

Targeted Constituents

● Significant Benefit		◐ Partial Benefit		○ Low or Unknown Benefit	
◐ Sediment	◐ Heavy Metals	◐ Floatable Materials	◐ Oxygen Demanding Substances		
◐ Nutrients	◐ Toxic Materials	◐ Oil & Grease	◐ Bacteria & Viruses	◐ Construction Wastes	

Description

It is often beneficial to use multiple stormwater treatment BMPs, either in series or in parallel. Possible reasons for doing this may include:

- Proximity to environmentally sensitive areas
- Enhanced reliability or improved performance
- Large expected pollutant loading
- Two (or more) radically different types of land uses or expected pollutant categories
- Optimal use of land area and resources to best improve stormwater quality

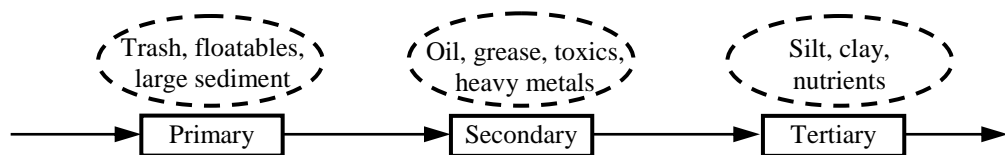
This practice may potentially provide significant reductions in pollutants for which the primary treatment BMP does not target, depending on the combinations involved.

Approach

Stormwater treatment BMPs may be placed either in series or in parallel. In essence, parallel stormwater treatment BMPs have different subbasins and act independently of each other. Stormwater treatment BMPs in series may be labeled as primary, secondary, or tertiary to reflect the order in which they occur.

Stormwater treatment BMPs in series should be placed in order to remove pollutants that may interfere with the functioning of a downstream BMP. For instance, large volumes of sediment should be removed from stormwater prior to entering an oil/water separator. An oil/water separator may be necessary upstream from a wetlands in order to control stormwater runoff from parking lots.

Figure ST-09-1 shows a typical arrangement for placing stormwater treatment BMPs with compatible land uses, typically along the edge of a property or project site. Aesthetics for these permanent structures help to maintain property values (residential), provide an attractive landscape for customers and employees (industrial, commercial), and improve the overall quality of the environment and recreational facilities.



Typical Stormwater Treatment BMPs - In Series

Applications The following combinations of multiple stormwater treatment BMPs are briefly discussed using the following terms to denote the order of treatment: (1) primary or upstream, (2) secondary, and (3) tertiary or downstream. This list is intended to be suggestive and should be adapted for specific sites based upon land use, land surfaces, slopes and grades, available space, pollution potential, etc.

- A**
 - (1) Baffle box, manhole, gate, or weir (with high flow bypass)
 - (2) Oil/water separator, filter swale, media filtration, water quality manhole/insert, wetlands

This is preferred for all stormwater quality systems to ensure that flows in excess of the design flow do not damage the treatment system or resuspend the previously collected pollutants. A baffle box or manhole should ideally capture trash and large sediment particles to assist operations of the downstream BMP.
- B**
 - (1) Wet detention basin or dry detention basin
 - (2) Media filtration or oil/water separator
 - (3) Wetlands

It is desirable to protect wetlands (either natural or constructed) from excessive flow volumes and from pollutants that typically runoff from parking lots, streets and highways, industrial or commercial properties, etc. Media filters will clog less frequently. Reduced maintenance costs for an oil/water separator.
- C**
 - (1) Filter strips and swales, forebay, baffle box or manhole
 - (2) Wet detention basin or dry detention basin

Treatment measures in front of a detention basin will collect floatable debris and coarse sediment (to reduce frequency and difficulty of detention basin cleanout).
- D**
 - (1) Oil/water separator, media filtration
 - (2) Wetlands, filter strips, swales, infiltration trench or basin

Pretreatment of stormwater runoff is desirable for sensitive vegetation systems wherever stormwater runoff comes from streets and highways, parking lots, industrial or commercial properties, etc.

Overall pollutant removal goals are discussed in Chapter 4 of the BMP Manual. The primary measurable pollutant is total suspended sediments (TSS), and the desirable goal is to achieve 75% removal based on the equivalent definition of the first flush treatment (mandated by the Knoxville Stormwater and Street Ordinance). Most other pollutants will be removed proportionately to the TSS removal rate.

Maintenance Maintenance for a system of multiple stormwater treatment BMPs should be conducted on a regular basis. Examine the system as a whole and note findings for future use. Coordinate cleanouts and repairs to occur during dry weather. In general, the upstream BMP is more likely to need maintenance and repair, since it is selected to reduce the loading and potential damage to the downstream BMP.

Limitations Available space may be limited for some stormwater treatment BMPs. Configuration may be difficult to accomplish. Stormwater detention is required by the City of Knoxville for most construction and redevelopment project sites, so that the largest portion of space is defined by hydrological requirements that are non-negotiable.

References 31 (see BMP Manual Chapter 10 for list)

Notes:

1. This figure illustrates how stormwater treatment BMPs may be incorporated into recreational areas, parking areas, landscaping, and outlying property areas near buffer zones and setbacks.
2. Reduce outlet velocities on all culverts and storm drains. Provide outlet protection where necessary.
3. Media filtration, stormwater quality inlets, and oil/water separators are highly desirable to reduce oils, grease, heavy metals and other pollutants associated with automobiles.
4. The wet detention basin shown has an aesthetically pleasing fountain, which also provides aeration for fish and aquatic life.

ST-01	Dry Detention Basin
ST-02	Wet Detention Basin
ST-03	Infiltration Systems
ST-04	Constructed Wetlands
ST-05	Filter Strips and Swales
ST-06	Media Filtration Systems and Water Quality Inlets
ST-07	Oil/Water Separator
ST-08	Underground Detention (not currently allowed by policy - City of Knoxville)

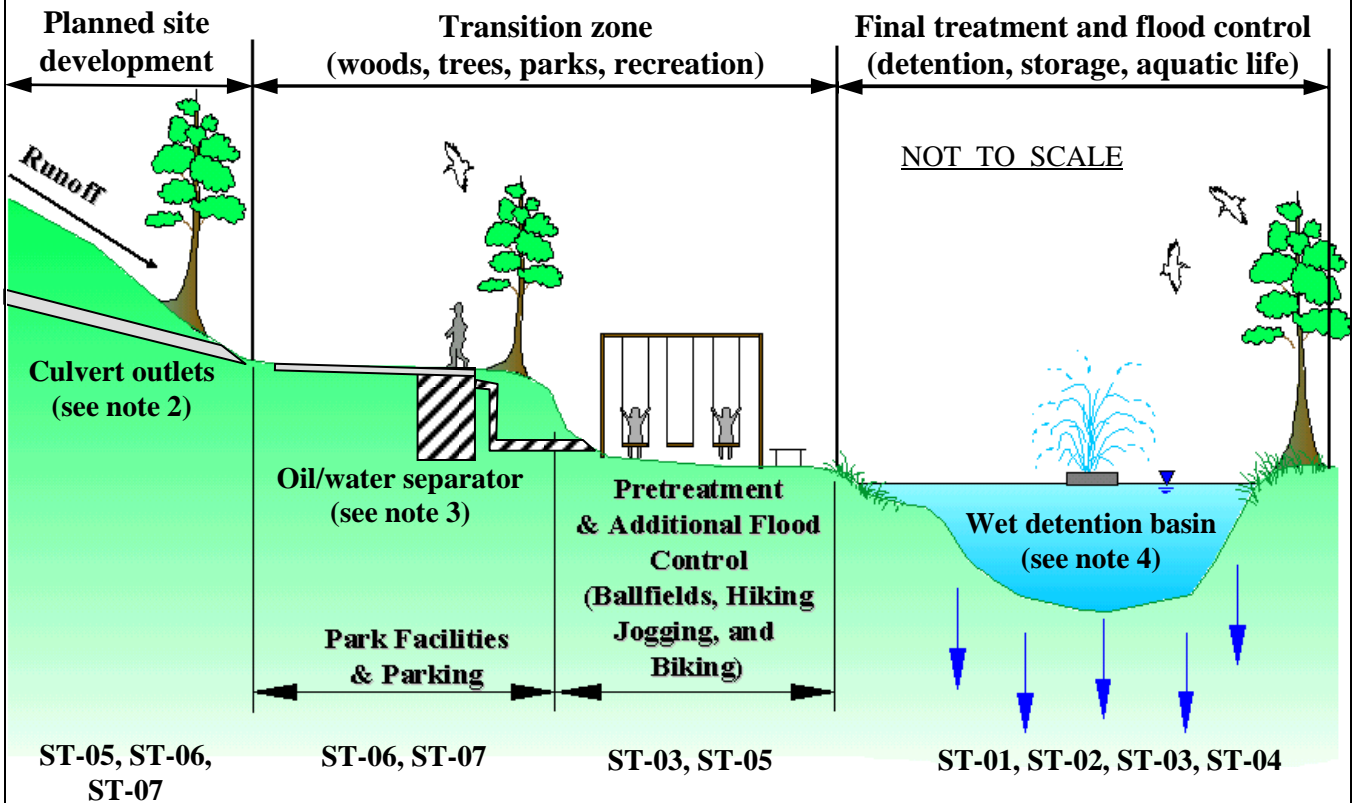


Figure ST-09-1

Multiple Systems for Stormwater Treatment BMPs