDES MS4 Permit to mean real property, the expansion, redevelopment, or reuse of which may be complicated by the presence of a hazardous substance, pollutant, or contaminant. Urban areas such as the City of Chattanooga may apply smart growth principles by working with TDEC to promote brownfield remediation and redevelopment to encourage the reuse of infill sites with pedestrian and public-transit access instead of increasing urban sprawl. TDEC maintains a database of properties identified as brownfields and oversees the remediation and redevelopment of those areas through the TDEC

Brownfields Program. More information about TDEC's Brownfields Program may be obtained at: (http://www.tn.gov/environment/dor/voap/).

Figure 6-3. This Salvation Army facility is located on a brownfield site and applied better storwmwater management practices.

Stormwater management options for brownfield redevelopment projects vary depending on the level of remediation a brownfield site has undergone prior to redevelopment (see Figure 6-3). Therefore, it is important to understand the extent and specific location of contamination to the greatest extent possible. Brownfield sites where contaminated soils have been completely removed may apply all stormwater management BMPs presented in this manual. Redevelopment of completely remediated brownfields should prioritize minimizing land disturbance and soil compaction, minimizing new impervious surfaces, and maximizing infiltration, evaporation/evapotranspiration, and reuse as an integrated measure throughout the site design. Brownfields that have not had contaminated soils completely removed during remediation may still be redeveloped, on the condition that certain precautionary protection measures are taken to avoid infiltration on or disturbance of "hot areas" where contaminated soils remain. Brownfields with remaining contaminated soils may not be suitable for structural stormwater infiltration measures, but may include nonstructural measures, such as disconnection of impervious surfaces, to promote evaporation, evapotranspiration, and infiltration.

The following recommendations may be applied when designing better stormwater practices for brownfield sites:

- **Understand the location and types of contaminants of concern at a site.** The pollutant concern areas may be localized or dispersed.
- **Avoid infiltration practices in contaminated areas.** This will prevent the further dispersement of pollutants. However, further testing may also demonstrate that the residual pollutants will not leach from the percolation of rainfall through the contaminated soils. It may not be necessary or desired to keep natural water movement from continuing through the soils.

- **Prevent runoff from "clean" areas from discharging on or through the area of contamination.** Never "mix" stormwater from contaminated areas with cleaner runoff, and avoid designs that could spread contamination from brownfield sites.
- **Retain existing vegetation and trees, and revegetate.** This will increase evapotranspiration as well as reduce the overall volume of runoff, while also restoring biological function to the soils.
- **Use impervious surfaces to prevent water movement through contaminated areas.** Impervious areas can be strategically placed over existing contamination areas.
- **Implement BMPs that reuse and evaporate rainfall**. Greenroofs and capture/reuse systems are especially important on brownfield sites.

In the event that a hot area, contaminated soils, or other hazardous materials are uncovered in the site investigation or construction, the designer or contractor should immediately contact TDEC at (423) 634-5755 for direction.

6.2 Highways and Roads

Highways and roadways present specific challenges for stormwater management. These include:

- Balancing stormwater management with safe traveling conditions
- Drainage areas comprised of up to 100 percent imperviousness
- Pollutant loads, especially high thermal pollution impacts
- Increased potential for hazardous material spills
- The use of chemical pollutants in construction materials
- Deicing and antiskid applications
- The linear nature of roadways, with limited right-of-way in many situations
- Visibility concerns associated with vegetation types and locations
- Areas of extensive cut and fill, especially in highway construction

These are only some of the issues to be considered when designing stormwater management BMPs for highway and road projects.

Water quality is perhaps the most important consideration in stormwater management measures for highway and roadway projects, as these areas tend to have higher levels of sediment and suspended solids. The Federal Highway Administration summarized the sources and concentrations of typical pollutant constituents in a 1999 study of highway and roadway drainage in ultra-urban areas. These summaries are shown in Table 6-2.

Table 6-2. Sources of Pollutants in Highway Runoff and Associated Concentrations (FHWA 1999)

Constituent	Source	Concentration (mg/L)
Particulates	Pavement wear, vehicles, atmospheric deposition, maintenance activities - Total Suspended Solids (TSS) - Volatile Suspended Solids (VSS) - Total Organic Carbon (TOC) - Chemical Oxygen Demand (COD) - Biochemical Oxygen Demand (BOD) - Fecal coliform (organisms/ 100 ml)	TSS - 45-798 VSS - 4.3-79 TOC - 24-77 COD - 14.7-272 BOD - 12.7-37 50-590
Nitrogen, Phosphorus	Atmosperic deposition and fertilizer application - Total Kjeldahl Nitrogen (TKN) - Total Phosphorus as P - Nitrate & Nitrite (NO_3+NO_2)	TKN - 0.335-55.0 P - 0.113-0.998
Lead	Leaded gasoline from auto exhausts and tire wear	0.073-1.78
Zinc	Tire wear, motor oil, and grease	0.056-0.929
Iron	Autobody rust, steel highway structures such as bridges and guardrails, and moving engine parts	
Copper	Metal plating, bearing and brushing wear, moving engine parts, brake lining wear, fungicides and insecticides	0.022-7.033
Cadmium	Tire wear and insecticide application	
Chromium	Metal plating, moving engine parts, and brake lining wear	
Nickel	Diesel fuel and gasoline, lubricating oil, metal plating, brushing wear, brake lining wear, and asphalt paving.	
Manganese	Moving engine parts	
Cyanide	Anti-caking compounds used to keep deicing salts granular	
Sodium, Calcium, Chloride	Deicing salts	
Sulphates	Roadway beds, fuel, and deicing salts	
Petroleum	Spill, leaks, antifreeze and hydraulic fluids, and asphalt surface leachate	

An additional pollutant of concern for roadways is thermal pollution, as the initial runoff from roadways is often significantly warmer or colder than the receiving stream temperatures, and roadway runoff is often diverted directly to water bodies.

Stormwater runoff volume and pollutant concentrations may be minimized by incorporating filtration and infiltration BMPs to the maximum extent practicable. Vegetated swales, vegetated filter strips, and bioretention systems have excellent potential for improving water quality, reducing temperature impacts, and managing SOV for highway and roadway projects. Chapter 5 of this manual provides more detailed information on the BMPs mentioned above.

The following recommendations may be applied when designing better stormwater practices for roads and highways:

- **Integrate environmental protection issues early in the planning process.** This is an emerging trend in federal transportation projects, and should be applied to all roadway improvement or construction projects. Designers should be familiar with this manual, and the site protection BMPs described in Chapter 5 should be applied to roadway projects.
- **Minimize clearing and grubbing, and implement vegetative BMPs.** Both existing vegetation and restored vegetation can slow the velocity of runoff, reduce temperature impacts, and allow for infiltration and pollutant reduction. The rhizosphere (plant rooting zone) is the landscape area where the most significant water quality benefits are achieved, and should be retained to the greatest extent possible by limiting any unnecessary clearing. The type of road and level of traffic will influence the extent of density of vegetation that may safely be retained. Local roads, with lower volumes and speeds, should always be evaluated to minimize site clearing to the greatest extent possible. Often, areas are disturbed because clear direction on limiting disturbance was not provided.
- **Limit compaction to load-bearing areas.** Highways tend to have a significant amount of cut and fill, and a large footprint of disturbance. Local roadways are often constructed or repaired with little consideration of the effects of compaction. Compaction beyond 85 percent bulk density can inhibit root growth, and compaction requirements for non-load-bearing areas should not exceed 85 percent. Much of the compaction in non-load-bearing areas may occur inadvertently during construction, and therefore, it is especially important on roadway projects that the site protection BMPs described in Chapter 5 be defined and implemented (see Figure 6-4).

Figure 6-4. Unnecessary material storage and equipment movement can compact soils, resulting in more runoff after construction. Clearly limiting vehicle access to unpaved areas can improve soil conditions adjacent to roadways.

- **Consider the issue of spills.** Spills may occur on any roadway, although the likelihood of spills at many locations is low and should not preclude the use of a full range of BMPs, including infiltration. However, certain areas may have a greater likelihood of spills, such as the portion of rest stop areas where trucks are parked and stored, certain industrial area roads, and road maintenance/material storage areas. These areas should incorporate spill prevention and control measures.
- **Reduce impervious surfaces.** Where feasible and safe, reductions in road and shoulder width will reduce both stormwater impacts and project costs. Especially on new roads and low-speed/low-volume residential roads, reducing impervious area can save construction costs and also serve as one of the most cost-effective retrofit options (see Figure 6-5). Alternatively, pervious pavements may be used in parking lanes and spaces

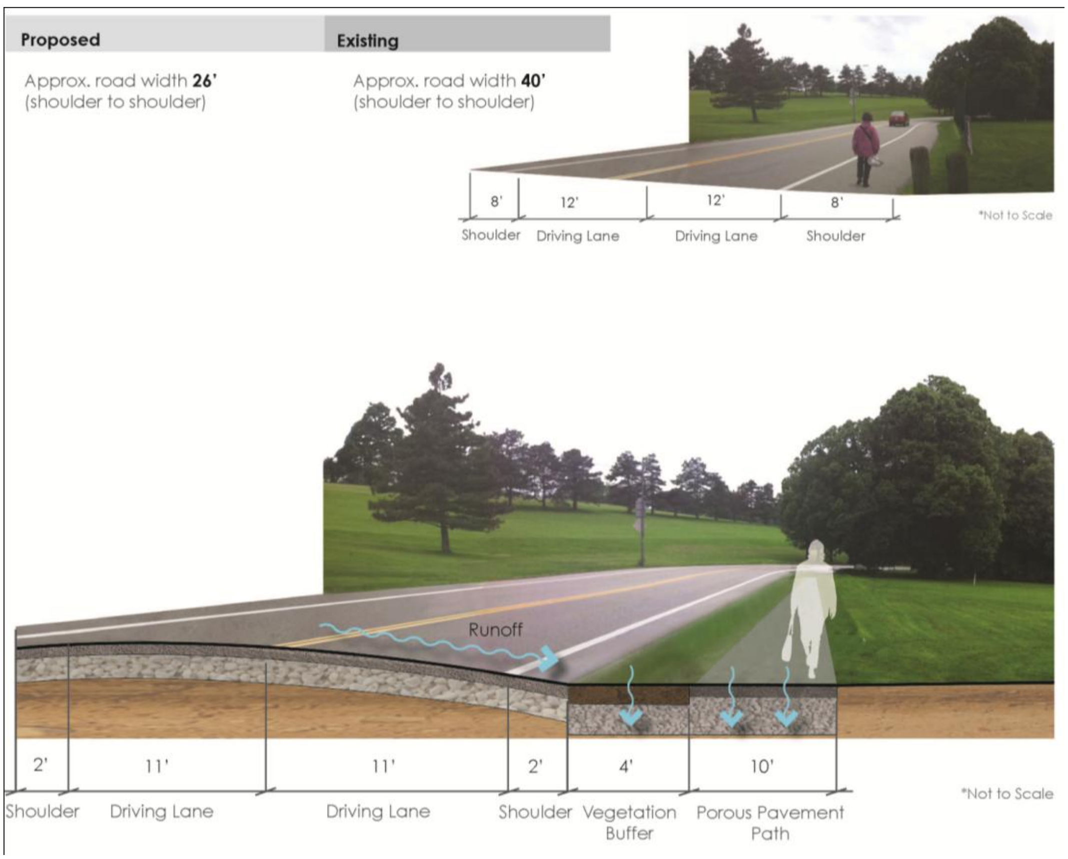

Figure 6-5. A green "skinny" street can manage runoff generated by the road and accommodate multiple users.

- **Limit the use of curb and gutter systems and the practice of conveying runoff in storm sewers wherever possible.** Where runoff from highways can be dispersed via sheet flow over a vegetated area, water quality can be improved. Level spreaders are an effective BMP for this practice. On local roads, curbs may be needed at certain locations to prevent traffic from straying from the pavement, such as entrances, intersections, etc. However, these curbs can be eliminated or depressed along portions of the road where curbs are not needed for traffic control.

Figure 6-6. A stormwater pipe discharging roadway runoff directly into an urban stream during a rainfall event.

- **Avoid discharging directly into water bodies.** In addition to spill concerns, the water quality and temperature impacts from roadways can decimate aquatic life. Temperature impacts alone can alter the entire microbial community and food chain in an otherwise healthy stream system. Roadway runoff should never be directed to any water body, including natural wetlands, without measures to reduce pollutants and temperature impacts (see Figure 6-6). Properly vegetated swales, filter strips, and dispersed flow over planted areas can serve this purpose.
- **Implement green infrastructure.** To achieve many of the recommendations above, the use of green infrastructure, such as tree trenches, vegetated swales, and bioretention systems, can and should be implemented following the guidelines provided in Chapter 5 of this manual.
- **Provide training and guidance for roadway maintenance staff, and require maintenance plan documentation in a format that can be easily used by maintenance staff.** In many roadway situations, little or no guidance or training is provided to the maintenance staff after construction is completed. It is imperative that maintenance staff be provided with specific guidance on the types of systems that have been installed, their required maintenance needs and schedules, and the appropriate practices. For example, many areas may require a reduced or altered mowing regime, but if guidance is not provided, this will not be put into practice. Every project should include a laminated 11-inch by 17-inch maintenance plan for guidance after designers and contractors have completed construction.

- **Reevaluate roadside ditch cleaning and maintenance practices.** Proper maintenance of ditches is important to both flood control and water quality, however, there may be opportunities to improve or maintain vegetation. The Washington State Department of Transportation assessed maintenance practices for highway ditches and bioswales and found significant water quality benefits when the lower portion of vegetation (approximately one-quarter) was retained. The specific findings and recommendations can be found at http://www.wsdot.wa.gov/Research/Reports/400/495.1.htm.

Additionally, all stormwater management measures associated with highway and roadway projects within the public right-of-way of a City or Tennessee Department of Transportation (TDOT) roadway shall be, at a minimum, designed, constructed, and maintained in a manner consistent with the City's Code and Engineering Standards and TDOT's current General NPDES Permit for Discharges of Storm Water Associated with Construction Activities (Construction General Permit or CGP) issued by TDEC, as appropriate. Additional information on TDOT's Construction General Permit and Statewide Storm Water Management Plan may be found at http://www.tdot.state.tn.us/sswmp/.

6.3 Urban Redevelopment and Combined Sewer Overflows

Two additional areas requiring special consideration for stormwater management within the City of Chattanooga are urban redevelopment areas and combined sewer overflows. Urban areas have often been subjected to significant soil compaction activities, which result in nearly impervious soil conditions. These areas may also be underlain by a maze of maintained and/or abandoned utilities and infrastructure with the potential to limit the implementation of infiltration BMPs. When redevelopment is proposed on an urban infill site, applicants may need to consider alternate stormwater management measures to achieve required SOV and meet water quality objectives. Redevelopment projects can improve stormwater conditions in a number of ways, including modifying soil to promote vegetated filters and swales, reducing the existing impervious surface area, and incorporating a green roof into building designs.

Reduction of impervious surface areas and installation of green roofs are also effective at managing stormwater in areas that are tributary to a CSO. CSOs may also benefit from the application of extended detention BMPs to allow for the slow release of site captured water; this allows for a reduction in synchronous peak flows, which are typical of the characteristic flashiness of small urban watersheds.

In both urban redevelopment and CSO areas, applicants must be diligent in the site assessment phase to document potential conflicts, such as underground utilities and other infrastructure, as well as current and past land use, to ensure appropriate BMP selection.

Potential urban redevelopment and CSO area design constraints:

- Limited space and zero lot line properties
- Underground utilities (both in use and abandoned)
- Unknown fill material, or fill consisting primarily of urban rubble
- Lack of remaining soil, and the need to recreate healthy soils
- Highly compacted soil conditions
- High density of use and the durability of materials, especially vegetative systems
- Need to maintain safe traffic and Americans with Disabilities Act (ADA) requirements

6.4 References

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