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VERIFICATION STATEMENT

GLOBE Performance Solutions

Verifies the performance of

SciCLONE™ Hydrodynamic Separator

Developed by Bio Clean Environmental Inc., a Forterra Company
Oceanside, CA, USA

Registration: GPS-ETV_VR2022-02-28

In accordance with

ISO 14034:2016

**Environmental Management —
Environmental Technology Verification (ETV)**

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February 28, 2022
Vancouver, BC, Canada

GLOBE PERFORMANCE SOLUTIONS

Verification Body
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Technology description and application

The Bio Clean SciCLONE™ hydrodynamic separator (also known as an oil grit separator) consists of a prefabricated concrete structure with various internal components designed to maximize the flow path of stormwater, protect against sediment scour and capture/retain light liquids. It removes pollutants from stormwater runoff using a series of flow splitters, weirs and baffles. The device traps suspended particulates by promoting gravity settling, and although not tested in this verification, the unit is also designed to capture and retain floatables and light liquids such as oil through an oil/floatables skimmer (Figure 1).

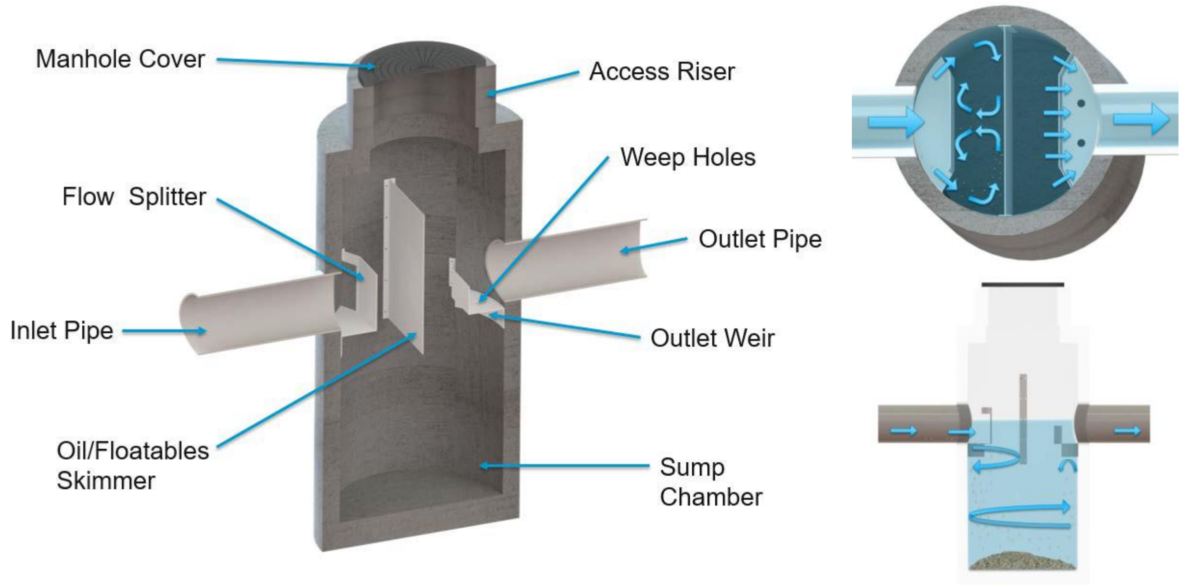

Figure 1: Schematic of system components (left) and flow paths during normal operation (right)

The unique design of the SciCLONE™, with a flow splitter, oil/floatables skimmer, and outlet weir maximizes the flow path (Figure 1) and minimizes velocity for maximum performance. The system is designed to be installed online and process high flows internally. Higher flows are able to pass over the top of the flow splitter without impedance, under the oil/floatables skimmer and to the outlet. The outlet weir creates less turbulent conditions into the pipe and thus reduces head loss during peak flow conditions. The outlet weir also contains one or more weep holes on the horizontal deck to allow the water level to return to a level even with the inlet of the outlet pipe following a storm event.

Performance conditions

The data and results published in this Technology Fact Sheet were obtained from the testing program conducted on the Bio Clean SciCLONE™ Hydrodynamic Separator, in accordance with the *Procedure for Laboratory Testing of Oil-Grit Separators (Version 3.0, June 2014)*. The Procedure was prepared by the Toronto and Region Conservation Authority (TRCA) for the Canadian Environmental Technology Verification Program. A copy of the Procedure may be accessed on the Canadian ETV website at www.etvcanada.ca.

Performance claim(s)

Capture test[1]:

During the capture test, the Bio Clean SciCLONE™ HDS device, with a false floor set to 50% of the manufacturer's recommended maximum sediment storage depth and a constant influent test sediment concentration of 200 mg/L, removes 70, 71, 60, 54, 51, 45, and 39 percent of influent sediment by mass at surface loading rates of 40, 80, 200, 400, 600, 1000, and 1400 L/min/m^2, respectively.

Scour test[1]:

During the scour test, the Bio Clean SciCLONE™ HDS device, with 10.2 cm (4 inches) of test sediment pre-loaded onto a false floor reaching 50% of the manufacturer's recommended maximum sediment sump storage depth, generate corrected effluent concentrations of 0.0, 0.0, 0.0, 0.0 and 3.8 mg/L at 5-minute duration surface loading rates of 200, 800, 1400, 2000, and 2600 L/min/m^2, respectively.

Performance results

The test sediment consisted of ground silica (1 – 1000 micron) with a specific gravity of 2.65, uniformly mixed to meet the particle size distribution specified in the testing procedure. The *Procedure for Laboratory Testing of Oil Grit Separators* requires that the average (minimum 3 samples) of the test sediment particle size distribution (PSD) meet the specified PSD percent less than values within a boundary threshold of 6%, with a median no greater than 75 µm. Comparison of the average test sediment PSD to the CETV specified PSD in Figure 2 indicates that the test sediment used for the capture and scour tests met these conditions, with a median particle size of 66 µm. The average was determined from seven samples prepared for each of the tested surface loading rates. All seven sample had a median particle size below 75 µm.

[1] The claim can be applied to other units smaller or larger than the tested unit as long as the untested units meet the scaling rule specified in the Procedure for Laboratory of Testing of Oil Grit Separators (Version 3.0, June 2014)

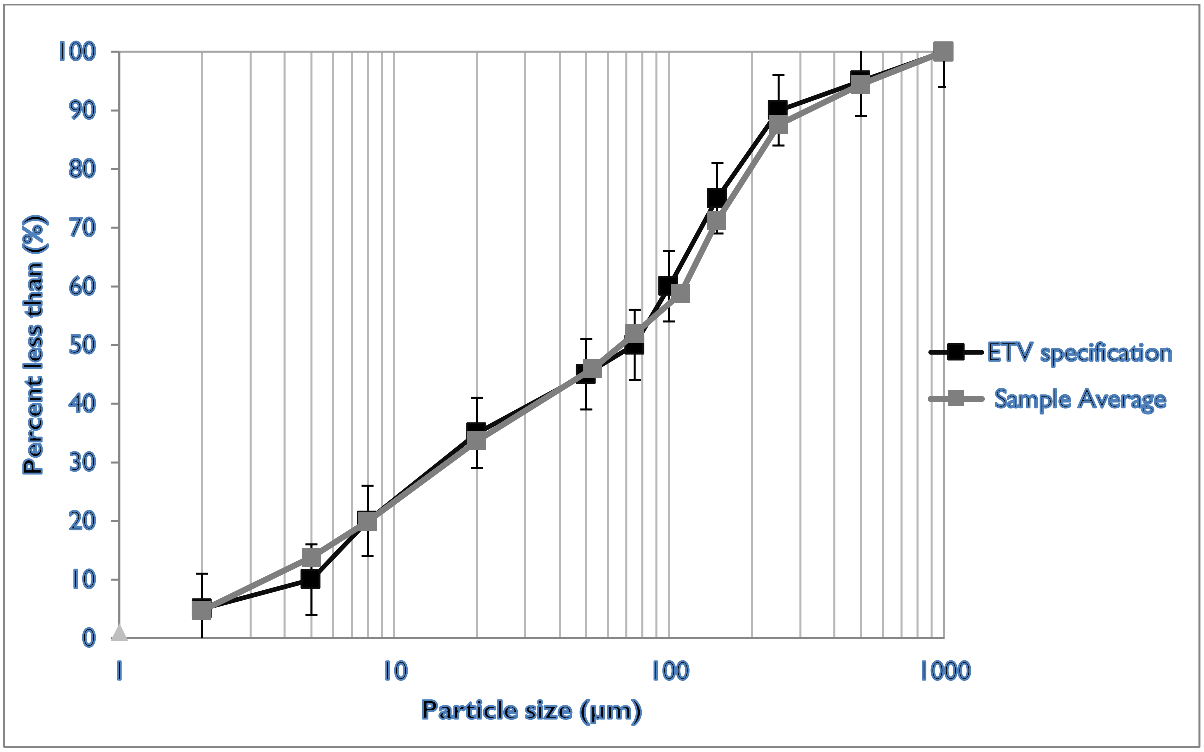

Figure 1. The sample average particle size distribution (PSD) of the test sediment used for the capture and scour test compared to the specified PSD.

The capacity of the device to retain sediment was determined at seven surface loading rates using the modified mass balance method. This method involved measuring the mass and particle size distribution of the injected and retained sediment for each test run. Performance was evaluated with a false floor at 0.23 m from the bottom, simulating the technology filled to 50% of the manufacturer's recommended maximum sediment storage depth. The test was carried out with clean water that maintained a sediment concentration below 20 mg/L. Based on these conditions, removal efficiencies for individual particle size classes and for the test sediment as a whole were determined for each of the tested surface loading rates (Table 1).

In some instances, the removal efficiencies were above 100% for certain particle size fractions. These discrepancies are not unique to any one test laboratory and may be attributed to challenges relating to the blending of sediment, collection of representative samples for laboratory submission, and laboratory analysis of PSD. Due to these errors, caution should be exercised in applying the removal efficiencies by particle size fraction for the purposes of sizing the tested device (see Bulletin # CETV 2016-11-0001). The results for "all particle sizes by mass balance" (see Table 1 and 2) are based on measurements of the total injected and retained sediment mass, and are therefore not subject to blending, sub-sampling or PSD analysis errors.

Table 1. Removal efficiencies (%) of the SciCLONE™ SC4 unit at specified surface loading rates.

Particle size fraction (µm)	Surface loading rate (L/min/m²)						
	40	80	200	400	600	1000	1400
>500	82	99	70	100*	92	76	72
250 - 500	88	95	100*	88	81	97	96
150 - 250	99	100*	95	98	100*	96	85
105 - 150	100*	95	100*	86	81	91	71
75 - 105	100*	95	71	99	83	55	40
53 - 75	83	97	100*	60	57	45	28
20 - 53	73	71	52	28	18	6	6
8 - 20	47	48	14	10	4	0	0
5 – 8	24	23	11	3	0	0	0
<5	0	1	1	0	0	0	0
All particle sizes by mass balance	**70.4**	**71.0**	**59.8**	**53.9**	**50.9**	**45.4**	**39.3**

* Removal efficiencies were calculated to be above 100%. Calculated values ranged between 101 and 116% (average 106%). See text and Bulletin # CETV 2016-11-0001 for more information on the potential causes of these errors.

Figure 3 compares the particle size distribution (PSD) of the three sample average of the test sediment to the PSD of the sediment retained by the SC4 unit at each of the tested surface loading rates. As expected, the capture efficiency for fine particles in the unit was generally found to decrease as surface loading rates increased.

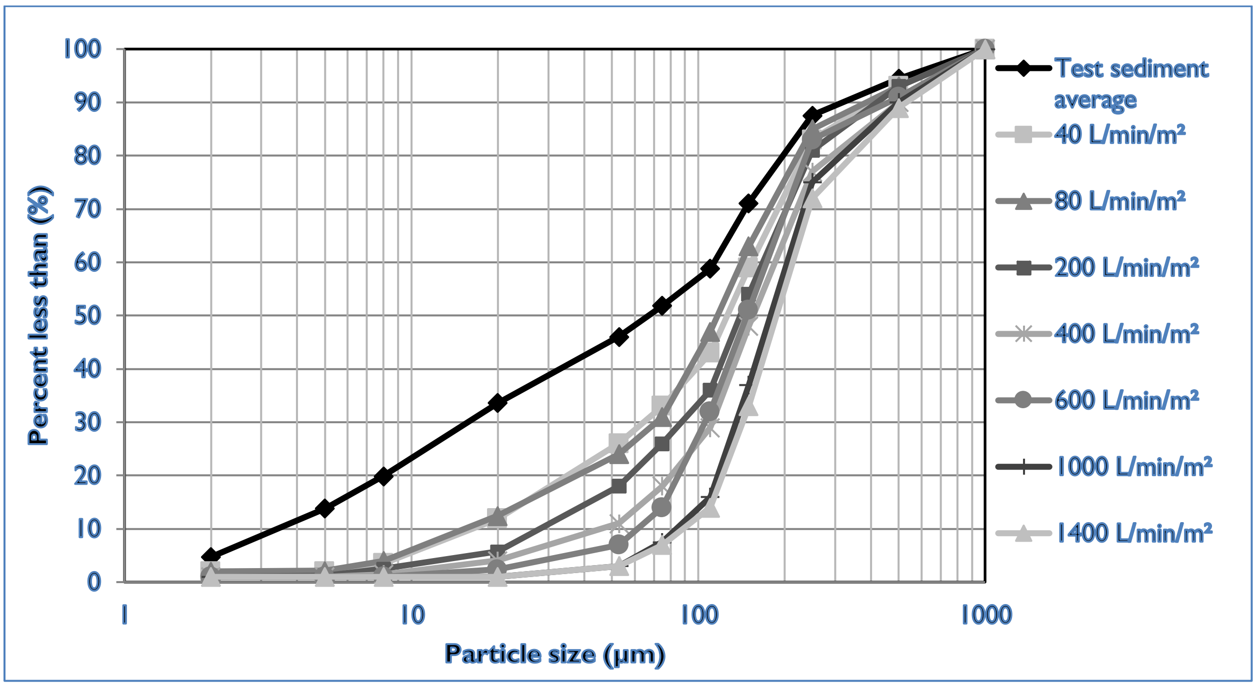

Figure 2. Particle size distribution of sediment retained in the SC-4 unit in relation to the injected test sediment average.

Table 2 shows the results of the sediment scour and re-suspension test for the SC-4 unit. The scour test involved preloading 10.2 cm of fresh test sediment into the sedimentation sump of the device. The sediment was placed on a false floor to mimic a device filled to 50% of the maximum recommended sediment storage depth. Clean water was run through the device at five surface loading rates over a 30 minute period. Each flow rate was maintained for 5 minutes with a one minute transition time between flow rates. Effluent samples were collected at one minute sampling intervals and analyzed for Suspended Sediment Concentration (SSC) and PSD by recognized methods. The effluent samples were subsequently adjusted based on the background concentration of the influent water. The smallest 5% of particles captured during the 40 L/min/m² sediment capture test (≤9.3 µm) was also used to adjust the concentration, as per the method described in Bulletin # CETV 2016-09-0001. Results showed average adjusted effluent sediment concentrations below 4 mg/L at all tested surface loading rates.

Table 2. Scour test adjusted effluent sediment concentrations

Run	Surface loading rate (L/min/m²)	Run time (min)	Background sample concentration (mg/L)[a]	Average adjusted effluent suspended sediment concentration (mg/L)[b]
1	200	5	0.0	0.0
2	800	5	0.5	0.0
3	1400	5	0.2	0.0
4	2000	5	0.6	0.0
5	2600	5	0.5	3.8

a. The test lab reported a concentration range of between 0 and 0.6 mg/L. Observed concentrations between these ranges were interpolated from a graph provided by the test lab.
b.The effluent suspended sediment concentration were adjusted based on the background concentration and smallest 5% of sediment particles (i.e. d5) removed during the 40 L/min/m² capture test, as per the procedure described in Bulletin # CETV 2016-09-0001.

Variances from testing Procedure

The following minor deviations from the *Procedure for Laboratory Testing of Oil-Grit Separators* (Version 3.0, June 2014) have been noted:

1. The Procedure stipulates that a minimum of 11.3 kg of test sediment be fed into the test unit for each tested surface loading rate (SLR). During the 1000 L/s/m² SLR test, only 11.0 kg was fed into the unit, which is 0.3 kg less than the specified minimum. The laboratory decided not to repeat the test because the ASTM C1746 'standard test method for suspended sediment removal efficiency of hydrodynamic stormwater separators and underground settling devices' specifies that only 10 kg is required to produce accurate and repeatable results. The verifier concurred that the slightly lower quantity of test sediment used for this SLR test was likely to have negligible impact on sediment capture test results.

2. It was necessary to change flow meters during the scour test, as the required flows exceeded the minimum and/or maximum range of any single meter. After the 800 L/min/m² SLR, the flow was gradually shut down and re-initiated through the larger meter immediately after closing the valve controlling flows to the small meter. The transition time of 1-minute for each target flow

was followed, This procedure was approved by the verifier prior to testing, in recognition that most particles susceptible to scour at low flows would not be in the sump at higher flows.

3. As part of the capture test, evaluation of the 40 and 80 L/min/m^2 surface loading rates were split into 4 and 2 parts, respectively, due to the long duration needed to feed the required minimum of 11.3 kg of test sediment into the unit. The amended procedure was reviewed and approved by the verifier prior to testing.

Verification

The verification was completed by the Verification Expert, Toronto and Region Conservation Authority, contracted by GLOBE Performance Solutions, using the International Standard ***ISO 14034:2016 Environmental management -- Environmental technology verification (ETV)***. Data and information provided by Bio Clean to support the performance claim included the following: Performance test report prepared by Alden Research Laboratory, Inc , and dated September 2018. This report is based on testing completed in accordance with the *Procedure for Laboratory Testing of Oil-Grit Separators* (Version 3.0, June 2014).

What is ISO14034:2016 Environmental management – Environmental technology verification (ETV)?

ISO 14034:2016 specifies principles, procedures and requirements for environmental technology verification (ETV), and was developed and published by the *International Organization for Standardization (ISO)*. The objective of ETV is to provide credible, reliable and independent verification of the performance of environmental technologies. An environmental technology is a technology that either results in an environmental added value or measures parameters that indicate an environmental impact. Such technologies have an increasingly important role in addressing environmental challenges and achieving sustainable development.

For more information on the Bio Clean Environmental Inc., SciCLONE™ Hydrodynamic Separator please contact:

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