



September 2019

GENERAL USE LEVEL DESIGNATION FOR BASIC (TSS), ENHANCED, PHOSPHORUS & OIL TREATMENT

For

Contech Engineered Solutions Filterra® Bioscape™

Ecology's Decision:

Based on Contech's submissions, including the Final Technical Evaluation Reports, dated August 2019, March 2014, December 2009 and additional information provided to Ecology, Ecology hereby issues the following use level designations:

1. A General Use Level Designation for Basic, Enhanced, Phosphorus, and Oil Treatment for the Filterra® Bioscape System constructed with a minimum media thickness of 21 inches (1.75 feet), at the following water quality design hydraulic loading rates:

Treatment	Infiltration Rate (in/hr) for use in BMP Sizing
Basic	175
Phosphorus	100
Oil	50
Enhanced	175

2. The Filterra® Bioscape™ unit is not appropriate for oil spill-control purposes.
3. Ecology approves the Filterra® Bioscape™ units for treatment at the hydraulic loading rates listed above, to achieve the maximum water quality design flow rate. Calculate the water quality design flow rates using the following procedures:

- Western Washington: for treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using the latest version of the Western Washington Hydrology Model or other Ecology-approved continuous runoff model.
- Eastern Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using one of the three flow rate based methods described in Chapter 2.2.5 of the Stormwater Management Manual for Eastern Washington (SWMMEW) or local manual.
- Entire State: For treatment installed downstream of detention, the water quality design flow rate is the full 2-year release rate of the detention facility.

4. This General Use Level Designation has no expiration date but Ecology may revoke or amend the designation, and is subject to the conditions specified below.

Ecology's Conditions of Use:

Filtterra Bioscape systems shall comply with the following conditions:

1. Design, assemble, install, operate, and maintain the Filtterra Bioscape systems in accordance with applicable Contech Filtterra manuals, document, and the Ecology Decision.
2. The minimum size filter surface-area for use in Washington is determined by using the design water quality flow rate (as determined in this Ecology Decision, Item 3, above) and the Infiltration Rate from the table above (use the lowest applicable Infiltration Rate depending on the level of treatment required). Calculate the required area by dividing the water quality design flow rate (cu-ft/sec) by the Infiltration Rate (converted to ft/sec) to obtain required surface area (sq-ft) of the Filtterra unit.
3. Each site plan must undergo Contech Filtterra review before Ecology can approve the unit for site installation. This will ensure that design parameters including site grading and slope are appropriate for use of a Filtterra Bioscape unit.
4. Filtterra Bioscape media shall conform to the specifications submitted to and approved by Ecology and shall be sourced from Contech Engineered Solutions, LLC with no substitutions.
5. Maintenance includes removing trash, degraded mulch, and accumulated debris from the filter surface and replacing the mulch layer. Use inspections to determine the site-specific maintenance schedules and requirements. Follow maintenance procedures given in the most recent version of the Filtterra® Bioscape™ Operation and Maintenance Manual.
6. Maintenance: The required maintenance interval for stormwater treatment devices is often dependent upon the degree of pollutant loading from a particular drainage basin. Therefore, Ecology does not endorse or recommend a "one size fits all" maintenance cycle for a particular model/size of manufactured filter treatment device.
 - Contech designs Filtterra systems for a target maintenance interval of 6 months in the Pacific Northwest. Maintenance includes removing and replacing the mulch layer above the media along with accumulated sediment, trash, and captured organic materials therein, evaluating plant health, and pruning the plant if deemed necessary.
 - Conduct maintenance following manufacturer's guidelines.
7. Bioscape™ systems may or may not utilize an underdrain. Bioscape systems without an underdrain shall be designed with a temporary water storage area beneath the treatment media to provide a detention reservoir. Water shall not saturate the treatment media at any time
8. The distance from the point of entry of water to the most distant point on the surface of the Filtterra Bioscape treatment media shall not exceed 12-feet. The Filtterra Bioscape requires water to flow across the entire surface area to obtain optimal performance.

9. Install the Filtterra Bioscape in such a manner that flows exceeding the maximum Filtterra operating rate are conveyed around the Filtterra Bioscape mulch and media and will not resuspend captured sediment.
10. Discharges from the Filtterra® units shall not cause or contribute to water quality standards violations in receiving waters.

Applicant: Contech Engineered Solutions, LLC.

Applicant's Address: 11815 NE Glenn Widing Drive
Portland, OR 97220

Application Documents:

- State of Washington Department of Ecology Application for Conditional Use Designation, Americast (September 2006)
- Quality Assurance Project Plan Filtterra® Bioretention Filtration System Performance Monitoring, Americast (April 2008)
- Quality Assurance Project Plan Addendum Filtterra® Bioretention Filtration System Performance Monitoring, Americast (June 2008)
- Draft Technical Evaluation Report Filtterra® Bioretention Filtration System Performance Monitoring, Americast (August 2009)
- Final Technical Evaluation Report Filtterra® Bioretention Filtration System Performance Monitoring, Americast (December 2009)
- Technical Evaluation Report Appendices Filtterra® Bioretention Filtration System Performance Monitoring, Americast (August 2009)
- Memorandum to Department of Ecology Dated October 9, 2009 from Americast, Inc. and Herrera Environmental Consultants
- Quality Assurance Project Plan Filtterra® Bioretention System Phosphorus treatment and Supplemental Basic and Enhanced Treatment Performance Monitoring, Americast (November 2011)
- Filtterra® letter August 24, 2012 regarding sizing for the Filtterra® Shallow System.
- University of Virginia Engineering Department Memo by Joanna Crowe Curran, Ph. D dated March 16, 2013 concerning capacity analysis of Filtterra® internal weir inlet tray.
- Filtterra® Bioscape™ Bioretention System Model Configuration Approval Request, January 2014
- Terraphase Engineering letter to Jodi Mills, P.E. dated April 2, 2013 regarding Terraflume Hydraulic Test, Filtterra® Bioretention System and attachments.
- Technical Evaluation Report, Filtterra® System Phosphorus Treatment and Supplemental Basic Treatment Performance Monitoring. March 27th, 2014.
- State of Washington Department of Ecology Application for Conditional Use Level Designation, Contech Engineered Solutions (May 2015)
- Quality Assurance Project Plan Filtterra® Bioretention System, Contech Engineered Solutions (May 2015)
- Filtterra Bioretention System Armco Avenue General Use Level Designation Technical Evaluation Report, Contech Engineered Solutions (August 2019)

Applicant's Use Level Request:

General Level Use Designation for Basic, Enhanced, Phosphorus, and Oil Treatment.

Applicant's Performance Claims:

Field-testing and laboratory testing show that the Filtterra® unit is promising as a stormwater treatment best management practice and can meet Ecology's performance goals for basic, enhanced, phosphorus, and oil treatment.

Findings of Fact:Field Testing 2015-2019

1. Contech completed field testing of a 4 ft. x 4 ft. Filtterra® unit at one site in Hillsboro, Oregon from September 2015 to July 2019. Throughout the monitoring period a total of 24 individual storm events were sampled, of which 23 qualified for TAPE sampling criteria.
2. Contech encountered several unanticipated events and challenges that prevented them from collecting continuous flow and rainfall data. An analysis of the flow data from the sampled events, including both the qualifying and non-qualifying events, demonstrated the system treated over 99 % of the influent flows. Peak flows during these events ranged from 25 % to 250 % of the design flow rate of 29 gallons per minute.
3. Of the 23 TAPE qualified sample events, 13 met requirements for TSS analysis. Influent concentrations ranged from 20.8 mg/L to 83 mg/L, with a mean concentration of 46.3 mg/L. The UCL95 mean effluent concentration was 15.9 mg/L, meeting the 20 mg/L performance goal for Basic Treatment.
4. All 23 TAPE qualified sample events met requirements for dissolved zinc analysis. Influent concentrations range from 0.0384 mg/L to 0.2680 mg/L, with a mean concentration of 0.0807 mg/L. The LCL 95 mean percent removal was 62.9 %, meeting the 60 % performance goal for Enhanced Treatment.
5. Thirteen of the 23 TAPE qualified sample events met requirements for dissolved copper analysis. Influent concentrations ranged from 0.00543 mg/L to 0.01660 mg/L, with a mean concentration of 0.0103 mg/L. The LCL 95 mean percent removal was 41.2 %, meeting the 30 % performance goal for Enhanced Treatment.
6. Total zinc concentrations were analyzed for all 24 sample events. Influent EMCs for total zinc ranged from 0.048 mg/L to 5.290 mg/L with a median of 0.162 mg/L. Corresponding effluent EMCs for total zinc ranged from 0.015 mg/L to 0.067 mg/L with a median of 0.029 mg/L. Total event loadings for the study for total zinc were 316.85 g at the influent and 12.92 g at the effluent sampling location, resulting in a summation of loads removal efficiency of 95.9 %.
7. Total copper concentrations were analyzed for all 24 sample events. Influent EMCs for

total copper ranged from 0.003 mg/L to 35.600 mg/L with a median value of 0.043 mg/L. Corresponding effluent EMCs for total copper ranged from 0.002 mg/L to 0.015 mg/L with a median of 0.004 mg/L. Total event loadings for total copper for the study were 1,810.06 g at the influent and 1.90 g at the effluent sampling location, resulting in a summation of loads removal efficiency of 99.9 %.

Field Testing 2013

1. Filtterra[®] completed field-testing of a 6.5 ft x 4 ft. unit at one site in Bellingham, Washington. Continuous flow and rainfall data collected from January 1, 2013 through July 23, 2013 indicated that 59 storm events occurred. The monitoring obtained water quality data from 22 storm events. Not all the sampled storms produced information that met TAPE criteria for storm and/or water quality data.
2. The system treated 98.9 percent of the total 8-month runoff volume during the testing period. Consequently, the system achieved the goal of treating 91 percent of the volume from the site. Stormwater runoff bypassed during four of the 59 storm events.
3. Of the 22 sampled events, 18 qualified for TSS analysis (influent TSS concentrations ranged from 25 to 138 mg/L). The data were segregated into sample pairs with influent concentration greater than and less than 100 mg/L. The UCL95 mean effluent concentration for the data with influent less than 100 mg/L was 5.2 mg/L, below the 20-mg/L threshold. Although the TAPE guidelines do not require an evaluation of TSS removal efficiency for influent concentrations below 100 mg/L, the mean TSS removal for these samples was 90.1 percent. Average removal of influent TSS concentrations greater than 100 mg/L (three events) was 85 percent. In addition, the system consistently exhibited TSS removal greater than 80 percent at flow rates at a 100 inches per hour [in/hr] infiltration rate and was observed at 150 in/hr.
4. Ten of the 22 sampled events qualified for TP analysis. Americast augmented the dataset using two sample pairs from previous monitoring at the site. Influent TP concentrations ranged from 0.11 to 0.52 mg/L. The mean TP removal for these twelve events was 72.6 percent. The LCL95 mean percent removal was 66.0, well above the TAPE requirement of 50 percent. Treatment above 50 percent was evident at 100 in/hr infiltration rate and as high as 150 in/hr. Consequently, the Filtterra[®] test system met the TAPE Phosphorus Treatment goal at 100 in/hr. Influent ortho-P concentrations ranged from 0.005 to 0.012 mg/L; effluent ortho-P concentrations ranged from 0.005 to 0.013 mg/L. The reporting limit/resolution for the ortho-P test method is 0.01 mg/L, therefore the influent and effluent ortho-P concentrations were both at or near non-detect concentrations.

Field Testing 2008-2009

1. Filtterra[®] completed field-testing at two sites at the Port of Tacoma. Continuous flow and rainfall data collected during the 2008-2009 monitoring period indicated that 89 storm events occurred. The monitoring obtained water quality data from 27 storm events. Not all the sampled storms produced information that met TAPE criteria for storm and/or water quality data.

2. During the testing at the Port of Tacoma, 98.96 to 99.89 percent of the annual influent runoff volume passed through the POT1 and POT2 test systems respectively. Stormwater runoff bypassed the POT1 test system during nine storm events and bypassed the POT2 test system during one storm event. Bypass volumes ranged from 0.13% to 15.3% of the influent storm volume. Both test systems achieved the 91 percent water quality treatment-goal over the 1-year monitoring period.
3. Consultants observed infiltration rates as high as 133 in/hr during the various storms. Filtterra® did not provide any paired data that identified percent removal of TSS, metals, oil, or phosphorus at an instantaneous observed flow rate.
4. The maximum storm average hydraulic loading rate associated with water quality data is <40 in/hr, with the majority of flow rates < 25 in/hr. The average instantaneous hydraulic loading rate ranged from 8.6 to 53 inches per hour.
5. The field data showed a removal rate greater than 80% for TSS with an influent concentration greater than 20 mg/l at an average instantaneous hydraulic loading rate up to 53 in/hr (average influent concentration of 28.8 mg/l, average effluent concentration of 4.3 mg/l).
6. The field data showed a removal rate generally greater than 54% for dissolved zinc at an average instantaneous hydraulic loading rate up to 60 in/hr and an average influent concentration of 0.266 mg/l (average effluent concentration of 0.115 mg/l).
7. The field data showed a removal rate generally greater than 40% for dissolved copper at an average instantaneous hydraulic loading rate up to 35 in/hr and an average influent concentration of 0.0070 mg/l (average effluent concentration of 0.0036 mg/l).
8. The field data showed an average removal rate of 93% for total petroleum hydrocarbon (TPH) at an average instantaneous hydraulic loading rate up to 53 in/hr and an average influent concentration of 52 mg/l (average effluent concentration of 2.3 mg/l). The data also shows achievement of less than 15 mg/l TPH for grab samples. Filtterra® provided limited visible sheen data due to access limitations at the outlet monitoring location.
9. The field data showed low percentage removals of total phosphorus at all storm flows at an average influent concentration of 0.189 mg/l (average effluent concentration of 0.171 mg/l). We may relate the relatively poor treatment performance of the Filtterra® system at this location to influent characteristics for total phosphorus that are unique to the Port of Tacoma site. It appears that the Filtterra® system will not meet the 50 percent removal performance goal when you expect the majority of phosphorus in the runoff to be in the dissolved form.

Laboratory Testing

1. Filtterra® performed laboratory testing on a scaled down version of the Filtterra® unit. The lab data showed an average removal from 83-91% for TSS with influents ranging from 21 to 320 mg/L, 82-84% for total copper with influents ranging from 0.94 to 2.3 mg/L, and 50-61% for orthophosphate with influents ranging from 2.46 to 14.37 mg/L.
2. Filtterra® conducted permeability tests on the soil media.

3. Lab scale testing using Sil-Co-Sil 106 showed percent removals ranging from 70.1% to 95.5% with a median percent removal of 90.7%, for influent concentrations ranging from 8.3 to 260 mg/L. Filterra® ran these laboratory tests at an infiltration rate of 50 in/hr.
4. Supplemental lab testing conducted in September 2009 using Sil-Co-Sil 106 showed an average percent removal of 90.6%. These laboratory tests were run at infiltration rates ranging from 25 to 150 in/hr for influent concentrations ranging from 41.6 to 252.5 mg/l. Regression analysis results indicate that the Filterra® system's TSS removal performance is independent of influent concentration in the concentration range evaluated at hydraulic loading rates of up to 150 in/hr.

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Date	Revision
July 2014	GULD for Basic, Enhanced, Phosphorus and Oil granted
March 2015	Revised Contact Information
December 2015	Revised device name from Filterra® Boxless™ to Filterra® Bioscape™
June 2016	Revised text regarding Hydraulic conductivity value
November 2016	Changed Contech contact information
September 2019	GULD for Basic and Enhanced at 175 in/hr infiltration rate