5.8.8 Trash Racks

An underflow type trash guard is preferred over conical type trash guards. Experience has shown underflow type trash guards to be highly effective in preventing clogging and superior in preventing litter and debris from being transported downstream.

SECTION 6: BMP Facility Planting and Soil

6.4 Landscape Plans

The design of the following structural BMP's must include a landscape plan prepared in accordance with Section 6.4.1 and plantings placed in accordance with Section 6.4.2 of the State BMP Manual:

- Stormwater Wetlands
- Wet Detention Basin
- Bioretention Cell

A one year (1 yr) warranty period is customary and acceptable. A note on the plan must be added making reference to the one year warranty.

6.4.2 - Trees or shrubs shall not be planted on portions of water impounding embankments.

6.5.1 Soils Analysis

A soils analysis / report as outlined in Section 6.5.1 of the State BMP Manual will be prepared and submitted to the City of Greensboro Stormwater Division for the structural BMP's listed above. For wet detention basins and Stormwater wetlands the soils analysis must include an analysis of the viability of the soils to retain a permanent pool.

6.5.3 Soil Specifications

Soils used within any BMP proposed within the City of Greensboro must adhere to the specifications listed in Section 6.5.3 of the State BMP Manual.

SECTION 7: BMP INSPECTION AND MAINTENANCE

7.2. Legal and Financial Issues

7.2.2 Inspection and Maintenance Agreements

The City's water-supply watershed (Ch. 30) ordinance and the 1999 stormwater management (Ch. 27) ordinance require that BMPs which are constructed to meet these requirements must be maintained by the property owner or owners' association. The BMPs must be maintained to continue to function to meet the regulations it was designed for. The City has the authority to inspect these BMPs periodically and require the BMP owner to perform maintenance activities, when necessary.

7.3.10 Dam Safety

Preserving the structural integrity of the dam of a pond BMP is important in protecting downstream life and property. There are at least four aspects of the dam that require specific attention: (1) *assessment of hazard potential* due to changes in downstream development; (2) *seepage*; (3) *dam material problems*; and (4) *vegetation growth* on the dam embankments

(1) Assessment of Hazard Potential

Before any dam is constructed, the design engineer is responsible for notifying the NC State Dam Safety Office of the proposed dam. If the dam falls under State Dam Safety jurisdiction, the dam must be constructed, maintained and operated according to their design and construction guidelines. Even if the dam does not fall under the NC Dam Safety Office's jurisdiction, the dam should be designed and constructed in accordance with current good engineering practice. The City has requirements concerning the maintenance of dams associated with required BMPs.

As new development occurs downstream of the BMP, the chance of significant property damage or danger to human life may increase if catastrophic failure of the dam occurs. Although the dam may be initially exempt from regulation by the State, the owner is responsible for reporting to the State Dam Safety Office downstream development that may affect the hazard classification of the dam.

(2) Seepage

The downstream side of the dam should be inspected regularly for evidence of significant seepage. Seepage can emerge anywhere below the normal pool elevation, including the downstream slope of earth dams, areas beyond the toe of the dam, and around the spillway or pond outlet conduit. Indications of significant seepage include areas where the soil is saturated or where there is a flowing "spring" or leak. If "sinkholes" in the dam embankment are noticed, or if constant flowing water is noticed on the downstream side of the dam, then seepage has become excessive and professional engineering advice should be sought immediately to avert a major structural problem or a catastrophic failure of the dam.

(3) Dam Material Problems

For earth dams, pronounced cracks on the embankment surface indicate the first stages of potential dam failure. Transverse cracks (running perpendicular to the embankment face) generally indicating differential settlement of the dam, can provide pathways for excessive seepage. Longitudinal cracks (running parallel to the embankment face) may be due to inadequate compaction of the dam during construction or shrinkage of the clay (desiccation) in the top of the embankment during prolonged dry conditions. These cracks may eventually lead to slope failure such as sliding or sloughing.

For reinforced concrete dams, the concrete should be checked for pronounced cracking, leakage from the joints, and displacement (noticeable leaning or bulging). Also, excessive seepage, leakage, or springs just downstream of the concrete dam could be indicative of potential seepage-related "piping" problems under the dam.

If such problems or other structural problems are observed, professional engineering advice should be sought.

(4) Vegetative Growth on Dam Embankment

Trees and other woody vegetation are not permitted on the top slopes of dam embankments. Large root systems from woody vegetation can weaken the dam structure and provide seepage pathways. Thick vegetative cover can also provide a haven for burrowing animals such as muskrats and/or groundhogs. These animals can create a network of burrows in the dam embankments that can significantly weaken the dam, by creating seepage paths, which may eventually lead to dam failure. Mowing of the dam embankments should occur, at a minimum, once every 6 months to prevent woody vegetation growth and cover for burrowing animals.

The exception to this rule is for existing woody vegetation that already exceeds six inches (6") in diameter and is located on the upstream or downstream face of the dam. Removing this large woody vegetation may cause the already established root system to decay, thus allowing seepage to occur where the root system once existed. In this case, the least potentially hazardous situation is to just leave the root system in place and intact.

7.3.11 Reduction of Pollutants Entering BMPs

Stormwater BMPs are not 100% efficient in removing pollutants; therefore, when the amount of pollutants into the BMP is higher, the amount of pollutants discharged from the BMP will be higher. Also, increased amounts of pollutants entering the BMP will increase the maintenance required to keep the BMP functioning properly.

To assist the stormwater BMP in removing pollutants, every effort should be made to reduce the initial pollutant load entering the BMP. Pollution prevention activities described elsewhere in this manual should be implemented along with the following efforts:

- ⇨ Outside trash dumpsters should be kept covered, and the area around the dumpster should be kept neat and clean.
- ⇨ Chemicals, petroleum products and other pollution sources (such as machinery) should be stored in a covered area away from possible stormwater contact. Spent chemicals are to be properly disposed or recycled.
- ⇨ Fertilizers and pesticides should be used conservatively on the property grounds. Excessive amounts of these chemicals can be washed away with stormwater runoff increasing the nutrient load to the pond.
- ⇨ Chemicals such as copper sulfate used to inhibit algae growth in the water quality pond degrade water quality. Since the pond's main function is to enhance water quality, these chemicals should not be used. Rather, reducing the amount of fertilizer application and ensuring that the pond outlets are properly functioning so the pool is flushed periodically will help to deter algae growth.
- ⇨ Trash and vegetative floatables (grass clippings, leaves, limbs, etc.) should be cleaned from the pond surface and surroundings periodically to promote a healthy, aesthetically pleasing environment, and to prevent blockage of the pond outlets. Studies have shown that people are less likely to litter ponds that are aesthetically pleasing and support wildlife.

7.3.12 Stabilization of BMP drainage area

The area draining to the BMP pond should remain stabilized to prevent excessive sediment from entering the BMP facility. When the bare soil is directly exposed to precipitation the sediment concentration in runoff is much higher than for soil that is stabilized. A stabilized area is covered by impervious surfaces (pavement, buildings), grass cover, landscaped cover (mulch, pine straw), etc.

For filtration practices such as sand filtration facilities and bioretention, maintaining a stabilized drainage area is especially important. Eroded sediment can quickly "seal" the filtration bed, drastically decreasing its filtration capacity.

Erosion Concerns

The inlet and outlet areas, side slopes (swales), and the rest of the conveyance area should be inspected for erosion problems.

Where water discharges from a pipe and where the stormwater runs off impervious area onto pervious area, there may be erosion problems. The BMP should have riprap protection at the end of pipes and a gravel trench at the edge of impervious areas to help prevent erosion. These devices should be inspected to ensure they are functioning properly. If erosion is noticed in within the rip rap pad or along the edges of the pad, more rock may be needed or it may have been improperly placed (no geotextile liner or improper placement of liner, rip rap not well graded, etc.) If the rock or gravel is displaced downstream, larger size rock or gravel should be used.

Rill erosion (small channels or gulleys in the ground) is a common problem found in these control devices where the water runoff is naturally trying to channelize. Rill erosion can be repaired by filling in the rills with suitable (clayey) soils and reseeding. It may be necessary to use a temporary erosion resistant matting or to use sod to repair these areas.

7.3.13 Blockage of Outlets

Wet extended detention ponds are designed for the water to exit the pond through the low flow orifice(s), the principal spillway, and the emergency spillway. It is important to check all three outlets for blockage that would impair the pond's water quality and hydraulic functionality.

Low Flow Orifice(s)

Unless an inverted orifice is used, some type of trash guard is to be maintained over the low flow orifice(s) to prevent clogging. When the orifice becomes clogged the water level rises to the principal spillway elevation and the benefits associated with temporary storage and its gradual release are lost. To preserve "extended detention" the low flow orifice should be inspected for blockage **twice a month and after large storms.**

7.3.14 Principal and Emergency Spillway

Principal and emergency spillways are designed to safely convey larger than one inch storms that produce runoff which exceed the water quality volume of the BMP. If these spillways are blocked so they do not operate at full capacity, the risk of dam overtopping or other uncontrolled

releases may result. To ensure the hydraulic capacity of the spillways, the spillways should be inspected for blockage **twice a month and after large storms.**

If a riser/barrel is used for the principal spillway, a trash rack is to be maintained on the riser. Vegetative growth in the riser should be removed promptly so that the design capacity of the spillway is maintained. Also, the outlet area where the barrel projects from the fill should be clear of tree limbs, sediment accumulation, etc.

SECTION 8: LEVEL SPREADER

The second paragraph in Section 8.3.3 in the State Manual states:

"One of the most important design criteria for the level spreader lip is that it must be constructed parallel to contour lines. Often, this will result in a level spreader that is curved, which is perfectly acceptable."
However if the curvature of the contours is significant and is likely to result in convergent and concentrated flow downstream of the lip (e.g. in swales of draws), construct the lip as a straight one or with a gentler curvature.

8.3.5 Level Spreaders in Series

8.3.5.1 Stream Buffer Widths

Refer to Section 2.9.3.2 for required stream buffer widths according to watersupply watershed requirements.

8.3.6 Options Where Level Spreaders are Not Appropriate

The Randleman Watersupply Watershed does not allow the outfall to be routed directly though the riparian buffer.

8.3.12 Stabilization of BMP drainage area

The area draining to the level spreader should remain stabilized to prevent excessive sediment from entering the level spreader. When the bare soil is directly exposed to precipitation the sediment concentration in runoff is much higher than for soil that is stabilized. A stabilized area is covered by impervious surfaces (pavement, buildings), grass cover, landscaped cover (mulch, pine straw), etc.

Erosion Concerns

Level spreaders must be inspected to make sure that they are functioning as designed. Standing water could cause issues to the lining material of the level spreader and therefore proper drainage is required.

The inlet and outlet areas, side slopes (swales), and the rest of the conveyance area should be inspected for erosion problems.