RESOLUTION NO. 034 - 2007

RESOLUTION AMENDING THE KITSAP COUNTY STORMWATER DESIGN MANUAL TO INCORPORATE LOW IMPACT DEVELOPMENT PRACTICES

WHEREAS, Kitsap County Code section 12.04.020 allows the Director of Public Works, subject to the approval of the Kitsap County Board of Commissioners, to amend the *Kitsap County Stormwater Design Manual* as necessary to reflect changing conditions and technology.

NOW, THEREFORE, BE IT RESOLVED, the Kitsap County Board of Commissioners, in regular session assembled, hereby amends the Kitsap County Stormwater Design Manual to incorporate Low Impact Development Practices as follows:

Add Appendix 5B: Low Impact Development Guidelines (8 pages)
Pages 8A-9 Maintenance Requirements for Pervious Pavement and Rain Gardens
Page 8A-10 & 11 6-inch Ring Infiltration Test

DATED this 12th day of Feb, 2007

BOARD OF COUNTY COMMISSSIONERS
KITSAP COUNTY, WASHINGTON

Chris Endresen, Chair

Jan Angel, Commissioner

Josh Brown, Commissioner

Low Impact Development Guidelines

These guidelines outline methods to reduce the amount of stormwater runoff generated on developed sites. The following references may also be of assistance in designing low impact development sites. In cases where these references differ with this manual, this manual will prevail.

1. Low Impact Development Technical Guidance Manual for Puget Sound, Puget Sound Action Team and Washington State University Pierce County Extension, January 2005.

2. Stormwater Management Manual for Western Washington, Washington Department of Ecology, February 2005.

3. Low Impact Development Design Strategies, An Integrated Design Approach, Prince George's County MD, June 1999.

4. Low Impact Development Hydrologic Analysis, Prince George's County MD, July 1999.

5. Bioretention Manual, Prince George's County MD, December 2002

5B.1 Site Design

Designers are referred to the Low Impact Development Technical Guidance Manual for Puget Sound for detailed guidance on how to plan a low impact development project.

5B.1.2 Compost Amended Soils

Soils meeting the design standards of section 5A.1.0 and table 5-6 shall be modeled per table 5-2 footnote #6 of this manual.

5B.2 Reduced Impervious Surface

5B.2.1 Permeable Pavement

A. The initial 5,000 square feet for each project of permeable pavement shall not be considered impervious when determining whether or not a project meets the definition of a major development. All permeable pavement and shall be modeled as a dirt road or parking lot per table 5-2 for sizing of water quantity and quality facilities if:

1. The paving system does not have an under drain system connected to a conveyance system

2. The site has a recorded covenant requiring paving system maintenance per section 5B.2.1.E.

3. The permeable pavement does not receive stormwater runoff from a separate area larger than 10% of the permeable pavement area.

4. The permeable pavement product has an installed infiltration rate of at least 10 inches per hour.

B. Permeable pavement may not be used in areas with heavy pollutant loading or high chemical spill risk such as but not limited to gas stations, heavy industrial areas, auto body/repair shops, auto wash areas commercial truck parking areas, areas with heavy industrial activity (as defined by USEPA regulations), or areas with high pesticide use.

C. Permeable pavement overlying an underground infiltration system shall be modeled as an impervious surface draining to an infiltration system designed per section 5.3.5 of this manual. This system does not require a separate water quality device.

D. Permeable pavement post construction infiltration testing:

1. Bucket Test – Surfaces can be tested by simply throwing a 5-gallon bucket of water on the surface. If the water puddles, remains on the surface greater than 2 minutes, or runs off the surface, 6-inch ring testing is required prior to accepting the construction.

2. A 6-inch ring infiltration test: Seal a 6-inch ring to the base of the road surface. Wet the surface continuously for 10 minutes. The surface must infiltrate at least 10 inches per hour to be considered permeable. (See the Stormwater Management Manual for Western Washington Volume III Appendix III C or Appendix 8A of this manual for more details on the test)

3. Surfaces shall be tested at least once per 10,000 sq ft. Clogged surfaces (infiltration rate less than 10 inches per hour) totaling greater than 10% of the total surface area shall be removed/replaced and retested.

E. Permeable Pavement Post Construction Maintenance Requirements

1. Surfaces shall be swept with a high-efficiency or vacuum sweeper at least once per year. The optimum time is in the autumn after leaf fall.

2. Porous asphalt and concrete shall be cleaned with a high-pressure hose following one of the annual sweepings at least once every other year.

3. A Bucket Test, and if necessary 6-inch ring infiltration test, shall be performed after the first year of use and each 5 years there after. Surfaces shall be tested at least once per 10,000 sq ft. If this test indicates the infiltration test is less than 10 inches per hour then the sweeping frequency shall be increased to semi annually and the high pressure washing annually. (See the Stormwater Management Manual for Western Washington Volume III Appendix III C or Appendix 8A of this manual for more details on the 6-inch ring test)

4. Owner/Operators must keep at least 5 years of written documentation of all cleaning and infiltration tests and make then available to County inspectors upon request.

5B.3 Dispersion

5B.3.1 Full Dispersion:

Impervious surfaces dispersed over native vegetation per section 5A.2.0 of this manual shall be considered mitigated and require no further water quality or quantity controls.

5B.3.2 Partial Dispersion:

A. Impervious surfaces dispersed as sheet flow over a flow length of at least 50 ft of native vegetation or lawn/landscaped areas shall be considered partially dispersed.

B. Lawn or landscaped areas shall meet the soil amendment requirements of table 5-6 of this manual.

C. Partially dispersed impervious surfaces shall meet all design criteria per section 5A.2.0 of this manual except the minimum flow length shall be 50 ft.

D. Partially dispersed impervious surfaces shall be considered impervious when determining whether or not a project meets the definition of a major development.

E. Partially dispersed impervious surfaces shall be modeled as open space in good condition per table 5-2 "Modified Curve Numbers" of this manual.

5B.3.3 Vegetated Roofs:

A. Design details for vegetated roofs can be found in section 6.4 of the Low Impact Development Technical Guidance Manual for Puget Sound.

B. Vegetated portions of roofs shall be modeled using the Curve Numbers from table 5-2 of this manual as:

1. Open Space Good Condition on till (C soil) for areas with 3-8 inches of growing media
2. Meadow or Pasture on till (C soil) for areas with greater than 8 inches of growing media.

5B.4 Minimum Excavation Foundations:

See section 7.6 of the Low Impact Development Technical Guidance Manual for Puget Sound for modeling credits given for this technology.

5B.5 Bioretention Facilities

A. Bioretention facilities shall be designed as either filtration systems or retention systems.

1. Facilities designed as retention systems do not require pre treatment per section 5.3.5 of this manual.

2. For facilities that receive runoff from less than or equal to 5000 sq ft of impervious surface subject to vehicular traffic, there shall be 1 ft clearance from the bottom of the facility to the seasonal high water table.

3. For facilities that receive runoff from greater than 5000 sq ft of impervious surface subject to vehicular traffic, there shall be 3 ft clearance from the bottom of the facility to the seasonal high water table.

4. Facilities designed only as filtration systems (water quality devices) shall have an underdrain system to ensure that the stormwater is filtered through the media prior to discharge.

5. Maximum ponding for bioretention systems shall be 12". However, a maximum ponding depth of 6-8" is preferred.

6. Maximum draw down time shall be 24 hours. Draw down volume includes the engineered soil and gravel void spaces within the facility.

7. Filtration systems shall be modeled as having a flow rate equivalent to a filtration rate of 1" per hour (no safety factor applied to the 1"/hr).

8. Retention systems shall be modeled per section 5.3.5 using the native soil infiltration rates. Soil void space shall be assumed to be 40%. Only void space below any under drains may be used for storage calculations.

9. Facilities will have an overflow system that connects the facility to either a designated dispersion area or downstream conveyance system.

10. Facilities receiving runoff from up to 5000 sq ft of impervious area shall have a minimum engineered soil depth of 18 inches for systems and an optional mulch layer of 2-3 inches. Facilities receiving runoff from greater than 5000 sq ft of impervious surface shall have a minimum engineered soil depth of 24 inches and a mulch layer of 2-3 inches.

11. Figures 5-31a, b, c show possible bioretention facility configurations. Designers may find other configurations in the references listed at the beginning of this appendix.

12. Engineered soils shall not be compacted.

B. The engineered soil component shall meet one of the following soil specifications:

1. On-Site Soil Mix

   a) Reuses native soils

   b) 65% on site soil, 35% compost (See 5A.1.0)

   c) Mix shall be free of debris, rocks, garbage and organic material greater than 2" in any dimension

   d) On site soils shall be loam, sandy loam or loamy sand per figure 5-14. Soils may be amended with sand to meet this specification

   e) Mix shall be well blended and covered to prevent wetting and saturation

2. Off-Site Soil Mix

   a) Uses imported soils

   b) 65 to 70% gravelly sand per ASTM D 422

Sieve Size	% Passing
US No 4	100
US No 6	88-100
US No 8	79-97
US No 50	11-35
US No 200	5-15

   c) 30 to 35% compost (See 5A.1.0)

   d) Clay content shall be less than 5%

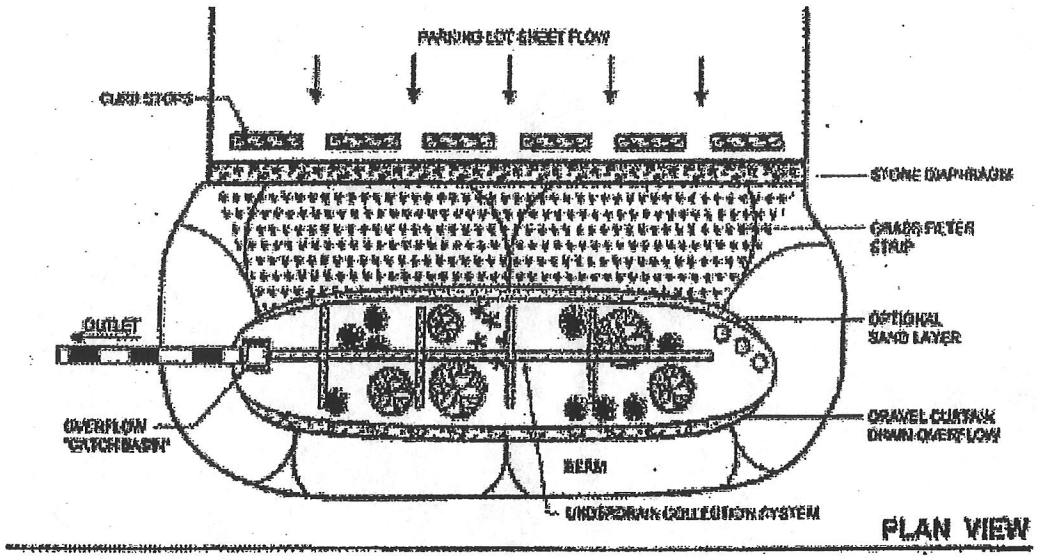
   e) Mix shall be free of debris, rocks, garbage and organic material greater than 2" in any dimension

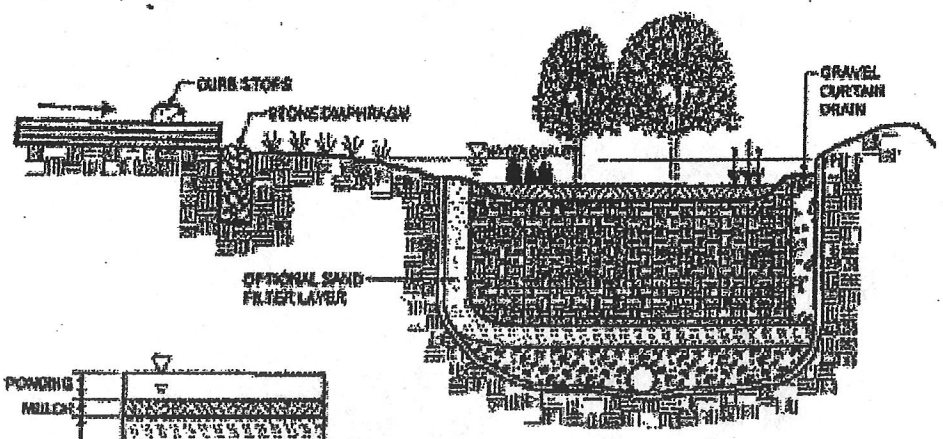
   f) Mix shall be well blended and covered to prevent wetting and saturation

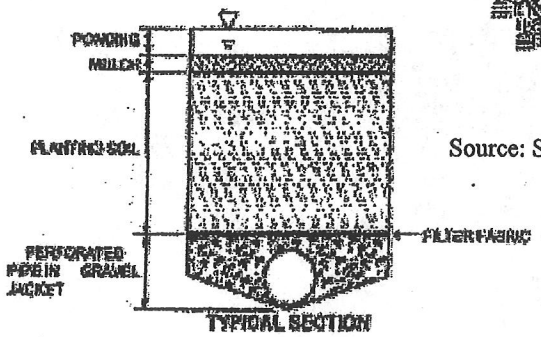
   g) This blend is available commercially as "Vegetable Garden Mix" by Cedar Grove Composting.

C. Maintenance: Facilities shall be maintained per Appendix 8A of this manual.

Figure 5-31a Typical Biorention Facility

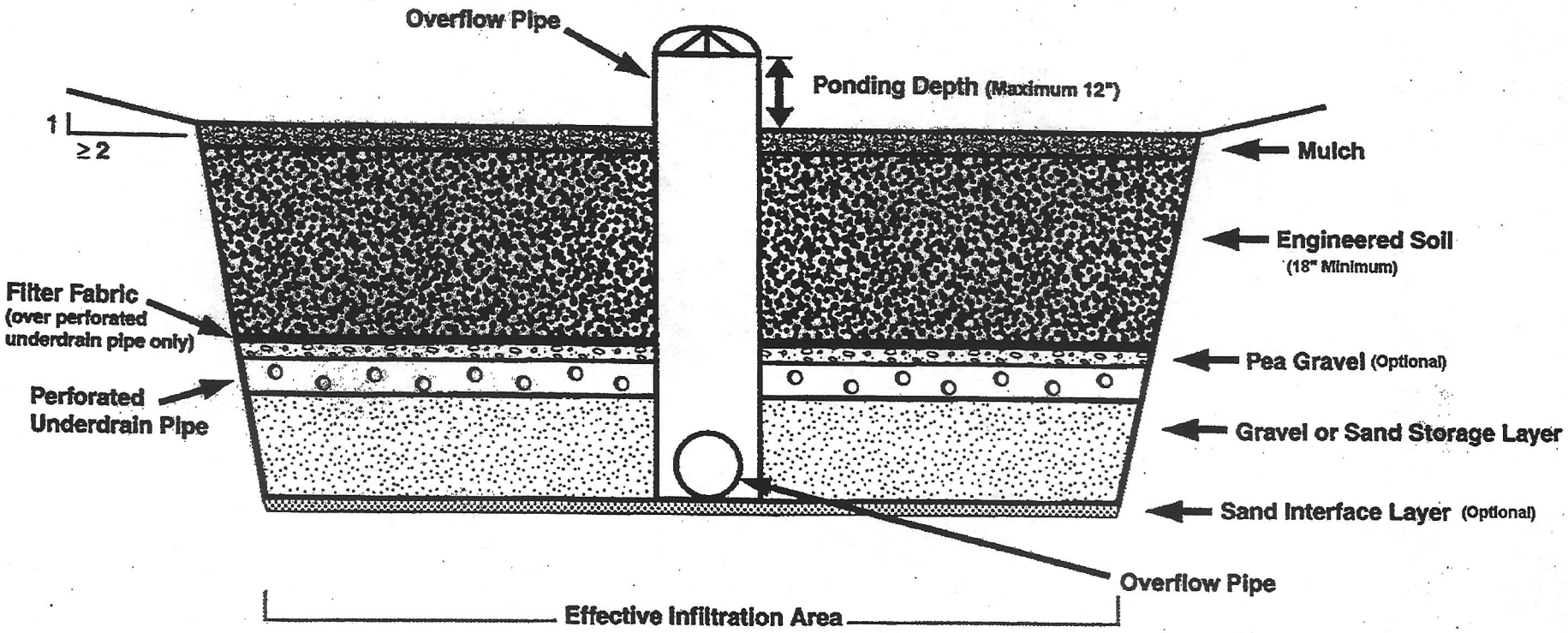






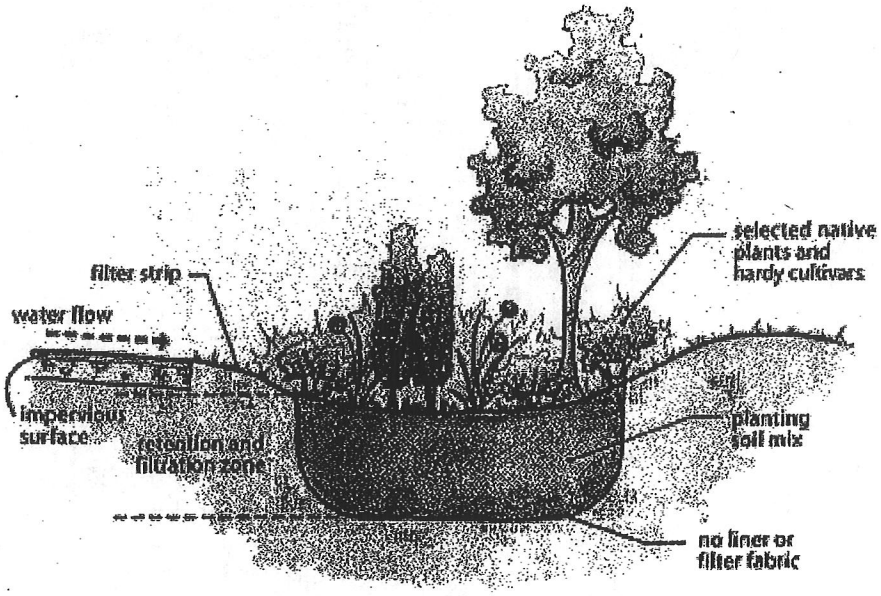
Source: Stormwater Managers' Resource Center

Figure 5-31b Typical Biorention Facility

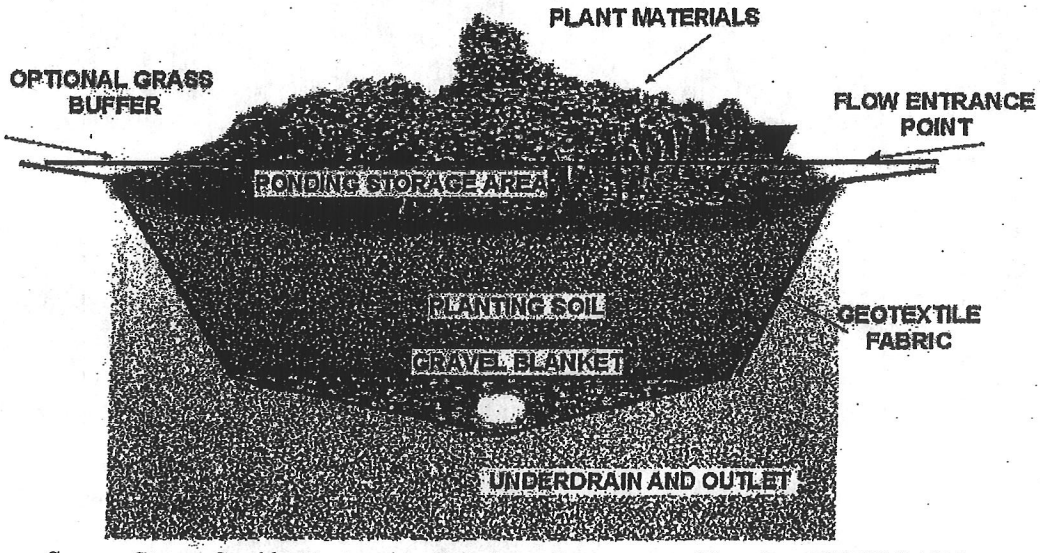


Source: Wisconsin Department of Natural Resources

Figure 5-31c Typical Biorention Facility



Source: Low Impact Development Technical Guidance Manual for Puget Sound



Source: Stream Corridor Restoration: Principles, Processes, and Practices, FISRWG 1998

H. BIORETENTION FACILITIES (RAIN GARDENS)

MAINTENANCE COMPONENT	DEFECT	CONDITIONS WHEN MAINTENANCE IS NEEDED	RESULTS EXPECTED WHEN MAINTENANCE IS PERFORMED	SCHEDULED FREQUENCY OF MAINTENANCE/INSPECTION
General	Sediment Accumulation on top layer	Sediment depth exceeds ½-inch	No sediment deposit on top layer of facility and engineered soil/mulch returned to design criteria	Semiannually – As Needed
	Trash and Debris Accumulations	Trans and debris accumulated on mulch or engineered soil layer	Trash and debris removed	Semiannually – As Needed
	Engineered Soil	Drawdown time of water through the bioretention facility takes longer than 24-hour, and/or flow through the overflow structure occurs frequently	Top several inches of engineered soil are scraped. May require replacement of entire engineered soil column depending on extent of plugging.	Periodically – As Needed
	Erosion Damage to Slopes	Erosion over 2-inches deep where cause of damage is prevalent or potential for continued erosion is evident.	Slopes stabilized using proper erosion control measures	Periodically – As Needed
	Short circuiting	When flow become concentrated over on section of the facility rather than dispersed.	Flow is uniform across entire facility	Periodically – As Needed
Mulch Layer	Mulch Replenishment	Mulch layer less than 2-3 inches deep or mulch deteriorated	2 to 3 inches of fresh mulch across entire facility	Annually for parking lots/roads Biennially for other
Plant Material	Dead or Diseased	Plants dead or diseased	Remove and replace plants	Annually
	Weeds	Unwanted plants growing in facility	No unwanted plants	Periodically – As Needed

I. Permeable Pavements (Porous Concrete, Porous Asphalt, Paver systems)

MAINTENANCE COMPONENT	DEFECT	CONDITIONS WHEN MAINTENANCE IS NEEDED	RESULTS EXPECTED WHEN MAINTENANCE IS PERFORMED	SCHEDULED FREQUENCY OF MAINTENANCE/INSPECTION
Porosity	Sediment Accumulation	Vacuum Sweep at least once annually (Pavers may be broom swept)	Infiltration test reveals infiltration rate equal to or greater than 10"/hr	Annual or as needed
	Sediment Accumulation	Cleaned with a high-pressure hose following every other sweeping	Infiltration test reveals infiltration rate equal to or greater than 10"/hr	Biennial or as needed
	Poor Infiltration	A bucket, and if necessary a 6-inch ring, infiltration test shall be performed. If less than 10"/hr, double frequency of sweeping and high-pressure wash cleanings.	Infiltration test reveals infiltration rate equal to or greater than 10"/hr	1 year after installation and every 5 years thereafter
	Poor Infiltration	6" ring infiltration test is less than 10"/hr	Double frequency of sweeping and high pressure washing. Repeat infiltration test after 1 year of increased maintenance.	As Needed
	Poor Infiltration	6" ring infiltration test is less than 2.5"/hr on two successive tests	Replace low infiltration rate sections of permeable pavement	As Needed
	Hydrocarbon Spill	Visual inspection indicates area of pavement subjected to high concentration of oil or other hydrocarbon.	Any free produce absorbed with spill control material. Historic residue treated with bacteria	Visually inspect quarterly or after spill

6-inch ring infiltration test

Equipment:

1. An open-ended cylinder of approximately 6-inch diameter, ≥12 inches in length
2. Bucket or other device to contain 2.5 to 5 gallons of water
3. Plumbers putty or other temporary waterproof sealant
4. Stop watch or other time keeping device accurate to a second
5. Infiltration test data sheet (page 8A-11)

Procedure:

1. Measure cylinder interior diameter in inches and note on test data sheet
2. Seal one end of the cylinder interior and exterior to the test surface.
3. Place a mark on the interior of the cylinder approximately 6 inches from the bottom.
4. Wet the test surface inside the cylinder continuously for 10 minutes.
5. Allow water to completely infiltrate.
6. Measure a known quantity of water between 1 and 5 gallons.
7. Start stop watch
8. Pour measured water into cylinder as needed until all the water has infiltrated. Do not fill the cylinder above the 6-inch mark.
9. Record time required to infiltrate measured water.
10. Determine infiltration rate

Infiltration Rate Data Sheet

Date:_____ Operator:_____

Test Site:_____

Quantity of Water Infiltrated:_____Gallons (W in equations below)

Time to Infiltrate Water: _____ Seconds (T in equations below)

Cylinder Interior Diameter:_____ Inches (D in equations below)

Determine Test Surface Area as follows: (A in equations below)

$A = [D/2]^2 \times Pi/144$

Divide Diameter by 2. Square resultant number. Multiply by 3.14. Divide by 144

(If interior diameter is 6 inches, A ~ 0.2 ft^2)

Determine Infiltration rate as follows: Inches per hour

Divide W by 7.48	_____	[W / 7.48]
Divide resultant number by T	_____	[W/7.48] / [T]
Divide resultant number by A	_____	[W/7.48]/[T]/[A]
Multiply resultant number by 3600	_____	[W/7.48]/[T]/[A] x 3600
Multiply resultant number by 12	_____	[W/7.48]/[T]/[A] x 3600 x 12

(If 2.5 gallons infiltrates in a 6 inch cylinder in 600 seconds, rate ~ 120 inches per hour)