

TECH SHEET

Determining In Situ Hydraulic Conductivity

Standard Operating Procedure for Determining In Situ Hydraulic Performance of High Flow Rate Bioretention Media Using the Rub-I Infiltrator

The Rub-I Infiltrator is the most effective way to field verify engineered soil performance for bioswale, golf course, and other root zone based applications where effective soil drainage is an imperative. The Rub-I was created by the team at Filterra, Incorporated to test the effectiveness of their high flow soils and to ensure quality control both in the lab, in the field, and for years beyond initial installation. Filterra is a leader in engineered soil development and is the primary component of the FocalPoint System. To ensure the highest level of effectiveness it is required that the FocalPoint System be tested within 60 days of installation and recommended the system be tested annually thereafter.

Objective

To provide an as-built confirmation of proper installation and hydraulic performance of Filterra bioretention media as designed on newly-installed bioretention systems.

Example Site Test Layout and Design Schematic

Specifications: (FSA = filter surface area, DA = drainage area)

0.2% FSA/DA, 5 acres site, 435 sqft FSA, headspace of 2 ft

435 sqft FSA will require 3 infiltrator tests. Testing should be performed on the perimeter since this is the area to most likely be affected due to sediment in the runoff.

Infiltrator Components:

X inches long x 6 inch ID schedule 40 white PVC pipe with 2 inch beveled ending and 2 opposite holes drilled one inch from top sized for rebar

(X = media depth + 2 inch pipe into UD + 3 inch pipe above media; ex: for a 12 inch media depth you would need 17 inch pipe)

24 inch piece of rebar for insertion through 2 drilled holes for removal of pipe from media after test

Hammering Components:

4 inch thick by 8 inch wide by 24 inch long pressure treated wood board
5# to 10# sledge hammer

Water Storage Components:

- 5 gallon clear graduated bucket (in gallons)
- Two 55 gallon sealed plastic drum with the following:
 - at least 1 bung hole (screw cap in lid) – hole prevents air lock
 - plastic barb with gasket placed at bottom for water discharge
 - plastic valve with shut off valve garden hose connector attached to barb to control flow and connect hose
 - placed at end of hose to control flow at test location
 - garden hose with screw on shut off valve at flow end

Other Materials

- Water
- Manhole lifter or crow bar for use on rebar to remove pipe from media after assembly
- Mineral oil, WD-40 or Vaseline with dry wipes for application
- Level
- Stopwatch
- Rake/shovel
- Yardstick and/or measuring tape
- Large stones (~2 inch)
- Flashlight
- Clipboard with pencil and Table 1 from this document

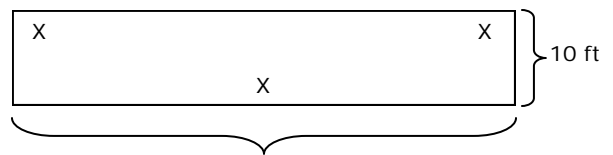


Figure 1: Site Layout

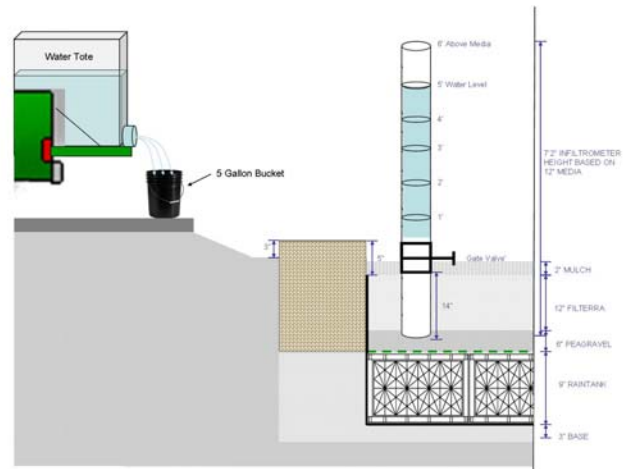


Figure 2: Design Schematic

Media Depth (Inches)	Max Drawdown Time (min: sec)	Media Depth (Inches)	Max Drawdown Time (min: sec)
6	8:00	28	38:12
8	11:30	30	40:00
10	15:00	32	41:42
12	18:18	34	43:24
14	21:24	36	44:54
16	24:18	38	46:18
18	25:42	40	47:42
20	27:00	42	49:00
22	29:30	44	50:12
24	31:54	46	51:24
26	34:06	48	52:30

Table 1. Maximum Time Criteria Based on Filterra Media Depth

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Test Methodology

- Carefully scrape away any surface covering (e.g. mulch, gravel, leaves) without disturbing the soil filter media surface.
- Confirm media profile depth by using a shovel to dig to under drain stone and place measuring tape in hole to determine depth from top of under drain stone to top of media bed. A flash light may be needed to ensure the under drain stone has been reached before a depth measurement is taken.
- At another location cleared of mulch, locate the 6 inch wide white PVC pipe (beveled end down) on the surface of the media. Ensure testing is not too close to vegetation. Place the wooden board over the pipe and then gently pound with the sledge hammer on top of the board (Figure 3). Hammer the PVC pipe into the entire media profile based on the depth previously determined until it is approximately 3 inches above the media (Figure 4). Check with level. Note: It is important that the pipe is driven in slowly and carefully to minimize disturbance of the filter media profile. The media may slightly move downward in the pipe during hammering, but not more than 1 inch, and will not significantly affect hydraulic performance.
- If pipe is less than 3 inches from media surface, remove media around outside of pipe so that the pipe is 3 inches from the media bed so that the gate valve coupling will properly slide onto the pipe.
- Remove board and rub mineral oil on outside of PVC pipe above media (Figure 5).
- Place 2 inch dissipater stones into pipe (Figure 6).
- Slide gate valve with clear PVC cylinder down onto the media PVC pipe (Figure 7). Note: Disregard black coupling on clear pipe as well as pipe plug. These were spare pieces used for the demonstration but are not part of the final design.
- Measure from the original surface of the media within the column to the 1ft, 2 ft, 3 ft, 4 ft and 5 ft gradations, and mark them on the clear PVC cylinder (Figure 8). The 1 ft and 5 ft marks are the critical marks, since the time to fall between these two intervals will be the pass/fail criteria for the test. (The time at other intervals between 1ft and 5 ft can be recorded for additional information, but will not be used in the pass/fail criteria).
- Fill a 5 gallon bucket with 3 gallons from the filled 55 gallon drum. Leave cap off of drum at test site to prevent airlock.
- Ensure the gate valve to the infiltrometer is closed. Fill with the 3 gallons of water (Figure 9). To create a worst case flow rate scenario (i.e. saturated condition), an initial wetting of the media using the infiltrometer is conducted by opening up the gate valve completely. The gate valve should be slowly opened by tapping on the handle with a hammer or wrench to prevent disturbance of the media surface by a sudden high flow of water. Pulling open by hand tends to force the valve open too quickly.
- After the water level disappears from the clear column, a drain down time of 25 minutes is allowed to ensure free water has drained from the system. The media is now at field capacity (fully saturated).
- After 25 minutes, ensure the gate valve is closed. Fill the 5 gallon bucket with water and continue to fill the column until water level reaches the very top of the clear pipe. Water is then re-introduced by opening the gate valve slowly by tapping the handle with a tool. The stopwatch should be started at the 5 ft gradation and time recorded at every 1 ft gradation. The stopwatch time is stopped when the water level reaches 1 ft.
- Pass/fail criteria is based on maximum drawdown times (Table 1). For example, a media profile depth of 12 inches should not exceed a drawdown time of 18 minutes and 18 seconds between the 5 ft and 1 ft gradations.
- For bioretention systems with a surface area less than 50 m² (538 ft²), in situ hydraulic testing should be conducted at three points that are spatially distributed. For systems with a surface area greater than 50 m², an extra monitoring point should be added for every additional 100 m² (1076 ft²). These values are based on recommendations from the Facility for Advancing Water Biofiltration in Australia.



Figure 3: Hammer Pipe Into Media



Figure 4: Pipe Installed Into Media



Figure 5: Oil Application



Figure 6: Dissipater Stones



Figure 7: Infiltrometer Placement



Figure 8: Gradation of Clear Pipe



Figure 9: Filling Infiltrometer With Water