calculations shall be based on impacts outside the existing roadway right-of-way. Determine the riparian setback limits according to the Permit and identify the setback limits on the Project Site Plan.

Mitigation for groundwater and riparian setback will be determined through coordination between Central Office – Office of Production and Ohio EPA prior to submittal of the NOI application.

Determine soil types required for groundwater recharge calculations using soil survey maps or the NRCS Web Soil Survey website.

While sediment basin locations are typically provided by the Contractor, designers of projects being developed under watershed specific NPDES permits shall identify locations with capacity to store sediment volumes required by the permit. The location and calculations for the sediment basins shall be shown on the Project Site Plan. Additional temporary sediment and erosion control features will be added to the SWPPP by the Contractor.

1113 Erosion Control at Bridge Ends

1113.1 General

For the purpose of reducing problems of erosion in the vicinity of bridge ends, details as shown on Standard Construction Drawing DM-4.1 shall be followed. At locations where the design flow exceeds 0.75 cubic feet per second, catch basins should generally be provided.

1113.2 Corner Cone

Item 670 Slope Erosion Protection shall be placed on all bridge approach embankment corner cones, beginning at the edge of the crushed aggregate or concrete slope protection.

1114 Temporary Sediment and Erosion Control

1114.1 General

Temporary sediment and erosion control is required on all projects that have Earth Disturbing Activities as outlined in Supplemental Specification 832. A Storm Water Pollution Prevention Plan (SWPPP) is required for all projects that require a NOI (See section 1112)

The SWPPP requirements are outlined in Supplemental Specification 832.

1114.2 Cost Estimate for Temporary Sediment and Erosion Control

For all projects that require temporary sediment and erosion control furnish an amount to be encumbered in the project final package. Use the temporary sediment and erosion control estimator located in the Design Reference Resource Center to develop this amount. Furnish the calculations with the final plan package.

1115 Post Construction Storm Water Structural Best Management Practices

1115.1 General

Post Construction Storm Water Best Management Practices (BMP) are provided for perpetual management of storm water runoff quality and quantity so that a receiving stream's physical, chemical and biological characteristics are protected and stream functions are maintained.

BMP, as described in Section 1117, shall meet or be equivalent in treatment effectiveness when compared with the BMP presented in Ohio EPA's NPDES General Permits. For ODOT projects, any proposed alternative BMPs that are not found in Section 1117 require submittal to ODOT Central Office – Office of Production. A review and approval of the alternative BMP by ODOT Central Office – Office of Production and Ohio EPA is required. Local-Let Local Public Agency projects may use an alternative post-construction BMP policy with Ohio EPA approval.

Post-construction BMP remove pollutants from runoff (water quality treatment) and protect streams by attempting to maintain existing stream conditions or by reducing runoff volumes through structural BMP (water quantity treatment).

Locate BMPs so that they are protected in accordance with Location and Design Manual, Volume 1.

1115.2 Project Thresholds for Post-Construction BMP

Post-construction BMP are required through Ohio EPA's NPDES General Permit for construction storm water discharges. The requirements to

provide post-construction BMP established in the NPDES General Permit are based on Project Earth Disturbing Activities. If a NOI is not required (Section 1112), then post construction BMPs are not needed.

Project Earth Disturbing Activity (EDA) is defined as any activity that exposes bare ground or an erodible material to storm water and anywhere Item 659 Seeding, SS 870 Seeding, Item 660 Sodding, or SS 870 Sodding is being furnished. An area where pavement is being removed to the sub-grade is considered earth disturbing activity, except for isolated repairs.

Requirements based on project EDA for non-routine maintenance projects are listed below:

Table 1115-1

Project Earth Disturbed Area Thresholds
• **EDA < 1 acre - BMP and NOI not required.**
• **1 acre = EDA < 5 acres - BMP required unless coordinated through Central Office – Office of Production for evaluation by Ohio EPA.**
• **EDA ≥ 5 - BMP are required**
• **Routine Maintenance projects as defined in Section 1112.2 do not require post-construction BMP.**

Provide post-construction BMP for all projects exceeding the project EDA thresholds. For projects requiring post-construction BMP, refer to Section 1115.6 to determine the level of treatment necessary.

ODOT-let and Local-Let Local Public Agency (LPA) projects are required to provide post-construction BMP as indicated in Table 1115-1. Projects with post-construction BMP may require coordination with LPAs when BMPs are required outside ODOT right-of-way. Inform the LPA of maintenance responsibilities associated with post-construction BMP.

Non-contiguous portions of projects sold under one contract that do not require an NOI, as described in Section 1112.1, do not require post-construction BMP.

1115.3 Water Quality and Water Quantity Treatment

Address water quality (pollutant removal) and water quantity (stream protection/volume control) for projects that require post-construction BMP.

BMP to address water **quantity** are not required for projects that meet any of the following criteria:

- Sites where one or less acre of new impervious area is created in new permanent right-of-way area being acquired for the project.
- Site is a redevelopment project within an ultra-urban setting. Redevelopment projects include construction projects on land where impervious surfaces had previously been developed and where the new land use will not increase the runoff coefficient. See Section 1115.6.
- Sites which discharge directly to a large river (>100 square mile drainage area or fourth order or greater) or to a lake and where the development area is less than 5 percent of the watershed area upstream of the development site, unless known water quality problems exist in the receiving waters. If there is a question regarding the stream classification, contact Central Office - Office of Production.

BMP that treat water quality **and** water quantity include:

- Exfiltration Trench
- Extended Detention
- Retention Basin
- Bioretention Cell
- Infiltration Trench
- Infiltration Basin
- Constructed Wetlands

BMP that treat **only** water **quality** include:

- Manufactured Systems
- Vegetated Biofilter

Water quantity (stream protection) treatment can also be provided through the use of paved depressed approach aprons, depressed inverts, and other grade control structures at stream crossings. See Section 1105 for further information.

1115.4 Water Quality Volume

The water quality volume (WQ_v) is used to define the amount of storm water runoff from any given storm that should be captured and treated in order to remove a majority of storm water pollutants on an average annual basis.

The following equation shall be used to calculate the water quality volume:

$$WQ_v = (P*A*Cq)/12$$

Where,

WQ_v = Water Quality Volume (Acre-feet)

P = Precipitation (0.75 inches)

A = Contributing Drainage Area (acres)

$Cq = 0.858i^3 - 0.78i^2 + 0.774i + 0.04$
(see figure 1115-1)

i = impervious area divided by the total area (use 0.9 within existing roadway right-of-way for calculation purposes)

Cq = 0.9 when all drainage area is impervious.

Water quality volume is directly used to determine sizing for the following BMP:

- Extended Detention
- Retention Basin
- Bioretention Cell
- Infiltration Trench
- Infiltration Basin
- Constructed Wetlands

1115.5 Water Quality Flow

The water quality flow (WQ_f) is the discharge that is produced by using an intensity of 0.65 in/hr in the rational equation (section 1101.2.2). Use the entire contributing drainage for the WQ_f calculation.

Use water quality flow to determine sizing for manufactured systems.

1115.6 Redevelopment and New Construction

With respect to post-construction storm water BMP, redevelopment projects include projects with limited addition of impervious surface. Redevelopment projects will not result in an increase to the runoff coefficient.

While all areas within existing ODOT right-of-way may not be covered by impervious surfaces, the area within existing ODOT right-of-way is considered impervious area for the purpose of post-construction BMP calculations. Therefore, consider all area within existing right-of-way to be impervious with a runoff coefficient of 0.90 when performing post-construction BMP calculations.

ODOT projects that do not require acquisition of new right-of-way are considered redevelopment projects.

1115.6.1 Treatment Requirements for Redevelopment Projects

Redevelopment projects utilizing BMPs designed based on WQ_v or WQ_f require treatment according to one of the following:

- Treat 20% of the WQ_v or WQ_f for 100% of the project
- Treat 100% of the WQ_v or WQ_f for 20% of the project earth disturbed area

Redevelopment projects utilizing Vegetated Biofilters require treatment as follows:

- Treat 100% of the contributing drainage area for 20% of the project earth disturbed area in a specified portion of the project. For example, a project with 10 acres of project EDA may provide treatment through the use of a vegetated biofilter with 2 acres of contributing drainage area. The vegetated biofilter design would be based on the contributing drainage area to the ditch of 2 acres.

Redevelopment projects utilizing Exfiltration Trenches require treatment according to one of the following:

- Multiply the required length of ExT by 20% for 100% of the project
- Use standard ExT length for 20% of the project earth disturbed area

For all scenarios, size the BMP based on the entire contributing drainage area, offsite and on-site, to the BMP.

When providing treatment based on a percentage of the project earth disturbed area, consider the following:

- Credit for water quality and water quantity treatment is only applied to the portion of the contributing drainage area within ODOT right-of-way (on-site). Any offsite contributing drainage area must be included in the BMP calculations for sizing purposes (i.e. width of ditch, length of ExT, etc.). However, the offsite area will not be included in the reduction of the required amount of project EDA that requires treatment.

  Example: A vegetated biofilter that has offsite contributing drainage area of one acre and on-site contributing drainage area of two acres would result in a reduction of the required treatment area by two acres. The vegetated biofilter must be sized for the total contributing drainage area of three acres. Multiple areas of a project may provide treatment to meet the total area required for compliance with the NPDES Permit. If the total area requiring treatment in this example was 4 acres, another vegetated biofilter with a minimum of two acres of on-site tributary area would be needed.

- For projects with multiple distinct stream crossings that do not immediately share a common confluence downstream, provide post-construction BMP treatment proportional to the amount of Project EDA tributary to each stream.

1115.6.2 Treatment Requirements for New Construction Projects

All projects that do not meet the definition of redevelopment are considered new construction. New construction projects allow for a reduction of treatment based on existing impervious area. New impervious area requires treatment of 100% of the area. Existing impervious area, including all existing right-of-way area, requires treatment of 20% of the area. Consider all area within existing ODOT right-of-way to be impervious for post-construction BMP calculations.

Determine the Treatment Percent (weighted average of impervious areas for a drainage area) using the following equation:

$$T = [(Aix * 0.20)+(Ain * 1.00)] / (Aix+Ain)$$

Where,

T = Treatment percent (decimal)

Aix = Existing impervious area (acres)

Ain = New impervious area (acres)

The Treatment Percent determined above shall be used to determine treatment in the same manner as described for redevelopment projects (i.e. Treat the Treatment Percent of WQ_v for 100% of Project EDA, etc.).

1116 BMP Selection and Submittals

1116.1 BMP Selection

Selection of BMP shall be based on providing maximum runoff treatment while minimizing impacts to the remaining project design features, including utilities and right-of-way.

For curbed roadways, total contributing drainage areas to sumps or intersections that are less than or equal to 0.25 acres as shown in figure 1116-1 do not require a BMP. Note that these exceptions are unique circumstances. Provide BMP as necessary for all other project features.

Projects where roadway drainage sheet flows off the roadway and continues outside existing or proposed right-of-way shall not channelize flow for the sole purpose of providing a post-construction BMP. Treatment is not required for areas where sheet flow off the roadway continues to sheet flow outside ODOT right-of-way. Areas where this occurs should be documented in the post-construction BMP calculations and identified on the Project Site Plan.

Design criteria for all BMP are available in Section 1117. A flow chart to determine BMP treatment requirements is provided in Figure 1115-2.

1116.2 BMP Submittals

BMPs shall be considered early in the design process to allow for right-of-way and utility coordination as well as a waterway permit determination. For Major Projects, as classified through the PDP, requiring BMP, include a conceptual BMP layout as part of the Assessment of Feasible Alternatives submittal to ODOT Central Office – Office of Production during Step 6. Refine the conceptual BMP layout during Step 7. Submittal during Step 7 is optional.

Develop the final BMP design no later than Step 8. For all major projects, submit documentation concerning BMP design during Step 8 to ODOT Central Office – Office of Production. Include the following information:

- Estimated Project Earth Disturbed Area
- Determination of pre-construction and post-construction runoff coefficient
- Existing and Proposed amounts of impervious area
- BMP selected for use
- Plan sheets showing locations of post-construction BMP
- Calculations for each BMP (Sec. 1117)
- Explanation for any area that is not treated (i.e. environmental commitment, total parcel take, environmental resource impact, etc.)

For Minor Projects, as classified through the PDP, requiring BMP, include a conceptual BMP layout as part of the Preliminary Engineering submittal (Step 3). Submittal of the conceptual BMP layout for Minor projects to Central Office – Office of Production is optional.

Develop the final BMP design no later than Step 4 for Minor projects. For all Minor project final BMP designs, submit documentation during Step 4 that consists of the same information requested for Major projects at Step 8 to ODOT Central Office – Office of Production.

As early as possible in the design process, coordinate projects that do not provide BMP that treat the required percentage or area of the project (see Section 1115.6.1 and 1115.6.2) through ODOT Central Office – Office of Production for review and further coordination with Ohio EPA.

Identify the final locations of post-construction BMP in the Project Site Plan as described in Section 1308 of Location and Design Manual, Volume 3. If applicable, provide cross-references to sheets showing post-construction BMP details on the Project Site Plan.

1117 BMP Toolbox

1117.1 Exfiltration Trench

An exfiltration trench (ExT) captures roadway drainage at the outside edge of shoulder through the use of a permeable concrete surface. The permeable concrete surface is placed parallel to the roadway within a concrete structure. The ExT is placed a minimum of 15 feet prior to any drainage inlet, pavement catch basin (see figure 1117-1), or curb cut. Storm water is filtered through the ExT until it reaches a 4-inch perforated conduit connected to a 4-inch non-perforated outlet conduit. The 4-inch outlet conduit may discharge into a drainage structure or onto the slope using a reinforced concrete outlet.

The ExT length is determined by the following equation:

$$L_t = (A*Cq)/689$$

Where,

L_t = Required Permeable Length of Trench (feet)
Use a minimum length of 4 feet
Length is in increments of 4 feet

A = Total Contributing Area (square feet) as determined according to Section 1103.3.

$Cq = 0.858i^3-0.78i^2+0.774i+0.04$
(see figure 1115-1)

i = impervious area divided by the total area

The length, L_t, may be reduced according to Sections 1115.6.1 and 1115.6.2.

Runoff bypassing the exfiltration trench is collected in the downstream catch basin or inlet. Therefore, once an area is treated, it may be removed from the next downstream ExT length calculation.

See SCD WQ-1.2 for ExT payment information.

- Use Type A for curb and gutter, Type 2.
- Use Type B for barrier and non-6-inch curb.
- Use Type C for 6 inch curb without gutter.

The following limitations apply to exfiltration trenches:

- Do not use the ExT in short tapers (less than 25 feet), parking areas, on a radius, or within a driveway.
- Do not use the ExT on the high side of a superelevated roadway.
- Do not use the ExT with shoulder widths less than 2 feet.

See Figure 1117-1 for further ExT implementation details.

1117.2 Manufactured Systems

Manufactured systems consist of underground structures that treat the water quality flow (WQ_f) by removing particulate matter through settlement. Supplemental Specifications 895 and 995 cover the material and performance criteria for these devices. They are placed in an off-line configuration with manholes to allow for routine maintenance procedures (see figure 1117-2).

Provide a No. 3 Manhole, With ___" Base ID and ___" Weir where flow is to be diverted to the off-line manufactured system. Furnish two lengths of 603, Type B Conduit placed perpendicular to the inflowing sewer (see reserved area table for the total length required). Use Table 1117-1 when placing a Manufactured System:

Table 1117-1

Manufactured Systems			
Type	WQ_f (cfs)	No. 3 Manhole Base ID (inches)	603 – Type B Conduit Diameter (inches)
1	1	84	12
2	2	90	15
3	3	96	18
4	6	108	24

Reserve an area (as measured from the centerline of the No. 3 Manhole) according to Table 1117-2:

Table 1117-2

Reserved Area for Manufactured System				
Type	Width (feet)	Length (feet)	603 – Type B Total Conduit Length (feet)	Weir Height (inches)
1	15	30	20	6
2	20	32	30	8
3	25	33	40	9
4	25	37	40	12

Center the length of the area at the No. 3 Manhole. If this area is not attainable, contact Central Office – Office of Production for further guidance. Ensure this area is void of all utilities and is accessible for routine cleanout and maintenance. When a manufactured system is connected to a storm sewer with a depth exceeding 10 feet, contact Central Office – Office of Production.

Manufactured systems are typically not suited for treatment of flows in large trunk sewers. As shown in the figure above, manufactured systems should not be provided on sewers that are carrying a water quality flow greater than 6 cfs. The water quality flow calculation to determine the flow in the storm sewer shall be based on the entire contributing drainage area.

1117.3 Vegetated Biofilter

A Vegetated Biofilter (VBF) is a BMP that filters storm water through vegetation. The vegetated biofilter consists of the vegetated portion of the graded shoulder, vegetated slope, and vegetated ditch.

When widening existing ditches, consider the following before purchasing new right-of-way:

- Provide a steeper ditch foreslope.
- Provide a steeper ditch backslope.
- Reducing the bench width to a minimum of 4 feet.

Consider soil conditions and safety issues prior to making any of the above changes to the existing slopes or benches.

Changes to existing ditches may be regulated through waterway permits since ditches may be considered streams or wetlands. All impacts to existing streams and wetlands should be avoided or minimized to the maximum extent practicable. To determine if the proposed ditch will impact an existing stream or wetland, contact the District Environmental Coordinator.

1117.3.1 Vegetated Ditch Design Process

For projects utilizing ditch conveyance, provide a bottom ditch width using the Enhanced Bankfull Width (EBW) or "Standard" ditch width to provide water quality treatment. Use the following steps to determine the ditch width:

A. Determine Enhanced Bankfull Width:

$$EBW = 5.4A^{0.356}$$

EBW = Enhanced Bankfull Width (feet)

A = Total contributing drainage area to the ditch (acres)

The enhanced bankfull width corresponds to the dimension of the bottom width of the ditch.

B. Determine "Standard" Ditch Width:

Determine the type and size of ditch that would typically be specified for the project without accounting for water quality treatment (use typical roadway design practices).

1. If using a Radius Ditch, refer to the "b" dimension in Figure 307-2E of Location and Design Manual, Volume 1 to determine the bottom width of the ditch.
2. If using a trapezoidal ditch, use the bottom width dimension. Ignore any rounding lengths associated with the trapezoidal ditch.

C. Determine the vegetated biofilter ditch width required for water quality treatment as described below:

1. If the EBW is less than or equal to the "Standard" ditch width, furnish the "Standard" ditch.

2. If the EBW is greater than the "Standard" width, furnish the EBW to a maximum bottom width of ten (10) feet.

The EBW can be calculated at multiple locations along its length. This would allow the width to be reduced where there is less tributary area (i.e. the upstream area of the ditch). However, the entire contributing drainage area to the location in the ditch being evaluated shall be considered whenever the EBW is determined.

At points where concentrated offsite runoff is accepted, the EBW should be recalculated.

Begin ditch width calculations at the outfall and move upstream through the drainage area.

Ensure that rock or other impervious soil layers will not prevent vegetation from being established at the invert of the flowline.

Constriction points in the enhanced bankfull width at drive pipes or other drainage related features are acceptable. A transition back to the calculated width shall be made immediately following the constriction point.

1117.4 Extended Detention

Extended detention is a method that captures storm water during rain events and slowly releases the captured volume over a period of time. The WQv is used to determine the storage volume of the detention basin. The WQv is discharged over a 48 hour time frame. Increase the WQv by 20% when sizing the BMP to allow for sedimentation to occur. Detention can be either above or below ground. Detention basins that are above ground are the preferred choice and should be used when feasible. However, when project site parameters dictate, an underground system may be the optimum choice.

1117.4.1 Detention Basin

A detention basin is a dry pond that detains storm water for quality and quantity. The following criteria apply when designing a detention basin:

A. Allow for 1 foot of freeboard above the storage volume.

B. Furnish a micro pool when feasible (see figure 1117-5)

C. Use side slopes of 4:1 (max).

D. Ensure the design check discharge will safely pass through the structure (section 1117.4.3).

E. Vegetate the sides of the basin with Item 670 Slope Erosion Protection.

F. Embankment work to create the impoundment will be constructed and paid for as Item 203 Embankment, Using Natural Soils, 703.16.A.

G. Consider vehicle access to the basin for periodic maintenance.

H. Do not locate on uncompacted fill or steep slopes (2:1 or more) or where infiltrating ground water could adversely impact slope stability.

I. Furnish an anti-seep collar around the outlet pipe.

J. Furnish gravel pack protection at the outlet structure (see SCD WQ1.1).

K. Place channel protection (RCP or Concrete Mat) at the entrance of the basin to minimize erosion and sediment resuspension.

L. Furnish a forebay that is approximately 10% of the total design volume.

M. Furnish a Water Quality Basin, Detention per section 1117.4.1.1

1117.4.1.1 Water Quality Basin and Weir

Furnish an outlet structure that fully drains the WQ_v in 48 hours or more. No more than 50% of the WQ_v should be released from the detention basin in less than one-third the drain time.

The outlet structure consists of a catch basin with a perforated riser pipe on the inlet side and a conduit on the outlet side. The perforated riser pipe is used for flow control to achieve the required discharge time. A gravel envelope surrounds the perforated riser pipe along the inlet side of the catch basin to prevent blockage of the orifice holes in the pipe. The catch basin and riser pipe are paid for as Item 604, Water Quality Basin, Detention. Details of a perforated riser pipe outlet structure can be found on standard drawing WQ1.1.

Furnish a weir to allow the design check discharge to bypass the structure without damage to the detention basin or embankment of the basin. The design check discharge shall be determined per 1117.4.3.

The equation for a single orifice is:

$$Q = A \cdot C \cdot \sqrt{64.4H}$$

Where,

A = Area of orifice (ft^2)

H = Head on orifice as measured to the centerline of the orifice (ft)

C = Orifice coefficient

Table 1117-3

Orifice Coefficient Guidance	
C	**Description**
0.66	Use for thin materials where the thickness is equal to or less than the orifice diameter.
0.80	Use when the material is thicker than the orifice diameter.
From CALTRANS, Storm Water Quality Handbooks, Project Planning and Design Guide, September 2002.	

A hydrograph curve for the outlet will be required to calculate the discharge time of the WQv and the design check discharge (see 1117.4.3). The discharge time should correspond to the minimum drain time of 48 hours with no more than 50% of the WQ_v being released from the detention basin in less than one-third the drain time.

Generally, it is easier to model the outlet structure and discharge time using software such as Pond Pak or HydroCad to develop the hydrograph.

1117.4.1.2 Anti-Seep Collar Design

Anti-seep collars shall be installed on conduits through earth fills where water is being detained. The following criteria apply to anti-seep collars:

A. Furnish a minimum of 2 collars per outlet conduit. Increase the seepage length along the conduit by a minimum of 15%. This percentage is based on the length of the pipe in the saturation zone.

B. Anti-seep collars should be placed equally within the saturation zone. Place one collar at the end of the saturation zone. In cases where the spacing limit will not allow this, place at least one collar within the saturation zone.

C. Maximum collar spacing should be 14 times the minimum projection above the pipe, but not more than 25 feet. The minimum collar spacing should be 5 times the minimum projection, but not less than 10 feet.

D. Extend the collar dimensions a minimum of 2 feet in all directions around the outside of the conduit, measured perpendicular to the conduit. Center the anti-seep collars around the conduit.

E. The top of collar shall not be less than 6 inches below, measured normal to, the finished groundline.

F. All anti-seep collars and their connections shall be watertight.

G. Minimum thickness shall be 6 inches.

H. Payment for the collar shall be Item 602 Concrete Masonry (see standard construction drawing WQ-1.2).

The design procedure for anti-seep collars is as follows:

1. Determine the length of the conduit within the saturated zone. The assumed normal saturation zone can be determined by projecting a line through the embankment, with a 4:1 (H:V) slope, from the point where the normal water elevation (10-year) meets the upstream slope to a point where it intersects the invert of the conduit. This line, referred to

as the "phreatic line", represents the upper surface of the zone of saturation within the embankment (See Figure 1117-11). The 10-year storm pool elevation is the phreatic line starting elevation.

$$L_s = Y(Z+4)[1+S/(0.25-S)]$$

Where,

L_s = Length of the conduit in the saturated zone (feet)

Y = Depth of the water at the spillway crest, 10-year frequency stormwater surface elevation (feet)

Z = Slope of the upstream face of the embankment (Z feet horizontal to 1 foot vertical)

S = Slope of the conduit (feet per foot)

2. Determine the required seepage length increase.

$$\Delta L_s = 0.15L_s$$

3. Choose a collar height and width that is at least 4 feet larger than the outside diameter of the conduit (minimum projection of 2 feet from all sides of the conduit). Give collar sizes in one foot increments.

$$P = W - D$$

Where,

P = Projection of collar (feet)

W = Height or width of collar (feet)

D = Inside diameter of conduit

4. Determine the total number of collars required. The collar size can be increased to reduce the number of collars. Alternatively, the collar size can be decreased by providing more collars. In any case, increase the seepage length by a minimum of 15%.

No. of collars required = $\Delta L_s/P$

1117.4.2 Underground Detention

Underground detention areas are made up of a series of conduits. They range from an oversized storm sewer to a series of conduits that are specifically used for storm water detention. The following criteria apply when designing underground detention:

A. Ensure the Hydraulic Grade Line design of the storm sewer will pass through the structure and meet the requirements of 1104.4.2.

B. Consider access to the conduits for periodic maintenance.

C. If practical, provide pretreatment of the storm water with vegetation.

D. Payment for the conduit shall be: Item 603 ____" Conduit, Type____, for underground detention.

1117.4.3 Design Check Discharge

A design check discharge with the frequency of a 10-year event shall be used. Use the entire drainage area that contributes to the BMP to calculate the design check discharge.

1117.5 Retention Basin

A retention basin is a "wet" pond that has a minimum water surface elevation between storms that is defined as the permanent pool. Above the permanent pool is a detention pool that provides storage for 75% of the WQv and drains in 24 hours or more. The full storage water depth is typically between 3-6 feet and the volume is less than 15 Ac-ft. The permanent pool is sized to provide storage for 75% of the WQv. A retention basin is ideal for large tributaries, but it may require a large amount of space. Consider the following when designing a retention basin:

A. Use RCP at the inlet of the basin to provide energy dissipation and erosion control.

B. Allow for 1 foot freeboard above the WQv.

C. Use side slopes of 4:1 (max).

D. Ensure the design check discharge will safely pass through the structure (section 1117.4.3).

E. Use a length to width ratio of at least 3:1 to prevent short-circuiting.

F. Vegetate the sides of the basin with Item 670 Slope Erosion Protection.

G. Furnish a forebay (7-10% of the total retention volume) to extend the service life of the BMP when feasible.

H. Furnish an anti-seep collar around the outlet pipe (see section 1117.4.1.2).

I. Furnish a trash rack at the outlet structure.

J. The underlying soils should be compacted to prevent infiltration of the permanent pool or an impervious liner should be used.

K. Consider vehicle access to the basin for periodic maintenance.

L. Retention basin must be greater than 10,000 feet from a municipal airport runway.

M. Embankment work to create the impoundment will be constructed and paid for as Item 203 Embankment, Using Natural Soils, 703.16.A.

N. Furnish a Water Quality Basin, Retention per 1117.5.1.

1117.5.1 Water Quality Basin and Weir

A retention basin outlet structure is designed similar to the outlet structure for a detention basin. The difference is that 75% of the WQv should be discharged out of the basin in 24 hours or more. No more than 50% of the WQ_v should be released from the detention basin in less than one-third the drain time. The outlet structures are of a similar type, except the openings will be set at a high enough elevation to maintain 75% of the WQv in the permanent pool (see standard construction drawing WQ-1.1). The catch basin and riser pipe is paid for as Item 604, Water Quality Basin, Retention.

1117.6 Bioretention Cell

Bioretention Cells consist of depressed low-lying areas that treat storm water through evapotranspiration and filtering through a planting soil. As the storm water passes through the soil it is filtered. An underlying perforated storm sewer or underdrain captures the treated storm water and carries it to an outlet. Extensive vegetation assists in the filtration of the storm water prior to filtering through the soil. Vegetation should consist of shrubs or grasses that are native to the area.

The existing soil must be removed and replaced when constructing a bioretention cell. The bioretention planting soil (plan note WQ101) should consist of a mixture of sand, topsoil, and compost.

A bioretention cell is sized to store the WQv prior to filtration. Total filtration should occur in 40 hours or more. Use the following equation to determine the minimum surface area of the bioretention invert:

$$A = \frac{WQv \cdot D}{3600 \cdot K \cdot T \cdot (h + D)}$$

Where,

WQv = Water quality volume (see section 1115) (Acre-feet)

T = Drain time of the cell, 40 hours

K = permeability of the planting soil (Use 3.3 x 10^-5 ft/sec)

A = Top surface area of the trench (Ac)

D = Depth of the planting soil (ft) (4.0 feet minimum)

h = Maximum depth of water above the cells top layer for the WQv (use 1 foot).

The following criteria apply when designing a bioretention BMP:

A. Do not place where snow may be stored.

B. Furnish 10 feet or less width between 4 inch underdrain laterals.

C. Furnish bypass or overflow for the design check discharge. Use a catch basin(s) in conjunction with an overflow weir as needed.

D. Furnish pretreatment of the storm water via vegetation.

E. Ensure the water table or bedrock is below the invert of the bioretention area.

F. Use side slopes of 4:1 (max).

G. Furnish a length to width ratio of 2:1 (min).

H. Use a minimum depth of 4 feet of planting soil. Provide at least 4 inches of depth deeper than the largest root ball.

I. Furnish an organic or mulching layer at the top of the planting soil.

J. Furnish a maximum depth of 1 foot to the riser pipe or catch basin outlet from the mulching layer for storage of the WQv.

K. Furnish a bioretention cell as Item 203-Special - Bioretention Cell.

1117.7 Infiltration

Infiltration techniques treat storm water through the interaction of a filtering substrate that consists of soil, sand, or gravel. This technique discharges the treated storm water into the ground water rather than into surface waters. Typically, infiltration practices are only suitable when Hydrologic Soil Group (HSG) Type A soils or, in some cases, HSG Type B soils exist.

Infiltration methods require an extensive investigation of the existing soils and geology to ensure success. The investigation should begin with a preliminary soil evaluation of the project site early in the design process (PDP Step 7 for major projects and PDP Step 3 for minor projects). In-situ testing is not anticipated during the preliminary evaluation process.

Use available soil and geology data found in the Soil and Water Conservation maps, United States Geological Survey (USGS), adjacent projects, or estimations from a geotechnical engineer.

National Resources Conservation Service's Web Soil Survey website may also provide soil and geology information.

Material property tables for infiltration, permeability, and porosity have been provided for the preliminary evaluation (Tables 1117-4 & 1117-5).

If the preliminary evaluation yields favorable results a more detailed evaluation should be performed. The detailed evaluation will require a geotechnical investigation of the underlying soils and geology. Soil borings should be performed to a maximum depth of 20 feet (or refusal) with samples taken every 5 feet for laboratory testing.

The number and location of soil borings should correspond with the approximate size (as determined in the preliminary evaluation) of the infiltration BMP and should be recommended by the geotechnical engineer.

If the detailed evaluation yields favorable results, the ground water depth must be verified. The geotechnical engineer shall provide the seasonal high ground water depth. In some cases, observation wells may be installed and static water levels may be observed over a dry and wet season for verification.

The infiltration and permeability rate of the soil shall be tested in the detailed soil evaluation at the discretion of the geotechnical engineer. In some cases, insitu testing at the proposed location of the infiltration BMP may be required.

The following criteria apply to infiltration methods and must be met to be considered a feasible alternative:

A. Design using the WQv as per Section 1115.

B. Do not place infiltration BMP where snow may be stored.

C. The appropriate soil type must be present:

   1. Infiltration must be greater than 0.50 in/hr and no greater than 2.4 in/hr.

   2. Soils must have less than 30% clay or 40% of clay and silt combined.

D. The invert of the structure must be at least 4 feet above the seasonal high water table and any impervious layer.

E. Infiltration techniques are not suitable on fill soil, compacted soil, or steep slopes (greater than 4:1). Consideration should be given to the long term impacts upon hillside stability if applicable.

F. Pretreatment shall be provided to remove large debris, trash and suspended sediment to extend the service life. An example of pretreatment includes providing vegetated ditches prior to flow entering the infiltration facility.

1117.7.1 Infiltration Trench

An infiltration trench is an excavated trench that has been lined with a geotextile fabric and backfilled with aggregate. The storm water is

filtered through the aggregate and is stored within the pore volume of the backfill material. It is allowed to percolate through the sides and bottom of the trench. The drawdown time of the WQv is 24 hours or more. Consider the following when designing an Infiltration trench:

A. The minimum acceptable permeability of the surrounding soil is =6.5*10^-5 ft/sec or 2.8 in/hr (see Table 1117-4).

B. Design using the WQv as per Section 1115.

C. Long and deep infiltration trenches are most efficient (3 feet bottom width and 3-6 feet deep).

D. Furnish a 6 inch layer of Item 601 Infiltration Basin Aggregate on the top of the trench.

E. The geometric shape of the trench is a trapezoid with sides at a 1:1 (H:V) slope due to constructability. The top width is calculated as:

Top Width = Bottom Width + (2 * Depth)

F. Pretreatment using vegetation shall be provided to ensure longevity of the infiltration trench.

G. An observation well shall be provided to facilitate ground water level inspection.

H. Locate the infiltration trench at least 1,000 feet from any municipal water supply well and at least 100 feet from any private well, septic tank, or field tile drains.

I. Ensure the bottom of the trench is below the frost line (2.5 feet)

The length of the trench depends upon the depth and the bottom width. The required length is calculated by assuming a depth and bottom width. The length is calculated based upon the inflow (WQv) and the outflow (ground water recharge). The following equation calculates the required length in feet:

$$L_t = \frac{43560 \cdot WQv}{3600 \cdot K \cdot T \cdot (b + 2D) + 0.4\left[D^2 + (b \cdot D)\right]}$$

Where,

WQv = Water quality volume (see section 1115) (Acre-feet)

T = Drain time through the sides of the trench, 24 hours

K = permeability of the surrounding soil (ft/sec) (table 1117-4)

D = Trench depth (ft)

b = Bottom width of the trench (ft)

Table 1117-4

Permeability of Soil (K)	
Soil Type	**Rate (K)**
	(ft/sec)
Gravel	$3.3x10^{-3}$ to $3.3x10^{-1}$
Sand	$3.3x10^{-5}$ to $3.3x10^{-2}$
Silt	$3.3x10^{-9}$ to $3.3x10^{-5}$
Clay (saturated)	< $3.3x10^{-9}$
Till	$3.3x10^{-10}$ to $3.3x10^{-6}$

From Urban Runoff Quality Management WEF Manual of Practice No. 23, 1998, published jointly by the WEF and ASCE, chapter five

1117.7.2 Infiltration Basin

An infiltration basin is an open surface pond that uses infiltration into the ground as the release mechanism. It is designed to store the WQv.

Depending on the soil permeability, it may be used to treat from 5 to 50 acres. Lower permeable soils may require an underdrain system as an additional outlet. The drawdown time of the WQv should be between 24-48 hours. The following criteria apply when designing an infiltration basin:

A. Use an energy dissipater at the inlet.

B. Allow for 1 foot (min) freeboard above the WQv.

C. Vegetate the sides of the basin with Item 670 Slope Erosion Protection.

D. Furnish a 6 inch layer of Item 601 Infiltration Basin Aggregate on the bottom of the basin.

E. Use side slopes of 4:1 (max).

F. Use a length to width ratio of 3:1

G. Furnish bypass or overflow for the design check discharge (see section 1117.4.3).

H. Consider vehicle access to the basin for periodic maintenance.

I. Locate basin at least 1,000 feet from any municipal water supply well and at least 100 feet from any private well, septic tank, or drain field.

J. Furnish 10 feet or less width between 4 inch underdrain laterals (if used in the design).

K. Do not locate the basin where infiltrating ground water may adversely impact slope stability.

L. Ensure the invert of any underdrain in the basin is below the frost line (2.5 feet).

M. Embankment work to create the impoundment will be constructed and paid for as Item 203 Embankment, Using Natural Soils, 703.16.A.

The invert area of the infiltration basin can be calculated by the following equation:

$$A=(WQv * S.F. * 12)/(k * t)$$

Where,

A = area of invert of the basin (Acres)

WQv = Water Quality Volume (see section 1115) (Acre-feet)

S.F. = Safety Factor of 1.5

k = Infiltration Rate (in/hr) (table 1117-5)

t = Drawdown time of 48 hours

The required depth of the infiltration basin can be calculated by the following equation:

$$D = WQv/A$$

Where,

A = area of invert of the basin (Acres)

WQv = Water Quality Volume (Ac-ft)

D = Required depth of the basin (ft)

Table 1117-5

NRCS Soil Type (from soil maps)	HSG Classification	Rate (k)
		(in/hr)
Sand	A	8.0
Loamy Sand	A	2.0
Sandy Loam	B	1.0
Loam	B	0.5
Silt Loam	C	0.25
Sandy Clay Loam	C	0.15
Clay Loam & Silty Clay Loam	D	< 0.09
Clays	D	< 0.05

Infiltration Rate (k)

From Urban Runoff Quality Management WEF Manual of Practice No. 23, 1998, published jointly by the WEF and ASCE, chapter five

1117.8 Constructed Wetlands

Constructed Wetlands treat storm water through bio-retention. They are depressed, heavily planted areas that are designed to maintain a dry weather flow depth ranging between 0.5 to 2 feet. The surface area required for a wetland is usually quite large due to the limited allowable depth. The area is usually on the magnitude of 1% of the entire drainage area. They are designed in a similar manner as a retention basin. The wetland is sized to provide storage for the WQ_v for a time frame of at least 24 hours (above the permanent pool) while providing a bypass or overflow for larger design check discharge (see section 1117.4.3). The water depth should be maintained by an outlet structure capable of providing the required water depth with the provision of a one foot freeboard. The following criteria apply when designing a Constructed Wetland:

A. Do not place on a steep or unstable slope or at a location, which could induce short-term or long-term instability.

B. Constructed Wetlands must be greater than 10,000 feet from a municipal airport runway.

C. Base flow must be present to maintain the constant water depth (such as ground water).

D. Furnish a forebay that is 7% of the total required volume at a depth between 3-6 feet to settle out sediments.

E. Furnish side slopes of 4:1 (max).

F. Consider access for maintenance to the forebay and the outlet structure.

G. Vegetate the sides and bottom with grass

H. Furnish an impervious liner. Use a compacted clay bottom or a geotextile fabric to prevent infiltration of the storm water.

I. Furnish a length to width ratio of 3:1 (min) to prevent short-circuiting.

Appendix B – Sample Plan Notes

E101 SEEDING AND MULCHING

THE FOLLOWING QUANTITIES ARE PROVIDED TO PROMOTE GROWTH AND CARE OF PERMANENT SEEDED AREAS:

659, SOIL ANALYSIS TEST	____ EACH
659, TOPSOIL	____ CU. YD. (CU. METER)
659, SEEDING AND MULCHING	____ SQ. YD. (SQ. METER)
659, REPAIR SEEDING AND MULCHING	____ SQ. YD. (SQ. METER)
659, INTER-SEEDING	____ SQ. YD. (SQ. METER)
659, COMMERCIAL FERTILIZER	____ TON (KILOGRAM)
659, LIME	____ ACRES (HECTARES)
659, WATER	____ M. GAL. (CU. METER)
659, MOWING	____ M. SQ. FT. (SQ. METER)

SEEDING AND MULCHING SHALL BE APPLIED TO ALL AREAS OF EXPOSED SOIL BETWEEN THE RIGHT-OF-WAY LINES, AND WITHIN THE CONSTRUCTION LIMITS FOR AREAS OUTSIDE THE RIGHT-OF-WAY LINES COVERED BY WORK AGREEMENT OR SLOPE EASEMENT. QUANTITY CALCULATIONS FOR SEEDING AND MULCHING ARE BASED ON THESE LIMITS.

Designer Note: The above quantities should be used on all projects that require grading work. The following is a basic guideline for estimating quantities for the above items. These quantities may be omitted from the note if they are itemized elsewhere in the plan. Calculations for all items should be shown in the plans.

659, Soil Analysis Test (Each)

Soil Analysis Tests are used to field adjust the rate of Lime based on soil conditions.

A. Soil Analysis Test is not specified.

    1. The standard rate for Lime will be used without adjustment.

B. Soil Analysis Test is specified. If specified, minimum of two tests.

    1. If no Topsoil to be placed - One test per 10 Acres (one test per 48400 Sq. Yd.)[one test per 40000 Sq. Meters] of permanent seeded area and sodded area.

    2. If placing Topsoil - One test per 10000 Cu. Yds. [7600 Cu. Meters] of Topsoil.

659, Topsoil (Cu. Yd.)[Cu. Meter]

111 Cu. Yds. per 1000 Sq. Yd. [0.10 Cu. Meter per Sq. Meter] of permanent seeded area. Topsoil is optional. However, it is recommended, especially for projects involving A4 silty materials, granular embankment or granular materials due to severe erosion problems.

659, Seeding and Mulching (Sq. Yd.)[Sq. Meter]

This quantity is usually calculated by the end width method using the cross sections. On short projects, seeding quantities may be determined by other methods. For example, the area for seeding may be estimated by calculating an area per Plan & Profile sheet determined by multiplying an average width (based on construction limits or right-of -way lines) by the distance on each sheet, and then deducting for paved surface areas. A deduction should be taken for 660 and 670 items.

659, Repair Seeding and Mulching (Sq. Yd.) [Sq. Meter]

5 % of the permanent seeding and mulching area.

659, Inter-seeding (Sq. Yd.)[Sq. Meter]

5% of the permanent seeding and mulching area.

659, Commercial Fertilizer (Ton)[Kilogram]

30 pounds per 1000 Sq. Ft. (one Ton per 7410 Sq. Yd.)[0.15 Kg/Sq. Meter] of permanent seeded area. This rate includes 20 pounds per 1000 Sq. Ft. [0.10 kg per Sq. Meter] for the first application and 10 pounds per 1000 Sq. Ft. [0.05 kg per Sq. meter] for the second application. If Inter-seeding is provided, use an additional 20 pounds per 1000 Sq. Ft. of commercial fertilizer for the Inter-seeding area.

659 Lime (Acre)[Hectare]

Apply over permanent seeded area.

659, Water (M. Gal.)[Cu. Meter]

Two applications each at 300 Gallons per 1000 Sq. Ft. (0.0027 M Gallons per Sq. Yd.) [12.2 Cu. Meters per 1000 Sq. Meters] of permanent seeded area. The above rate is for a single application. If Inter-seeding is provided, use an additional 300 Gallons per 1000 Sq. Ft. of water for the Inter-seeded area.

659, Mowing (M. Sq. Ft.)[Sq. Meter]

25 % of the permanent seeded area for projects expected to last more than one construction season.

E102 SODDING

THE FOLLOWING QUANTITIES ARE PROVIDED TO PROMOTE GROWTH AND CARE OF PERMANENT SODDED AREAS.

659, SOIL ANALYSIS TEST	____ EACH
659, TOPSOIL	____ CU. YD. (CU. METER)
659, COMMERCIAL FERTILIZER	____ TON (KILOGRAM)
659, LIME	____ ACRE (HECTARE)
659, WATER	____ M. GAL. (CU. METER)
660, SODDING, UNSTAKED, STAKED, REINFORCED	____ SQ. YD. (SQ. METER)

Designer Note: The above quantities should be used on all projects that have pay item(s) for permanent sodding. The following is a basic guideline for estimating quantities for the above items. These quantities may be omitted from the note if they are itemized elsewhere in the plan. Calculations for all items should be shown in the plans.

Appendix B – Sample Plan Notes

659, Soil Analysis Test (Each)

Soil Analysis Tests are used to field adjust the rate of Lime based on soil conditions.

C. Soil Analysis Test is not specified.

1. The standard rate for Lime will be used without adjustment.

D. Soil Analysis Test is specified. If specified, minimum of two tests.

1. If no Topsoil to be placed - One test per 10 Acres (one test per 48400 Sq. Yd.)[one test per 40000 Sq. Meters] of permanent sodded area.

2. If placing Topsoil - One test per 10000 Cu. Yds. [7600 Cu. Meters] of Topsoil.

659, Topsoil (Cu. Yd.)[Cu. Meter]

111 Cu. Yds. per 1000 Sq. Yd. [0.10 Cu. Meter per Sq. Meter] of permanent sodded area. Topsoil is optional. However, it is recommended, especially for projects involving A4 silty materials, granular embankment or granular materials due to severe erosion problems.

659, Commercial Fertilizer (Ton)[Kilogram]

30 pounds per 1000 Sq. Ft. (one Ton per 7410 Sq. Yd.)[0.15 Kg/Sq. Meter] of permanent sodded area. This rate includes 20 pounds per 1000 Sq. Ft. [0.10 kg per Sq. Meter] for the first application and 10 pounds per 1000 Sq. Ft. [0.05 kg per Sq. meter] for the second application.

659, Lime (Acre)[Hectare]

Apply over permanent sodded area.

659, Water (M. Gal.)[Cu. Meter]

1 application every 7 days for an additional 2 months beyond the requirements of 660.09. The rate shall be 300 gallons per 1000 Sq. Ft. (0.0027 M. Gallons per Sq. Yd.) [12.2 Cu. Meters per 1000 Sq. Meters] of permanent sodded area.

660, Sodding (Sq. Yd.)[Sq. Meter]

This is the actual number of Sq. Yds. [Sq. Meters] of permanent sodded area.

W99 **POST CONSTRUCTION STORM WATER TREATMENT**

THIS PLAN UTILIZES STRUCTURAL BEST MANAGEMENT PRACTICES (BMP'S) FOR POST CONSTRUCTION STORM WATER TREATMENT.

Designer Note: This plan note shall be used on all projects that have post construction storm water management BMP's. The note shall be followed by the below notes if applicable.

W101 **BIORETENTION CELL(S)**

CONSTRUCT THE BIORETENTION CELL(S) AFTER ALL CONTRIBUTING DRAINAGE AREAS ARE STABILIZED AS SHOWN ON THE CONTRACT PLANS AND TO THE SATISFACTION OF THE ENGINEER. DO NOT USE THE COMPLETED BIORETENTION CELL(S) AS TEMPORARY SEDIMENT CONTROL FACILITIES DURING CONSTRUCTION. DO NOT OPERATE HEAVY EQUIPMENT WITHIN THE PERIMETER OF A BIORETENTION FACILITY DURING EXCAVATION, UNDERDRAIN PLACEMENT, BACKFILLING, PLANTING, OR MULCHING OF THE FACILITY. USE ALL SUITABLE EXCAVATED MATERIAL IN THE WORK. ALTERNATIVELY, LEGALLY USE, RECYCLE, OR DISPOSE OF ALL EXCAVATED MATERIALS ACCORDING TO 105.16 AND 105.17.

EXCAVATE THE BIORETENTION CELL(S) TO THE DIMENSIONS, SIDE SLOPES, AND ELEVATIONS SHOWN ON THE CONTRACT PLANS. MINIMIZE THE COMPACTION OF THE BOTTOM OF THE BIORETENTION FACILITY BY THE METHOD OF EXCAVATION. EMBANKMENT WILL BE MEASURED AND PAID AS ITEM 203, EMBANKMENT, USING NATURAL SOIL, 703.16.A.

THE BIORETENTION SOIL SHALL BE A UNIFORM MIX THAT IS FREE OF STONES, STUMPS, ROOTS, OR ANY OTHER OBJECT THAT IS LARGER THAN TWO INCHES. THE SOIL MAY CONSIST OF EXISTING SOIL, FURNISHED SOIL, OR A COMBINATION OF BOTH PROVIDED THAT IT MEETS THE FOLLOWING REQUIREMENTS:

PH RANGE:	5.2-7.0
COMPOSITION BY VOLUME	
4 PARTS SAND – CMS FINE AGGREGATE AS PER 703	
2 PARTS COMPOST – CMS 659.06	
2 PARTS TOPSOIL – CMS 659.05	

THOROUGHLY MIX THE BIORETENTION SOIL PRIOR TO PLACEMENT. TEST AND ADJUST THE PH AS PER CMS 659.02.B. ALL SAND USED SHALL MEET CMS 203.02.H, NATURAL GRANULAR MATERIALS.

PLACE THE SOIL IN 12 INCH LIFTS AND CONSOLIDATE BY WATERING UNTIL SATURATED.

CONSTRUCT THE UNDERDRAIN SYSTEM AS PER CMS 605. PLACE THE GRANULAR BACKFILL MATERIAL TO THE INVERT OF THE BIORETENTION SOIL. ENSURE A MINIMUM OF 2 INCHES OF GRANULAR COVER OVER THE UNDERDRAIN PRIOR TO PLACEMENT OF THE BIORETENTION SOIL.

PLACE OBSERVATION WELLS AND CLEANOUTS WHERE SHOWN IN THE PLANS. CONNECT THE WELLS/CLEANOUTS TO THE PERFORATED UNDERDRAIN WITH THE APPROPRIATE MANUFACTURED CONNECTIONS. THE WELLS/CLEANOUTS SHALL EXTEND 6 INCHES ABOVE THE TOP ELEVATION OF THE BIORETENTION FACILITY MULCH. CAP THE WELLS/CLEANOUTS

WITH A THREADED SCREW CAP. CAP THE ENDS OF UNDERDRAIN PIPES NOT TERMINATING IN AN OBSERVATION WELL/CLEANOUT OR CONNECTED TO OTHER CONDUITS.

PLACE TREES, SHRUBS, AND OTHER PLANT MATERIALS SPECIFIED FOR BIORETENTION FACILITIES AS SPECIFIED IN THE PLANS. PLANT MATERIALS WILL BE MEASURED AND PAID FOR PER CMS ITEM 661. APPLY NO PESTICIDES, HERBICIDES, AND FERTILIZERS DURING PLANTING, ESTABLISHMENT, OR MAINTENANCE UNDER ANY CIRCUMSTANCES.

BIORETENTION CELLS WILL BE PAID FOR AS ITEM SPECIAL, BIORETENTION CELL AT THE CONTRACT BID LUMP SUM PRICE. THE PAYMENT WILL BE FULL COMPENSATION FOR ALL APPLICABLE INCIDENTALS NECESSARY TO SATISFACTORILY COMPLETE THE WORK.

Designer Note: This plan note shall be used on all projects that have bioretention cell(s) identified in the plan. Embankment work to create the impoundment will be constructed and paid for as Item 203 Embankment, using natural soils, 703.16.A.

W102 INFILTRATION TRENCH (OR BASIN)

THIS PLAN UTILIZES INFILTRATION FOR POST CONSTRUCTION STORM WATER TREATMENT. CONSTRUCT THE COMPLETED INFILTRATION TRENCH(ES) (AND OR BASIN(S)) AFTER ALL CONTRIBUTING DRAINAGE AREAS ARE STABILIZED AS SHOWN IN THE CONTRACT PLANS AND TO THE SATISFACTION OF THE ENGINEER. DO NOT USE INFILTRATION DEVICES AS TEMPORARY SEDIMENT CONTROL FACILITIES DURING CONSTRUCTION. DO NOT OPERATE HEAVY EQUIPMENT WITHIN THE PERIMETER OF AN INFILTRATION DEVICE DURING EXCAVATION OR BACKFILLING OF THE FACILITY.

Designer Note: This plan note shall be used on all projects that have infiltration trenches and or basins identified in the plan. Embankment work to create the impoundment will be constructed and paid for as Item 203 Embankment, using natural soils, 703.16.A.

W103 MANUFACTURED WATER QUALITY STRUCTURE

THIS PLAN UTILIZES MANUFACTURED WATER QUALITY STRUCTURES FOR WATER QUALITY TREATMENT. AREAS HAVE BEEN SHOWN IN THE PLANS FOR PLACEMENT OF AN OFF-LINE SYSTEM. PAYMENT FOR THESE DEVICES SHALL BE MADE AT THE CONTRACT UNIT PRICE FOR ITEM 895, MANUFACTURED WATER QUALITY STRUCTURE, TYPE ____.

Designer Note: This plan note shall be used on all projects that have manufactured water quality structures identified in the plan. If more than one manufactured water quality structure is provided in the plans, a table shall be provided to indicate the location and type of each structure used. Supplemental specification 895 outlines the different types of structures (1-4). **Manufactured systems may not be used without approval of the Hydraulics Section through a feasibility study. Contact the Hydraulics Section for an area dimension that shall be shown in the plan.**