



September 2017

CONDITIONAL USE LEVEL DESIGNATION (CULD) FOR BASIC (TSS) AND PHOSPHORUS

For

**Bio-Clean Environmental Services, Inc's
The Kraken™ Membrane Filter**

Ecology's Decision:

Based on Bio-Clean Environmental Services, Inc's application submissions for The Kraken™ Membrane Filter, Ecology hereby issues the following use level designations:

1. Conditional Use Level Designation (CULD) for Basic Treatment:

- **Sized at a hydraulic loading rate of no more than 0.05 gpm/ft² per cartridge (surface area of 170 square feet).**

Table 1. Kraken Membrane Filter cartridge design flow rates, operating at 0.05 gpm/sq ft.

Effective Cartridge Height (in)	Surface Area (ft²)	Cartridge Flow Rate (gpm/cartridge)
30.75	170	8.5

2. Ecology approves The Kraken™ Membrane Filter systems at the hydraulic loading rates shown in Table 1, to achieve the maximum water quality design flow rate. The water quality design flow rates are calculated 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 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.**

- 3. The use level designation expires on December 1, 2018 unless extended by Ecology, and is subject to the conditions specified below.**

Ecology's Conditions of Use:

The Kraken™ Membrane Filter shall comply with these conditions:

- 1. Bio-Clean Environmental Services shall design, assemble, install, operate, and maintain The Kraken™ Membrane Filter installations in accordance with Bio-Clean Environmental Services, Inc.'s applicable manuals and the Ecology Decision.**
- 2. Each site plan must undergo Bio-Clean Environmental Service's review before Ecology can approve the unit for site installation. This will ensure that site grading and slope are appropriate for use of a Kraken™ unit.**
- 3. Install The Kraken™ Membrane Filter in such a manner that you bypass flows exceeding the maximum operating rate and you will not resuspend captured sediment.**
- 4. Bio-Clean Environmental Services, Inc. commits to submitting a QAPP for Ecology approval by July 1, 2016 that meets the TAPE requirements for attaining a GULD for Basic Treatment at a hydraulic loading rate of 0.05 gpm/sq ft.**
- 5. Bio-Clean Environmental Services, Inc. shall complete all required testing and submit a TER for Ecology review by July 1, 2018.**
- 6. Bio-Clean Environmental Services, Inc. may request Ecology to grant deadline or expiration date extensions, upon showing cause for such extensions.**
- 7. Discharges from the Kraken™ Membrane Filter shall not cause or contribute to water quality standards violations in receiving waters.**

Applicant: Bio-Clean Environmental, Inc.

Applicant's Address: PO Box 869
Oceanside, CA 92049

Application Documents:

Application for Pilot Use Level Designation, The Kraken™ Membrane Filter, Bio-Clean Environmental Services, Inc. November 2015

NJCAT Technology Verification: Kraken™ Membrane Filtration System, Bio-Clean Environmental Services, Inc. October 2015

Application for Conditional Use Level Designation, The Kraken™ Membrane Filter, Bio-Clean Environmental Services, Inc. June 20, 2017

Applicant's Use Level Request:

- Conditional Use Designation as a Basic Treatment device in accordance with Ecology's *Stormwater Management Manual for Western Washington*

Applicant's Performance Claims:

- Based on laboratory testing, at a hydraulic loading rate of 0.05 gpm/sq. ft. (8.5 gpm/cartridge for a 30.75" tall cartridge), The Kraken™ Membrane Filter has an average suspended sediment concentration (SSC) removal efficiency of 83%. Bio-Clean achieved these results using a custom blended test sediment (d₅₀ of 52 µm) at an average influent concentration of 200 mg/L.

Ecology's Recommendations:

Ecology finds that:

- Bio-Clean Environmental, Inc. qualifies for the opportunity to demonstrate, through field-testing in the Pacific Northwest, whether The Kraken™ Membrane Filter can attain Ecology's Basic Treatment goals.

Findings of Fact:

1. Good Harbour Laboratories conducted laboratory testing in August 2015 at their site in Mississouga, Ontario. Good Harbour Laboratories is an independent water technology-testing lab. The laboratory set up tested a commercially available Kraken™ Membrane Filter, model KF-4-4. This unit has a total sedimentation area of 11.72 sq. ft. and contains 16 filters, which allowed for a hydraulic loading rate of 0.303 cfs (136 gpm). Based on the lab test results:
 - Bio-Clean evaluated the system using a custom blended test sediment consisting of a 50:7 ratio of 1- to 1,000-micron Silica blended with Min-U-Sil® 30. The test sediment had a mean particle size of 52 microns, with an overall particle size distribution of 43 percent sand, 46 percent silt, and 11 percent clay.
 - Bio-Clean evaluated removal efficiency over 16 events using an influent SSC concentration of 200 mg/L. The Kraken™ Membrane Filter model KF-4-4, operating at 100% of the hydraulic flow capacity with an average influent SSC concentration of 200 mg/l, had an average removal efficiency of 83 percent.

- Bio-Clean evaluated sediment mass loading capacity over an additional 17 events using an influent SSC concentration of 400 mg/L. The Kraken™ Membrane Filter model KF-4-4, operating at 100% of the hydraulic flow capacity with an average influent SSC concentration of 400 mg/l, had an average removal efficiency of 89 percent.
 - Bio-Clean terminated the sediment mass loading capacity test once the mass of the captured sediment exceeded 1.5 times the recommended minimum amount for filter maintenance. The total mass of sediment captured was 434 pounds.
 - Bypass conditions did not occur during the removal efficiency or sediment mass loading capacity tests.
2. Bio-Clean performed field-testing of the Kraken at the Lake Union Ship Canal Test Facility in Seattle, WA which shows:
 - A mean TSS removal rate of 85% and median removal of 91% based on a total of 14 storm events with concentrations greater than 20 mg/l. A regression analysis of percent removal vs. flow rate show that the Kraken obtained 80% removals at the design flow rate of 0.05 gpm per square foot of filter area.
 - A mean total phosphorus removal rate of 72% and a median removal of 75% based on a total of 14 storm events. A regression analysis of the percent removal vs flow rate show that the Kraken obtained 50% removals at the design flow rate of 0.05 gpm per square foot of filter area.
 - A mean dissolved copper removal rate of 2%, with an export of dissolved copper during 6 out of 14 storm events.
 - A mean dissolved zinc removal rate of 5%, with an export of dissolved zinc during 5 out of 14 storm events.

Other The Kraken™ Membrane Filter Related Issues to be Addressed By the Company:

1. Test the system under normal operating conditions, such that pollutants partially fill the settling basin. Results obtained for “clean” systems may not be representative of typical performance.
2. Conduct field-testing at sites that are indicative of the treatment goals.
3. Conduct testing to obtain information about maintenance requirements in order to come up with a maintenance cycle.
4. Conduct loading tests on the filter to determine that the filter can run successfully for the full maintenance cycle and determine the maximum treatment life of the system.

Technology Description:

Download at <http://www.biocleanenvironmental.com/>

Contact Information:

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Applicant website: <http://www.biocleanenvironmental.com/products/>

Ecology web link: <http://www.ecy.wa.gov/programs/wq/stormwater/newtech/index.html>

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Revision History

Date	Revision
January 2016	PULD Granted
July 2017	Revised Manufacturer Contact Information
September 2017	Upgrade certification to a CULD