NJCAT TECHNOLOGY VERIFICATION

Oldcastle BioPod™ HF

Oldcastle Infrastructure

August 2025

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1. Description of Technology

The BioPod™ HF system (**Figure 1**) is a filtration manufactured treatment device (MTD) that utilizes an advanced biofiltration design for treatment to remove total suspended solids (TSS), trash, and debris from storm water runoff[1]. The BioPod™ HF is available in 3 configurations; a planter style, where stormwater runoff flows directly onto the media bed, and two tree box configurations, one with an external bypass and the other with an integral bypass tray. Environmentally friendly and aesthetically pleasing, BioPod™ HF systems are a proven, Low-Impact Development (LID) solution for stormwater treatment. BioPod™ HF systems integrate seamlessly into standard site drainage and can accommodate a wide variety of vegetation to meet green infrastructure requirements.

BioPod™ HF Underground with External Bypass

BioPod™ HF Tree with Integral Bypass Tray

BioPod™ HF Planter

Figure 1 BioPod™ HF Model Configurations

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[1] Only the removal of suspended sediment was assessed and verified in this test plan.

BioPod™ HF uses proprietary StormMix™ HF media, an engineered media specifically designed for high-flow applications, to enable treatment of a large drainage area in a compact footprint. The StormMix™ HF media is comprised of aggregate, organic matter and an additive that is commonly used in drinking water treatment. Water flows onto the media bed directly or by way of an inlet tray or chamber, depending on the configuration. Treated flow exits through the media bed underdrain pipe. During periods of high flow, excess volume bypasses the media bed when the driving head exceeds six inches above the mulch layer. This prevents high flow from entering the biofiltration chamber where it could resuspend previously captured pollutants. The various BioPod™ HF configurations are listed in the Verification Appendix.

The BioPod™ HF system can be configured as a tree box filter with tree and curb inlet or as a planter box filter with shrubs, grasses and an open top. Additionally, an open bottom configuration is available to promote infiltration and groundwater recharge. The configuration and size of the BioPod™ HF system can be designed to meet the specific requirements of each individual project.

2. Laboratory Testing

Testing was performed to determine the sediment removal efficiency and the sediment mass loading capacity using the effluent grab sample test method. The test unit was equivalent to a commercially sized 2 X 4 BioPod™ HF system with external bypass, filled with StormMix™ HF media. The maximum treatment flow rate (MTFR) for this BioPod™ HF is 17 GPM, based on a hydraulic loading rate of 4.25 gpm/ft^2. Water is conveyed into the BioPod™ HF system in a variety of ways, depending on the configuration. For the purposes of this certification study, flow was piped directly onto the surface of the media bed as a worst-case scenario. The external bypass chambers for the 2 X 4 BioPod™ HF have been excluded from the test unit, leaving only the media bed.

The BioPod™ HF Lab Test Unit (**Figure 2**) was the biofiltration chamber, a 2-foot X 2-foot vault housing the media bed and underdrain system. As in all commercial installations, the media layer was 18-inches deep and topped with 2-inches of mulch. The media bed sat over a slotted drainage pipe imbedded within 6-inches of drainage stone. For the purposes of determining the water level in the vault during the performance test, the vault was equipped with an external sight glass.

Performance testing was conducted from June - July 2025 at the Oldcastle Water Lab located in Mississauga, Ontario. Since testing was carried out in-house, all test activities were conducted under the observation of a 3rd party witness, Dr. Pierre Plouffe of Plouffe Consulting. Dr. Plouffe's credentials were reviewed and approved by NJCAT prior to the start of testing.

The laboratory test unit vault was constructed out of plywood. In commercial systems, the vault is typically made of concrete. For this testing however, the use of a plywood vault was proposed due to the difficulties associated with transporting and physically supporting the weight of a concrete vault. The plywood vault of the test unit is equivalent to commercial concrete vaults in all key dimensions. The use of the plywood vault in lieu of concrete did not have an impact on system performance. For the laboratory performance evaluation, the test unit did not contain any vegetation. The addition of vegetation in the field would serve to enhance the performance and longevity of the system.

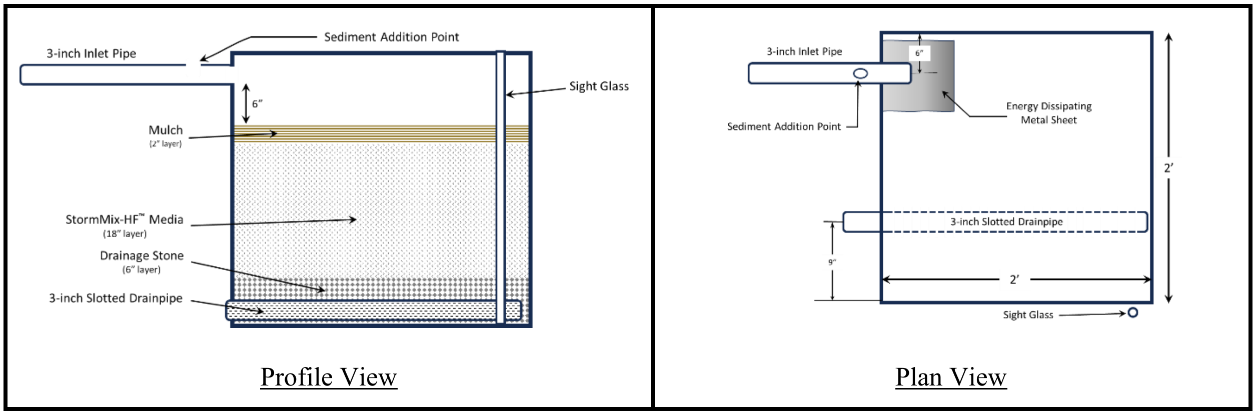

Figure 2 BioPod™ HF Lab Test Unit Configuration

2.1 Test Setup

The laboratory test set-up was a water flow loop, capable of moving water at a rate of up to 200 GPM. The test loop, illustrated in **Figure 3**, was comprised of water reservoirs, pumps, sediment filter, receiving tank and a flow meter.

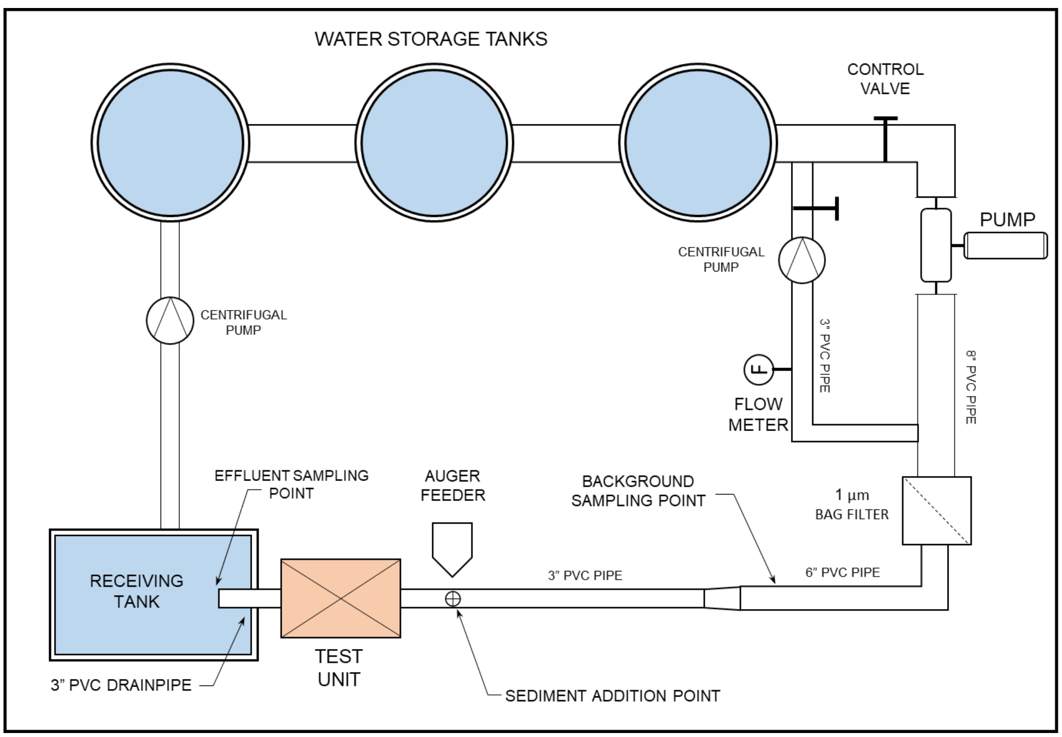

Figure 3 Laboratory Test Setup

Water Flow and Measurement

From the water supply tanks, water was pumped using a WEG centrifugal pump. Flow measurement was done using a Toshiba Model LF620FFA211E electromagnetic type flow meter with an accuracy of ± 0.2% of reading. The data logger used was a MadgeTech Process 101A data logger, configured to record a flow measurement once every 30 seconds.

The water in the flow loop was circulated through a filter housing containing high-efficiency pleated bag filters with a 1.0 µm absolute rating. The inlet pipe delivering flow to the media bed was 3-inches in diameter and 91-inches in length. The slope of the inlet pipe was 1.5%. An energy dissipating metal sheet was placed on the surface of the media, just below the water inlet (**Figure 4**). A metal sheet or a layer of river rock is typically used to prevent media erosion at the surface of the bed.

Figure 4 Media Bed Surface

Sediment addition was done through a port on the crown of the influent pipe, 23 inches upstream of the BioPod™ HF. The sediment feeder was an Auger Feeders Model VF-1 volumetric screw feeder with vibratory hopper. The feeder had a 10-gallon hopper above the auger screw to provide a constant supply of sediment.

The effluent pipe exiting the test unit was 3-inches in diameter and 26-inches in length. The effluent pipe was fitted with an orifice flow control to maintain the water level within the media bed at the desired level. The slope of the outlet pipe was 1.5% and the pipe terminated with a free-fall into a receiving tank. The water that collected in the receiving tank was pumped back to the supply tanks, completing the flow loop.

Sample Collection

Background water samples were taken by hand. A 1L, wide-mouth, sample jar was filled using a ¾-inch, full-port, sampling ball valve located downstream of the sediment bag filter and upstream of the sediment addition point (**Figure 5**).

Effluent samples were also taken using 1L, wide-mouth jars as the effluent emptied into the effluent tank (**Figure 6**). The effluent sample was taken by holding the sample bottle at the narrowest part of the effluent stream until the bottle was filled.

Figure 5 Background Sampling Point

Figure 6 Effluent and Drawdown Sampling Point

Sediment calibration samples were taken at the end of the auger feeder's spout attachment (**Figure 7**) by holding a 500 mL jar just under the opening. The test sediment was sampled three times per run to confirm the sediment feed rate. Each sediment feed rate sample was collected over an interval timed to the nearest 0.01 second. Samples were weighed to the nearest 0.01 g.

Figure 7 Sediment Auger Feeder

The BioPod™ HF employs a post-operation drawdown feature. At the end of each test run, flow to the unit was stopped and the drawdown effluent was sampled at the effluent sampling point. Two evenly volumetrically spaced samples were collected to determine suspended sediment concentration (SSC). The first volumetrically spaced sample was taken after 1/3 of the water volume had drained from the vault and the second after 2/3 of the volume had drained.

Other Instrumentation and Measurement

Water temperature was measured and recorded using a MadgeTech MicroTemp data logger that was suspended in a basin, located under the effluent pipe in the receiving tank. The MicroTemp was configured to take a temperature reading once every minute.

Run and sampling times were measured using a NIST traceable stopwatch, Control Company Model 61161-350.

The sediment feed samples that were taken during the run were collected in 500 mL jars and weighed on a top loading balance (Mettler Toledo, PB4002-S/FACT).

The sediment that was added to the auger feeder, and the sediment recovered following each run, was weighed on an industrial balance (Mettler Toledo, BBA231-3BB35A/S) with a resolution of 5 grams.

Water elevation measurements were taken using an engineer's rule with a resolution of 1/8-inches, positioned at the sight glass and at the surface of the media.

2.2 Test Sediment

Removal Efficiency Test Sediment

The test sediment used for the removal efficiency study (1-1000 µm) was a custom blend of commercially available silica sediments that was blended by Oldcastle Infrastructure; this particular batch was lot # A005-034. The sediment was blended in four separate batches. Three composite sediment samples were formed by taking sediment samples from the top and bottom of the mixing drum, all in different locations, for each batch. Each of the three composite samples was reduced in size using a riffle splitter. Sediment sampling was performed under the observation of the 3rd party witness. Following the sampling, the sediment was stored in two 50-gallon drums lined with 6-mil plastic liners. The drums were security sealed until used. The three composite sediment samples were sent to Bureau Veritas in Mississauga, ON for particle size analysis using the methodology of ASTM D6913-17, "Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis" and ASTM D7928-21 "Standard Test Method for Particle-Size Distribution (Gradation) of Fine-Grained Soils Using the Sedimentation (Hydrometer) Analysis". The test results are summarized in **Table 1** and shown graphically in **Figure 8.**

Table 1 Particle Size Distribution of 1- 1000 µm Test Sediment

Particle Size (µm)	Test Sediment Particle size (%passing) ◊				NJDEP Specification (minimum % Passing) ±
	Sample 1	Sample 2	Sample 3	Average	
1000	100	100	100	100	100
500	96	96	98	97	95
250	90	90	91	90	90
150	77	77	78	78	75
100	60	61	61	61	60
75	53	54	55	54	50
50	43	43	43	43	45
20	32	33	33	33	35
8	18	18	18	18	20
5	13	13	12	13	10
2	6	6	6	6	5
d_{50}, um	68	66	65	66	<75

◊ Where required, particle size data has been interpolated to allow for comparison to the required particle size specification.

± A measured value may be lower than a target minimum % less than value by up to two percentage points, provided the measured d_{50} value does not exceed 75 microns.

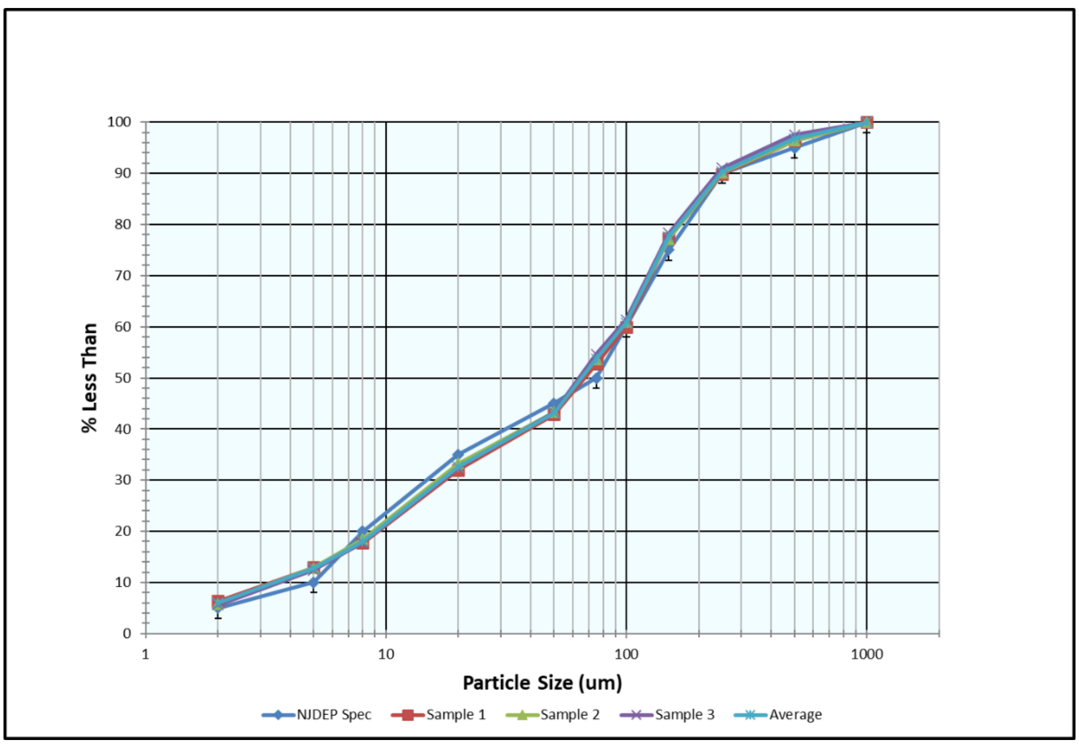

Figure 8 Average Particle Size Distribution of 1-1000 µm Test Sediment

In addition to particle size distribution, Bureau Veritas also performed a moisture analysis of the test sediment in accordance with ASTM D2216 "Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass". The determined water content in the test sediment was found to be < 0.30%. This amount of moisture was not considered significant and therefore no correction for the amount of moisture in the sediment mass was made.

With a d_{50} of 66 µm (NJDEP specifications is <75 µm), the test sediment was finer than the sediment required by the NJDEP test protocol.

The blended test sediment was found to meet the NJDEP particle size specification and was acceptable for use.

2.3 Removal Efficiency Testing

Removal Efficiency Testing was conducted in accordance with Section 4 of the NJDEP Laboratory Protocol for Filtration MTDs. Testing was completed at a target flow rate of 17 GPM and a target sediment concentration of 200 mg/L.

Effluent grab samples were taken 5 times per run (at evenly spaced intervals), with each run lasting 32 minutes in duration, followed by a drawdown period. In addition to the effluent samples, 3 background samples were taken with every odd-numbered effluent sample (1st, 3rd and 5th). In all cases, effluent sampling did not start until the BioPod™ HF had been in operation for a minimum of three detention times. When the test sediment feed was interrupted for measurement, the next effluent sample was collected following a minimum of three detention times. Sampling times for removal efficiency testing are summarized in **Table 2**. Effluent and background samples were collected in clean 1L wide-mouth jars.

Three sediment feed samples were collected during each run to confirm the sediment feed rate, one sample at the start of dosing, one sample in the middle of the test run and one sample just prior to the conclusion of dosing. Each sediment feed rate sample was collected in a clean 500 mL jar in approximately one-minute duration. Sediment sampling was timed to the nearest 0.01 second using a calibrated stopwatch and samples were weighed to the nearest 0.01 g.

Table 2 Removal Efficiency Sampling Frequency

Run Time (min.)	Sample/Measurement Taken
0.0	**START PUMP**
0.0	Feed Sediment-1
5.0	Water Level
10.0	Water Level
12.5	Background-1 & Water Level
13.0	Effluent-1 & Water Level
14.0	Effluent-2 & Water Level
14.5	Background-2 & Water Level
15.0	Effluent-3 & Water Level
16.0	Feed Sediment-2 & Water Level
20.0	Water Level
25.0	Water Level
30.0	Effluent-4 & Water Level
30.5	Background-3 & Water Level
31.0	Effluent-5 & Water Level
32.0	Feed Sediment-3 & Water Level
32.0	**STOP PUMP / END OF RUN**
To be determined	Drawdown-1
To be determined	Drawdown-2

Notes: (1) The maximum possible detention time (DT) at MTFR is 1.3 min therefore 3 x DT = 3.9 min.

(2) The Background sampling preceded the Effluent sampling by approximately 30 seconds at each background sampling timepoint.

(3) The drawdown time was determined based on water volume in the vault.

The effluent drawdown samples were collected at the end of each removal efficiency run, after the pump had been switched off and the sediment feed stopped. The drawdown effluent was volumetrically quantified based on the liquid level in the vault at the end of each run. The drawdown samples were taken at the same spot as the normal operation effluent samples. Two evenly volumetric spaced samples were collected to determine SSC concentration. The first volumetrically spaced sample was taken after approximately 1/3 of the water volume had drained from the vault and the second after 2/3 of the volume had drained.

2.4 Sediment Mass Load Capacity

The Sediment Mass Loading Capacity of the BioPod™ HF was determined as a continuation of the Removal Efficiency Testing. All aspects of the test procedure remained the same except that the target influent sediment concentration was increased from 200 to 400 mg/L. Sediment Mass Loading Capacity testing began after 14 runs of removal efficiency had been completed. Testing continued until the run removal efficiency dropped below 80%.

2.5 Scour Testing

Scour testing was not assessed for the BioPod™ HF system. The BioPod™ HF is intended for off-line configurations where flows in excess of the MTFR will be diverted away from the media bed.

2.6 Laboratory Proficiency Testing

Prior to the start of testing, six spiked blind SSC samples, three at a concentration of 20.0 ± 5.0 mg/L and three at a concentration of 50.0 ± 5.0 mg/L, were prepared using the same test sediment as for the Removal Performance Testing. These samples were submitted to OSHTECH Incorporated in Etobicoke, Ontario for analysis. Since ASTM D3977 is not part of their scope of accreditation, per the NJDEP protocol, they are required to demonstrate proficiency testing. Samples were analyzed for sediment concentration (SSC) in accordance with ASTM Method D 3977-97 “Standard Test Methods for Determining Sediment Concentrations in Water Samples”. Samples analysis occurred on March 13, 2025. The results of the proficiency testing are summarized in **Table 3** below. The average percent recovery at each level of the spiked SSC samples was within the range of 85 - 115%, meeting the proficiency requirement for SSC testing.

Table 3 Laboratory Proficiency Testing Results

Sample ID	Sample Concentration (mg/L)	Reported SSC (mg/L)	% Recovery
Control #1	20.13	19.2	95.4
Control #3	20.09	20.5	102
Control #4	20.06	17.9	89.2
		Average	95.6
Control #2	50.07	47.7	95.3
Control #5	51.01	50.5	99.0
Control #6	50.02	49.4	97.8
		Average	97.4

3. Performance Claims

Per the NJDEP verification process and based on the laboratory testing conducted for the BioPod™ HF, the following are the performance claims made by Oldcastle Infrastructure.

Total Suspended Solids (TSS) Removal Efficiency

Based on the laboratory testing conducted in accordance with the New Jersey Department of Environmental Protection Laboratory Protocol to Assess Total Suspended Solids Removal by a Filtration Manufactured Treatment Device, the 2X4 BioPod™ HF biofiltration chamber (2'x2') achieved a cumulative removal efficiency of 88.4% after 14 runs of the specified NJDEP silica gradation, under a hydraulic loading rate of 4.25 GPM/sq. ft.

Maximum Treatment Flow Rate (MTFR)

The MTFR of the 2X4 BioPod™ HF system was 17 GPM based on a media bed surface area of 4 sq. ft. The MTFR increases with system size but always maintains the same loading rate of 4.25 GPM/sq. ft. (409 in/hr).

Effective Sedimentation Treatment Area (ESTA)

The ESTA for the 2X4 BioPod™ HF is 4 sq. ft.

Effective Filtration Treatment Area (EFTA)

In a horizontal bed filter the Effective Filtration Treatment Area is equal to the Effective Sedimentation Treatment Area.

Sediment Mass Loading Capacity

The sedimentation mass loading capacity varies with the BioPod™ HF Biofilter model size. Based on the laboratory testing results, a filter with a media surface area of 4 sq. ft. has a mass loading capacity of 90.3 lbs (22.6 lb/sq. ft.). Throughout the mass load capacity testing, the BioPod™ HF maintained a removal efficiency of greater than 80%.

Wet Volume and Detention Time

The wet volume of the media bed was determined empirically by collecting and weighing the water within the vault while at an elevation equal to the top of the mulch layer above the media bed. The measured water volume for the 4 sq. ft. bed was 24.0 gallons. At an MTFR of 17 GPM, the detention time would be 1.4 minutes.

Maximum Allowable Inflow Drainage Area

Based on the NJDEP requirement to determine maximum allowable inflow area using 600 lbs of sediment per acre annually, and the sediment mass loading capacity for the BioPod™ HF tested of 90.3 lbs (22.6 lbs/sq. ft. of EFTA), the 2 X 4 BioPod™ HF system has a maximum allowable inflow drainage area of 0.038 acres per square foot of media bed area.

4. Supporting Documentation

The NJDEP Procedure (NJDEP, 2021) for obtaining verification of a stormwater manufactured treatment device (MTD) from the New Jersey Corporation for Advanced Technology (NJCAT) requires that "copies of the laboratory test reports, including all collected and measured data; all data from performance evaluation test runs; spreadsheets containing original data from all performance test runs; all pertinent calculations; etc." be included in this section. This was discussed with NJDEP and it was agreed that as long as such documentation could be made available to NJCAT upon request that it would not be prudent or necessary to include all this information in this verification report. All supporting documentation will be retained securely by Oldcastle Infrastructure to be provided to NJCAT or NJDEP upon request.

4.1 Removal Efficiency Testing

A total of 14 removal efficiency testing runs were completed in accordance with the NJDEP filter protocol. The target flow rate and influent sediment concentration were 17 GPM and 200 mg/L respectively. For Run #13, there was an error with the data acquisition from the flow data logger. As a result, no data is available for the first 9 minutes of the run. As a result, this run has been omitted from the calculation of Cumulative Mass Removal Efficiency for the BioPod™ HF, however the sediment added during the run will contribute towards the mass load calculation. The results from the remaining 13 runs were used to calculate the overall removal efficiency of the BioPod™ HF.

Flow Rate

The flow rate was measured using a mag-type flow meter and a data logger configured to take a reading every 30 seconds. For each run, the flow rate was required to be maintained within 10% of the target flow with a COV (coefficient of variation) ≤ 0.03.

The flow data has been summarized in **Table 4**, including the compliance to the QA/QC acceptance criteria. The average flow for all removal efficiency runs was 17.0 GPM. Temperature readings of the effluent water were recorded once every minute however only the maximum water temperature during a run was reported. The water temperature for all testing did not exceed 80 degrees Fahrenheit.

Sediment Addition

The target sediment concentration was 200 ± 20 mg/L with a COV ≤ 0.10. The sediment feed rate was checked three times during each run. The average influent sediment concentration for each run was determined by mass balance. The amount of sediment loaded into the auger feeder and the amount remaining at the end of a run was used to calculate the amount of sediment fed during the run. The sediment mass was corrected for the mass of the three feed rate samples taken during the run. The mass of the sediment that was fed was divided by the volume of water that flowed through the BioPod™ HF test unit during dosing (average flowrate x time of dosing) to determine the run average influent sediment concentration (C_I):

$$C_I\left(\frac{mg}{L}\right)=\frac{(Sediment\ fed\ by\ auger\ (mg)-Sediment\ calibration\ samples\ (mg))}{Average\ run\ flow\ rate\left(\frac{L}{min}\right)\times Time\ of\ sediment\ dosing\ (min)} \quad [1]$$

For Run 10, the second sediment feed calibration sample was dropped, and lost while being transported to the analytical lab for measurement. As a result, the COV calculation is based only on the 1st and 3rd measurements. Additionally, the feed rate was estimated by averaging the feed rate of these two samples. The sediment weight checks, feed rates, final concentrations and compliance to QA/QC criteria are summarized in **Table 5.**

Table 4 Removal Efficiency Water Flow Rates

Run #	Runtime	Water Flow Rate			QA/QC Compliance		Max. Water Temperature (°F)
	(min)	Target (GPM)	Actual (GPM)	COV	(Flow Rate 15.3 – 18.7 GPM)	(COV ≤ 0.03)	
1	32	17.0	17.1	0.005	Pass	Pass	72.5
2	32	17.0	17.0	0.005	Pass	Pass	70.5
3	32	17.0	17.1	0.005	Pass	Pass	74.3
4	32	17.0	17.0	0.004	Pass	Pass	73.8
5	32	17.0	17.0	0.005	Pass	Pass	71.8
6	32	17.0	16.9	0.005	Pass	Pass	74.5
7	32	17.0	16.9	0.003	Pass	Pass	73.6
8	32	17.0	17.0	0.003	Pass	Pass	72.0
9	32	17.0	16.9	0.005	Pass	Pass	71.6
10	32	17.0	17.0	0.005	Pass	Pass	76.1
11	32	17.0	16.9	0.005	Pass	Pass	75.6
12	32	17.0	17.0	0.003	Pass	Pass	73.9
13*	32	17.0	16.9*	0.004*	Not Reported		73.4
14	32	17.0	17.0	0.005	Pass	Pass	73.0

* Flow data not available for first 9 minutes of run. Reported results based on runtime of 9.0 - 32.0 minutes.

Table 5 Removal Efficiency Sediment Feed Rates

Run #	Run Time (min)	Weight (g)	Duration (s)	Feed Rate (g/min)	Conc. [(a)] (mg/L)	QA/QC Compliance [(b)]	Run #	Run Time (min)	Weight (g)	Duration (s)	Feed Rate (g/min)	Conc. [(a)] (mg/L)	QA/QC Compliance [(b)]
1	0	12.29	59.81	12.33	197.2	Yes	8	0	11.86	59.94	11.87	197.5	Yes
	16	13.00	59.78	13.05				16	13.41	60.00	13.41		
	32	12.71	59.90	12.73				32	12.98	59.87	13.01		
	COV			0.028				COV			0.063		
2	0	12.12	59.84	12.15	193.1	Yes	9	0	12.00	59.84	12.03	196.7	Yes
	16	11.76	59.97	11.77				16	12.35	59.94	12.36		
	32	12.71	59.82	12.75				32	12.54	60.00	12.54		
	COV			0.040				COV			0.021		
3	0	13.47	59.81	13.51	203.9	Yes	10	0	12.51	60.06	12.50	204.1	Yes
	16	13.78	59.94	13.79				16	13.36[(e)]	59.85	13.40 [(c)]		
	32	12.92	59.91	12.94				32	14.27	59.90	14.29		
	COV			0.032				COV			0.095 [(d)]		
4	0	12.13	59.88	12.15	205.4	Yes	11	0	12.96	59.81	13.00	189.4	Yes
	16	13.88	59.94	13.89				16	11.35	59.94	11.36		
	32	12.84	59.81	12.88				32	12.70	59.84	12.73		
	COV			0.067				COV			0.071		
5	0	12.87	59.91	12.89	204.7	Yes	12	0	11.97	59.88	11.99	195.2	Yes
	16	14.14	59.90	14.16				16	12.90	59.90	12.92		
	32	13.42	59.91	13.44				32	12.97	59.78	13.02		
	COV			0.047				COV			0.045		
6	0	11.96	59.88	11.98	205.9	Yes	13	0	14.63	59.93	14.65	202.4	Yes
	16	13.18	59.94	13.19				16	13.05	59.88	13.08		
	32	13.50	59.66	13.58				32	12.84	59.85	12.87		
	COV			0.064				COV			0.072		
7	0	11.98	59.82	12.02	196.3	Yes	14	0	11.47	59.91	11.49	200.8	Yes
	16	12.66	59.93	12.67				16	13.30	59.94	13.31		
	32	13.19	59.88	13.22				32	13.45	60.03	13.44		
	COV			0.048				COV			0.086		

(a) Based on sediment mass balance and average water flow rate

(b) Average concentration 180 - 220 mg/L and COV ≤ 0.1

(c) Feed Rate estimated based on average of samples at 0 and 32 minutes

(d) COV calculated from samples at 0 and 32 minutes

(e) Calculated value based on feed rate and duration

Removal Efficiency

The effluent, background and drawdown samples were analysed by OSHTECH for SSC; the samples were personally delivered to the lab by the independent observer. Any samples not delivered on the day the samples were taken were secured in a refrigerator, under seal, by the independent observer. The test results are summarized in **Table 6**. The required background SSC concentration was < 20mg/L. The reporting limit (RL) for the analytical method was 1.0 mg/L. For the purposes of calculation, any result that was reported as being below the RL was assigned a value of half of the RL, 0.5 mg/L. As background samples were only collected with the odd-numbered effluent samples, the background concentration for the even-numbered effluent samples was estimated by averaging the previous and subsequent sample. The average corrected effluent sediment concentration for a run was determined by:

$$SSC_{Cor} = \frac{\sum(SSC_{E_i} - SSC_{B_i})}{n} \qquad [2]$$

where,

SSC_{Cor} = the average corrected effluent suspended sediment concentration

SSC_{Ei} = the measured effluent suspended sediment concentration at time *i*

SSC_{Bi} = the measured or interpolated background suspended sediment concentration at time *i*

n = the number of samples

Water elevation measurements within the vault were recorded at five-minute intervals, as well as at the end of each test run and when samples are collected. For brevity, only the water elevation at the end of the run is reported as this is the only value used for volume calculations. At no time during any of the test runs was the surface of the media bed completely flooded.

The amount of sediment that was captured during a run was corrected for the amount of sediment that was lost during the post-run drawdown of the vault. Using the measurement of the water elevation in the vault, two evenly spaced volumetric samples were collected and the SSC was measured. The sediment losses were calculated by multiplying the average drawdown SSC and the drawdown volume:

$$DL = SSC_D \times V_D \qquad [3]$$

where,

DL = drawdown losses (mg)

SSC_D = the average measured drawdown suspended sediment concentration (mg/L)

V_D = the drawdown volume (L)

Table 7 summarizes the drawdown losses for the removal efficiency runs.

Table 6 Removal Efficiency SSC Data

<table>
<tr><th rowspan="2">Run #</th><th colspan="7">Suspended Sediment Concentration, SSC (mg/L)</th><th rowspan="2">QA/QC Compliance (Background SSC < 20 mg/L)</th></tr>
<tr><th>Run Time* (min)</th><th>13</th><th>14</th><th>15</th><th>30</th><th>31</th><th>SSC_{COR}</th></tr>
<tr><td rowspan="2">1</td><td>Effluent</td><td>20.1</td><td>23.4</td><td>22.7</td><td>22.9</td><td>23.3</td><td rowspan="2">21.2</td><td rowspan="2">YES</td></tr>
<tr><td>Background</td><td>1.7</td><td>1.4</td><td>1.0</td><td>1.1</td><td>1.1</td></tr>
<tr><td rowspan="2">2</td><td>Effluent</td><td>20.2</td><td>21.3</td><td>22.5</td><td>22.3</td><td>21.3</td><td rowspan="2">20.3</td><td rowspan="2">YES</td></tr>
<tr><td>Background</td><td>1.6</td><td>1.3</td><td>1.0</td><td>1.2</td><td>1.3</td></tr>
<tr><td rowspan="2">3</td><td>Effluent</td><td>22.8</td><td>23.2</td><td>22.2</td><td>21.4</td><td>21.0</td><td rowspan="2">21.0</td><td rowspan="2">YES</td></tr>
<tr><td>Background</td><td>0.5</td><td>1.0</td><td>1.5</td><td>1.4</td><td>1.2</td></tr>
<tr><td rowspan="2">4</td><td>Effluent</td><td>23.0</td><td>24.3</td><td>26.5</td><td>17.3</td><td>23.2</td><td rowspan="2">21.3</td><td rowspan="2">YES</td></tr>
<tr><td>Background</td><td>1.8</td><td>1.6</td><td>1.3</td><td>1.6</td><td>1.8</td></tr>
<tr><td rowspan="2">5</td><td>Effluent</td><td>26.4</td><td>26.5</td><td>23.4</td><td>23.2</td><td>24.3</td><td rowspan="2">23.7</td><td rowspan="2">YES</td></tr>
<tr><td>Background</td><td>1.2</td><td>1.1</td><td>1.0</td><td>1.1</td><td>1.1</td></tr>
<tr><td rowspan="2">6</td><td>Effluent</td><td>22.5</td><td>24.1</td><td>22.5</td><td>27.4</td><td>29.5</td><td rowspan="2">24.7</td><td rowspan="2">YES</td></tr>
<tr><td>Background</td><td>0.5</td><td>0.5</td><td>0.5</td><td>0.5</td><td>0.5</td></tr>
<tr><td rowspan="2">7</td><td>Effluent</td><td>22.4</td><td>23.9</td><td>25.1</td><td>27.5</td><td>28.2</td><td rowspan="2">24.7</td><td rowspan="2">YES</td></tr>
<tr><td>Background</td><td>1.1</td><td>0.8</td><td>0.5</td><td>0.5</td><td>0.5</td></tr>
<tr><td rowspan="2">8</td><td>Effluent</td><td>28.7</td><td>26.3</td><td>25.3</td><td>25.1</td><td>24.5</td><td rowspan="2">25.5</td><td rowspan="2">YES</td></tr>
<tr><td>Background</td><td>0.5</td><td>0.5</td><td>0.5</td><td>0.5</td><td>0.5</td></tr>
<tr><td rowspan="2">9</td><td>Effluent</td><td>24.5</td><td>29.5</td><td>25.4</td><td>25.3</td><td>25.3</td><td rowspan="2">24.5</td><td rowspan="2">YES</td></tr>
<tr><td>Background</td><td>1.5</td><td>1.6</td><td>1.7</td><td>1.4</td><td>1.1</td></tr>
<tr><td rowspan="2">10</td><td>Effluent</td><td>22.3</td><td>24.3</td><td>20.6</td><td>27.8</td><td>25.2</td><td rowspan="2">23.1</td><td rowspan="2">YES</td></tr>
<tr><td>Background</td><td>1.3</td><td>1.2</td><td>1.0</td><td>0.8</td><td>0.5</td></tr>
<tr><td rowspan="2">11</td><td>Effluent</td><td>20.0</td><td>22.7</td><td>21.4</td><td>21.2</td><td>21.5</td><td rowspan="2">20.6</td><td rowspan="2">YES</td></tr>
<tr><td>Background</td><td>1.5</td><td>1.0</td><td>0.5</td><td>0.5</td><td>0.5</td></tr>
<tr><td rowspan="2">12</td><td>Effluent</td><td>22.8</td><td>16.5</td><td>24.1</td><td>14.2</td><td>21.1</td><td rowspan="2">18.7</td><td rowspan="2">YES</td></tr>
<tr><td>Background</td><td>1.3</td><td>0.9</td><td>0.5</td><td>1.1</td><td>1.6</td></tr>
<tr><td rowspan="2">13</td><td>Effluent</td><td>23.9</td><td>25.3</td><td>26.2</td><td>23.1</td><td>24.2</td><td rowspan="2">24.0</td><td rowspan="2">YES</td></tr>
<tr><td>Background</td><td>0.5</td><td>0.5</td><td>0.5</td><td>0.5</td><td>0.5</td></tr>
<tr><td rowspan="2">14</td><td>Effluent</td><td>26.9</td><td>26.5</td><td>26.5</td><td>26.9</td><td>26.0</td><td rowspan="2">25.5</td><td rowspan="2">YES</td></tr>
<tr><td>Background</td><td>1.2</td><td>1.3</td><td>1.4</td><td>1.0</td><td>0.5</td></tr>
</table>

*Background samples preceded effluent samples by 30 s

Interpolated value

Table 7 Removal Efficiency Drawdown Losses

Run #	Water Level at End of Run (inches)	Total Water Volume (L)	Average Sediment Concentration of Drawdown Samples (mg/L)	Drawdown Sediment Lost (g)
1	21 1/2	83.1	24.2	2.01
2	21 3/8	82.6	27.8	2.29
3	21 3/4	84.0	26.5	2.23
4	21 1/2	83.1	29.9	2.48
5	21 3/8	82.6	33.3	2.75
6	21 3/8	82.6	34.0	2.81
7	21 1/8	81.6	34.0	2.77
8	21 1/8	81.6	31.8	2.59
9	21 1/4	82.1	32.3	2.65
10	21 3/4	84.0	43.7	3.67
11	21 1/4	82.1	29.2	2.40
12	21 1/8	81.6	22.8	1.86
13	21 1/8	81.6	31.2	2.54
14	21 1/2	83.1	33.6	2.79

The run data and analytical results were used to calculate the removal efficiency for each run using equation [4] and summarized in **Table 8**.

$$Removal\ Efficiency\ (\%) = \frac{V_T \times C_I - (V_T - V_D)SSC_{Corr} - DL}{V_T \times C_I} \times 100 \qquad [4]$$

where,

V_T = water volume during sediment dosing (L)
C_I = average influent sediment concentration (mg/L)
V_D = the drawdown volume (L)
SSC_{Corr} = the average corrected effluent suspended sediment concentration (mg/L)
DL = drawdown losses (mg)

When Run 13 is excluded, the cumulative removal efficiency after 14 runs for the BioPod™ HF is 88.4% with 9.74 lbs (4.42 kg) of sediment captured. When the mass of sediment for Run 13 is included, the total mass captured is 10.5 lbs (4.76 kg).

Table 8 Removal Efficiency Results

Run #	Avg. Influent SSC [C_I] (mg/L)	Adjusted Effluent SSC [SSC_{Corr}] (mg/L)	Total Water Volume [V_T] (L)	Average Drawdown SSC (mg/L)	Volume of Drawdown Water [V_D] (L)	Run Removal Efficiency (%)	Mass of Captured Sediment (Lbs.)	Cumulative Mass Removal Efficiency (%)
1	197.2	21.2	1,937	24.2	83.1	89.2	0.751	89.2
2	193.1	20.3	1,934	27.8	82.6	89.3	0.736	89.3
3	203.9	21.0	1,937	26.5	84.0	89.6	0.780	89.4
4	205.4	21.3	1,928	29.9	83.1	89.5	0.781	89.4
5	204.7	23.7	1,928	33.3	82.6	88.2	0.768	89.2
6	205.9	24.7	1,925	34.0	82.6	87.8	0.767	88.9
7	196.3	24.7	1,922	34.0	81.6	87.2	0.725	88.7
8	197.5	25.5	1,933	31.8	81.6	87.0	0.732	88.5
9	196.7	24.5	1,922	32.3	82.1	87.4	0.728	88.4
10	204.1	23.1	1,935	43.7	84.0	88.2	0.768	88.3
11	189.4	20.6	1,916	29.2	82.1	89.0	0.712	88.4
12	195.2	18.7	1,933	22.8	81.6	90.3	0.751	88.6
13*	202.4	24.0	1,925	31.2	81.6	88.0	0.755	-
14	200.8	25.5	1,927	33.6	83.1	87.1	0.743	88.4
Cumulative Mass Removal Efficiency (Runs #1-14, excluding Run #13)						88.4%		
Captured Sediment Mass (Runs #1-14, including Run #13)						10.5 lbs.		

*Run excluded from cumulative mass removal efficiency.

4.2 Sediment Mass Load Capacity

The sediment mass loading capacity study was a continuation of the removal efficiency study. All aspects of the testing remained the same, except that the target feed concentration was increased to 400 mg/L, up from the 200 mg/L used for the removal efficiency testing.

An additional 56 runs were completed for sediment mass load capacity testing, resulting in a total of 70 runs overall. The system had not reached a failure point as defined by the NJDEP protocol. Though the protocol allows testing to continue until the TSS removal efficiency (on a cumulative mass basis) drops below 80%, Oldcastle made the decision to terminate testing once the run TSS removal efficiency dropped below 80%. Therefore, only runs 1-69 have been used to calculate the sediment mass load capacity.

For Runs 15 - 70, the water flow rates, sediment feed rates, drawdown losses, SSC data and removal efficiencies are presented in **Table 9 - Table 13**.

The total mass of sediment captured over the 69 runs was 90.3 lbs. and the cumulative mass removal efficiency was 84.0%. The relationship for removal efficiency versus the sediment mass loading is illustrated in **Figure 9**. As the water elevation never rose above the entire media bed during testing, no graph of driving head versus sediment mass loading is presented.

Departures from the Test Plan

During the Sediment Mas Load Capacity testing, there were two unplanned departures from the test plan:

1. During Run #32, the temperature data logger stopped acquiring data because of low battery. The temperature of the effluent was manually taken at 23 minutes and reported.
2. During Run #39, Background Sample #1 was not collected at the target run time of 13 minutes. The omission was discovered at 20 minutes and the sample was taken. All background SSC results were consistent throughout the run and with previous results.

Neither departure had any impact on the removal efficiency or sediment mas loading of the BioPod™ HF system.

Table 9 Mass Load Capacity Water Flow Rates

Run #	Runtime (min)	Water Flow Rate			QA/QC Compliance		Max. Water Temperature (°F)
		Target (GPM)	Actual (GPM)	COV	(Flow Rate 15.3 – 18.7 GPM)	(COV ≤ 0.03)	
15	32	17.0	17.0	0.007	Pass	Pass	72.7
16	32	17.0	16.9	0.004	Pass	Pass	71.8
17	32	17.0	17.0	0.003	Pass	Pass	71.6
18	32	17.0	17.0	0.006	Pass	Pass	75.7
19	32	17.0	17.0	0.005	Pass	Pass	75.2
20	32	17.0	17.0	0.003	Pass	Pass	73.4
21	32	17.0	16.9	0.003	Pass	Pass	74.8
22	32	17.0	16.9	0.004	Pass	Pass	74.7
23	32	17.0	17.0	0.004	Pass	Pass	73.6
24	32	17.0	16.9	0.003	Pass	Pass	73.0
25	32	17.0	16.9	0.003	Pass	Pass	75.4
26	32	17.0	17.0	0.003	Pass	Pass	74.8
27	32	17.0	17.1	0.003	Pass	Pass	73.9
28	32	17.0	16.9	0.004	Pass	Pass	73.4
29	32	17.0	17.0	0.005	Pass	Pass	74.8
30	32	17.0	17.0	0.006	Pass	Pass	73.4
31	32	17.0	17.0	0.004	Pass	Pass	72.5
32	32	17.0	17.0	0.003	Pass	Pass	73.0
33	32	17.0	17.0	0.003	Pass	Pass	72.1
34	32	17.0	17.0	0.003	Pass	Pass	72.1
35	32	17.0	17.0	0.003	Pass	Pass	72.1
36	32	17.0	17.0	0.006	Pass	Pass	72.1
37	32	17.0	17.0	0.003	Pass	Pass	70.3
38	32	17.0	16.9	0.003	Pass	Pass	70.3
39	32	17.0	16.9	0.003	Pass	Pass	70.5
40	32	17.0	17.0	0.004	Pass	Pass	71.4

Table 9 (Cont'd)

Run #	Runtime (min)	Water Flow Rate Target (GPM)	Water Flow Rate Actual (GPM)	Water Flow Rate COV	QA/QC Compliance (Flow Rate 15.3 – 18.7 GPM)	QA/QC Compliance (COV ≤ 0.03)	Max. Water Temperature (°F)
41	32	17.0	17.1	0.005	Pass	Pass	70.9
42	32	17.0	17.0	0.003	Pass	Pass	70.9
43	32	17.0	17.0	0.003	Pass	Pass	71.1
44	32	17.0	17.0	0.003	Pass	Pass	74.7
45	32	17.0	17.1	0.005	Pass	Pass	72.0
46	32	17.0	17.1	0.004	Pass	Pass	72.1
47	32	17.0	17.0	0.006	Pass	Pass	72.1
48	32	17.0	17.0	0.003	Pass	Pass	72.1
49	32	17.0	17.0	0.004	Pass	Pass	73.8
50	32	17.0	17.1	0.007	Pass	Pass	72.5
51	32	17.0	17.0	0.004	Pass	Pass	74.1
52	32	17.0	17.1	0.005	Pass	Pass	72.7
53	32	17.0	17.2	0.003	Pass	Pass	73.0
54	32	17.0	17.1	0.005	Pass	Pass	72.5
55	32	17.0	17.1	0.003	Pass	Pass	72.5
56	32	17.0	17.0	0.005	Pass	Pass	71.8
57	32	17.0	17.1	0.005	Pass	Pass	71.8
58	32	17.0	17.2	0.008	Pass	Pass	71.6
59	32	17.0	17.1	0.006	Pass	Pass	71.6
60	32	17.0	17.1	0.005	Pass	Pass	71.6
61	32	17.0	17.0	0.003	Pass	Pass	74.3
62	32	17.0	17.1	0.004	Pass	Pass	72.9
63	32	17.0	17.0	0.004	Pass	Pass	72.7
64	32	17.0	17.0	0.004	Pass	Pass	73.4
65	32	17.0	17.1	0.005	Pass	Pass	72.7
66	32	17.0	17.1	0.006	Pass	Pass	72.7
67	32	17.0	17.1	0.005	Pass	Pass	72.7
68	32	17.0	16.9	0.006	Pass	Pass	72.1
69	32	17.0	17.1	0.006	Pass	Pass	72.0
70	32	17.0	17.1	0.004	Pass	Pass	75.0

Table 10 Mass Load Capacity Sediment Feed Rates

Run #	Run Time (min)	Weight (g)	Duration (s)	Feed Rate (g/min)	Conc. (a) (mg/L)	QA/QC Compliance (b)	Run #	Run Time (min)	Weight (g)	Duration (s)	Feed Rate (g/min)	Conc. (a) (mg/L)	QA/QC Compliance (b)
15	0	25.55	59.97	25.56	395.8	Yes	22	0	24.87	59.87	24.92	404.1	Yes
	16	25.26	59.91	25.30				16	27.02	59.85	27.09		
	32	25.78	60.00	25.78				32	25.96	59.81	26.04		
	COV			0.009				COV			0.042		
16	0	24.48	59.84	24.55	390.7	Yes	23	0	25.74	59.91	25.78	403.0	Yes
	16	24.34	59.78	24.43				16	25.94	59.91	25.98		
	32	24.59	59.97	24.60				32	26.97	59.91	27.01		
	COV			0.004				COV			0.025		
17	0	24.71	59.87	24.76	396.3	Yes	24	0	25.73	59.91	25.77	398.9	Yes
	16	25.51	59.81	25.59				16	25.50	59.78	25.59		
	32	25.60	59.82	25.68				32	26.11	59.94	26.14		
	COV			0.020				COV			0.011		
18	0	25.27	59.91	25.31	401.2	Yes	25	0	24.86	60.00	24.86	393.7	Yes
	16	26.30	59.94	26.33				16	25.18	59.94	25.21		
	32	25.15	59.81	25.23				32	25.20	59.90	25.24		
	COV			0.024				COV			0.008		
19	0	24.78	60.00	24.78	396.0	Yes	26	0	27.19	59.87	27.25	427.4	Yes
	16	26.08	59.84	26.15				16	27.10	59.97	27.11		
	32	25.21	60.00	25.21				32	26.38	60.03	26.37		
	COV			0.028				COV			0.018		
20	0	24.77	60.03	24.76	398.9	Yes	27	0	24.95	59.88	25.00	399.3	Yes
	16	25.39	59.85	25.45				16	25.69	59.85	25.75		
	32	26.43	59.90	26.47				32	25.91	59.91	25.95		
	COV			0.034				COV			0.020		
21	0	25.38	59.94	25.41	402.8	Yes	28	0	25.24	59.78	25.33	405.0	Yes
	16	25.60	59.81	25.68				16	26.07	59.88	26.12		
	32	26.19	60.03	26.18				32	25.56	59.75	25.67		
	COV			0.015				COV			0.015		

(a) Based on sediment mass balance and average water flow rate

(b) Average concentration 360 - 440 mg/L and COV ≤ 0.1

Table 10 (Cont'd)

Run #	Run Time (min)	Weight (g)	Duration (s)	Feed Rate (g/min)	Conc. [(a)] (mg/L)	QA/QC Compliance [(b)]	Run #	Run Time (min)	Weight (g)	Duration (s)	Feed Rate (g/min)	Conc. [(a)] (mg/L)	QA/QC Compliance [(b)]
29	0	27.32	59.90	27.37	430.4	Yes	36	0	25.22	60.16	25.15	414.5	Yes
	16	26.58	59.91	26.62				16	25.74	59.97	25.75		
	32	27.18	59.91	27.22				32	25.76	59.78	25.85		
	COV			0.015				COV			0.015		
30	0	26.65	59.85	26.72	421.4	Yes	37	0	24.45	59.78	24.54	388.4	Yes
	16	26.77	59.97	26.78				16	25.04	60.04	25.02		
	32	27.74	59.90	27.79				32	25.49	60.04	25.47		
	COV			0.022				COV			0.019		
31	0	26.12	59.87	26.18	419.7	Yes	38	0	24.54	59.84	24.61	385.0	Yes
	16	26.41	60.00	26.41				16	24.26	59.87	24.31		
	32	28.22	59.97	28.23				32	25.22	60.03	25.21		
	COV			0.042				COV			0.018		
32	0	26.62	59.75	26.73	422.3	Yes	39	0	25.53	59.88	25.58	398.5	Yes
	16	27.59	59.90	27.64				16	26.27	59.88	26.32		
	32	26.01	59.91	26.05				32	26.17	60.13	26.11		
	COV			0.030				COV			0.015		
33	0	26.50	59.91	26.54	413.4	Yes	40	0	25.72	59.85	25.78	393.6	Yes
	16	26.34	59.97	26.35				16	25.34	59.81	25.42		
	32	26.04	59.82	26.12				32	23.97	59.91	24.01		
	COV			0.008				COV			0.037		
34	0	25.37	59.94	25.40	409.8	Yes	41	0	24.40	60.00	24.40	380.9	Yes
	16	26.01	59.87	26.07				16	25.01	59.85	25.07		
	32	26.64	60.00	26.64				32	24.57	59.90	24.61		
	COV			0.024				COV			0.014		
35	0	27.50	59.97	27.51	404.5	Yes	42	0	24.86	59.85	24.92	409.1	Yes
	16	26.59	59.94	26.62				16	25.36	59.90	25.40		
	32	25.96	59.90	26.00				32	24.90	59.97	24.91		
	COV			0.028				COV			0.011		

(a) Based on sediment mass balance and average water flow rate

(b) Average concentration 360 - 440 mg/L and COV ≤ 0.1

Table 10 (Cont'd)

Run #	Run Time (min)	Weight (g)	Duration (s)	Feed Rate (g/min)	Conc. (a) (mg/L)	QA/QC Compliance (b)	Run #	Run Time (min)	Weight (g)	Duration (s)	Feed Rate (g/min)	Conc. (a) (mg/L)	QA/QC Compliance (b)
43	0	24.57	59.94	24.59	391.5	Yes	50	0	26.79	59.94	26.82	431.0	Yes
	16	25.84	59.82	25.92				16	27.12	59.87	27.18		
	32	25.12	59.96	25.14				32	27.80	59.90	27.85		
	COV			0.026				COV			0.019		
44	0	28.12	59.97	28.13	406.3	Yes	51	0	27.44	59.81	27.53	422.2	Yes
	16	24.22	59.94	24.24				16	26.80	59.88	26.85		
	32	25.97	59.94	26.00				32	27.86	61.62	27.13		
	COV			0.075				COV			0.012		
45	0	26.86	59.87	26.92	420.2	Yes	52	0	26.93	59.88	26.98	408.8	Yes
	16	28.07	60.00	28.07				16	26.50	59.94	26.53		
	32	25.82	59.91	25.86				32	26.38	59.91	26.42		
	COV			0.041				COV			0.011		
46	0	26.25	59.97	26.26	410.3	Yes	53	0	27.66	59.78	27.76	424.4	Yes
	16	26.57	59.94	26.60				16	27.62	59.85	27.69		
	32	26.55	60.03	26.54				32	26.60	59.94	26.63		
	COV			0.007				COV			0.023		
47	0	25.81	59.97	25.82	423.7	Yes	54	0	27.53	59.91	27.57	416.2	Yes
	16	27.81	59.91	27.85				16	25.97	59.93	26.00		
	32	27.72	59.94	27.75				32	26.28	59.93	26.31		
	COV			0.042				COV			0.031		
48	0	26.65	59.84	26.72	411.4	Yes	55	0	26.82	59.87	26.88	425.8	Yes
	16	25.80	59.82	25.88				16	28.51	60.00	28.51		
	32	27.08	59.97	27.09				32	26.22	60.19	26.14		
	COV			0.023				COV			0.045		
49	0	26.67	60.06	26.64	423.5	Yes	56	0	26.58	61.46	25.95	427.1	Yes
	16	26.68	59.91	26.72				16	27.17	59.94	27.20		
	32	28.24	60.00	28.24				32	26.57	59.88	26.62		
	COV			0.033				COV			0.024		

(a) Based on sediment mass balance and average water flow rate

(b) Average concentration 360 - 440 mg/L and COV ≤ 0.1

Table 10 (Cont'd)

Run #	Run Time (min)	Weight (g)	Duration (s)	Feed Rate (g/min)	Conc. [(a)] (mg/L)	QA/QC Compliance [(b)]	Run #	Run Time (min)	Weight (g)	Duration (s)	Feed Rate (g/min)	Conc. [(a)] (mg/L)	QA/QC Compliance [(b)]
57	0	28.56	59.97	28.57	427.9	Yes	64	0	23.72	60.13	23.67	371.2	Yes
	16	27.72	59.96	27.74				16	23.64	59.90	23.68		
	32	27.82	59.88	27.88				32	22.68	59.87	22.73		
	COV			0.016				COV			0.023		
58	0	27.52	59.97	27.53	440.0	Yes	65	0	27.96	60.09	27.92	419.1	Yes
	16	28.61	60.12	28.55				16	27.53	60.03	27.52		
	32	30.19	60.06	30.16				32	26.80	60.00	26.80		
	COV			0.046				COV			0.021		
59	0	26.68	59.87	26.74	403.7	Yes	66	0	28.19	59.84	28.27	415.3	Yes
	16	26.75	60.00	26.75				16	24.50	59.75	24.60		
	32	26.31	59.97	26.32				32	25.94	60.19	25.86		
	COV			0.009				COV			0.071		
60	0	27.73	60.03	27.72	401.1	Yes	67	0	25.61	59.88	25.66	410.6	Yes
	16	25.90	59.94	25.93				16	25.76	60.13	25.70		
	32	25.47	59.78	25.56				32	27.27	59.94	27.30		
	COV			0.044				COV			0.036		
61	0	24.31	60.16	24.25	405.3	Yes	68	0	22.73	59.97	22.74	365.5	Yes
	16	27.62	59.94	27.65				16	23.37	59.97	23.38		
	32	26.51	62.50	25.45				32	23.21	60.00	23.21		
	COV			0.067				COV			0.014		
62	0	25.85	59.90	25.89	402.0	Yes	69	0	27.92	59.96	27.94	418.6	Yes
	16	26.88	59.81	26.97				16	27.73	60.10	27.68		
	32	25.86	60.00	25.86				32	25.78	59.85	25.84		
	COV			0.024				COV			0.042		
63	0	27.27	59.88	27.32	400.0	Yes	70	0	28.51	59.87	28.57	403.9	Yes
	16	26.55	59.88	26.60				16	25.95	60.12	25.90		
	32	27.82	60.91	27.40				32	25.01	60.09	24.97		
	COV			0.016				COV			0.071		

(a) Based on sediment mass balance and average water flow rate

(b) Average concentration 360 - 440 mg/L and COV ≤ 0.1

Table 11 Mass Load Capacity SSC Data

Run #	Suspended Sediment Concentration, SSC (mg/L)							QA/QC Compliance (Background SSC < 20 mg/L)
	Run Time* (min)	13	14	15	30	31	SSC_{COR}	
15	Effluent	53.6	53.6	53.2	53.1	55.4	53.3	YES
	Background	0.5	0.5	0.5	0.5	0.5		
16	Effluent	53.2	54.2	53.1	54.8	54.5	53.5	YES
	Background	0.5	0.5	0.5	0.5	0.5		
17	Effluent	55.7	57.0	53.9	58.0	56.2	55.3	YES
	Background	1.0	0.8	0.5	0.8	1.1		
18	Effluent	52.7	58.5	55.4	58.1	59.0	55.7	YES
	Background	1.3	0.9	0.5	1.0	1.5		
19	Effluent	55.5	60.0	56.0	63.7	58.7	56.9	YES
	Background	2.0	1.9	1.7	1.9	2.0		
20	Effluent	57.5	60.8	57.8	58.6	59.5	57.1	YES
	Background	1.6	1.8	1.9	1.8	1.6		
21	Effluent	53.3	63.2	61.1	58.7	57.2	57.2	YES
	Background	1.7	1.7	1.6	1.4	1.2		
22	Effluent	59.3	62.2	60.1	59.5	60.0	58.0	YES
	Background	2.5	2.4	2.2	2.2	2.1		
23	Effluent	58.9	61.3	59.4	62.6	61.4	58.7	YES
	Background	2.3	2.0	1.7	1.9	2.1		
24	Effluent	62.3	63.4	61.5	60.1	63.8	59.6	YES
	Background	2.9	2.8	2.7	2.6	2.4		
25	Effluent	62.8	69.7	63.8	59.2	59.0	60.1	YES
	Background	3.9	2.9	1.9	2.4	2.8		
26	Effluent	64.1	70.0	64.8	63.4	63.9	62.9	YES
	Background	2.9	2.6	2.3	2.0	1.7		
27	Effluent	59.3	65.9	61.1	62.5	53.2	58.1	YES
	Background	2.3	2.2	2.1	2.4	2.6		
28	Effluent	59.9	67.3	62.6	55.9	64.4	59.6	YES
	Background	2.9	2.9	2.8	2.2	1.5		

*Background samples preceded effluent samples by 30 s

Interpolated value

Table 11 (Cont'd)

Run #	Suspended Sediment Concentration, SSC (mg/L)							QA/QC Compliance (Background SSC < 20 mg/L)
	Run Time* (min)	13	14	15	30	31	SSC_{COR}	
29	Effluent	68.3	71.1	65.4	72.6	73.0	67.1	YES
	Background	2.9	2.9	2.8	3.1	3.3		
30	Effluent	66.3	68.9	68.3	68.0	68.2	65.4	YES
	Background	2.0	2.4	2.7	2.9	3.0		
31	Effluent	64.6	66.6	67.6	67.7	67.1	63.6	YES
	Background	3.2	2.9	2.6	3.2	3.7		
32	Effluent	66.8	72.3	68.3	67.3	68.1	64.7	YES
	Background	3.8	3.7	3.5	3.9	4.3		
33	Effluent	66.9	69.8	65.5	68.4	68.2	64.8	YES
	Background	3.2	3.0	2.7	2.9	3.1		
34	Effluent	65.5	67.3	66.3	64.9	67.2	64.0	YES
	Background	2.8	2.4	2.0	2.0	1.9		
35	Effluent	66.8	64.3	70.2	66.8	67.4	64.2	YES
	Background	3.0	3.0	2.9	2.9	2.9		
36	Effluent	70.4	57.9	67.1	68.3	70.1	66.3	YES
	Background	0.5	0.5	0.5	0.5	0.5		
37	Effluent	61.3	67.7	63.1	67.5	66.1	63.6	YES
	Background	2.2	1.7	1.2	1.3	1.3		
38	Effluent	57.9	61.6	60.1	62.9	61.5	59.7	YES
	Background	1.5	1.4	1.2	0.9	0.5		
39	Effluent	67.8	66.2	70.1	64.5	66.2	65.6	YES
	Background	1.5±	1.5	1.5	1.4	1.2		
40	Effluent	81.6	75.5	62.7	64.8	63.4	68.4	YES
	Background	1.3	1.2	1.1	1.1	1.1		
41	Effluent	62.1	65.0	60.0	63.0	61.8	60.9	YES
	Background	1.8	1.6	1.4	1.4	1.3		
42	Effluent	69.3	71.7	68.2	71.4	70.6	68.4	YES
	Background	1.9	2.0	2.0	1.8	1.6		

*Background samples preceded effluent samples by 30 s

±Sample mistakenly taken at 20 minutes

Interpolated value

Table 11 (Cont'd)

Run #	Suspended Sediment Concentration, SSC (mg/L)							QA/QC Compliance (Background SSC < 20 mg/L)
	Run Time* (min)	13	14	15	30	31	SSC_{COR}	
43	Effluent	65.1	66.3	65.9	66.5	64.0	63.8	YES
	Background	2.3	1.9	1.5	1.5	1.5		
44	Effluent	70.5	69.6	63.7	66.6	70.3	66.3	YES
	Background	2.1	2.0	1.8	1.7	1.5		
45	Effluent	73.6	72.5	71.1	67.8	68.6	68.9	YES
	Background	1.5	1.7	1.9	1.9	1.9		
46	Effluent	75.9	72.4	67.4	64.2	67.6	67.8	YES
	Background	1.1	1.5	1.9	1.9	1.9		
47	Effluent	69.2	74.2	70.9	70.0	69.4	69.3	YES
	Background	1.3	1.3	1.3	1.6	1.9		
48	Effluent	68.5	72.6	66.5	69.6	71.5	66.9	YES
	Background	3.8	2.9	1.9	2.5	3.0		
49	Effluent	71.0	102.2	78.2	71.5	73.0	77.5	YES
	Background	1.0	1.8	2.5	1.9	1.2		
50	Effluent	79.2	78.9	74.8	73.0	77.6	75.5	YES
	Background	0.5	1.0	1.4	1.6	1.7		
51	Effluent	66.6	71.6	69.0	71.3	69.8	68.5	YES
	Background	1.5	1.3	1.0	1.1	1.1		
52	Effluent	65.2	90.0	80.2	73.3	68.2	74.1	YES
	Background	1.7	1.5	1.2	1.1	1.0		
53	Effluent	74.2	105.5	110.4	75.1	71.9	86.2	YES
	Background	1.5	1.0	0.5	1.2	1.8		
54	Effluent	70.4	75.0	68.4	75.4	73.7	71.6	YES
	Background	1.1	1.2	1.2	0.9	0.5		
55	Effluent	78.5	81.1	72.6	72.7	75.0	75.0	YES
	Background	0.5	0.9	1.3	1.2	1.1		
56	Effluent	72.1	76.4	74.5	74.4	74.7	73.7	YES
	Background	0.5	0.8	1.0	0.8	0.5		

*Background samples preceded effluent samples by 30 s

Interpolated value

Table 11 (Cont'd)

Run #	Suspended Sediment Concentration, SSC (mg/L)							QA/QC Compliance (Background SSC < 20 mg/L)
	Run Time* (min)	13	14	15	30	31	SSC_{COR}	
57	Effluent	73.5	79.4	76.4	75.9	75.9	75.7	YES
	Background	0.5	0.5	0.5	0.5	0.5		
58	Effluent	79.4	81.4	81.0	83.3	79.9	80.3	YES
	Background	1.1	0.8	0.5	0.5	0.5		
59	Effluent	72.2	72.4	72.8	73.0	72.8	71.3	YES
	Background	1.4	1.2	1.0	1.4	1.8		
60	Effluent	72.0	70.2	69.1	71.2	72.5	69.1	YES
	Background	2.3	2.0	1.7	1.8	1.9		
61	Effluent	70.8	71.4	71.6	73.2	68.2	69.5	YES
	Background	1.6	1.5	1.3	1.6	1.8		
62	Effluent	68.5	70.5	70.2	74.9	73.5	69.8	YES
	Background	1.8	1.7	1.5	1.7	1.8		
63	Effluent	69.5	73.3	73.5	77.7	75.6	71.8	YES
	Background	1.8	2.0	2.2	2.3	2.3		
64	Effluent	68.2	70.7	66.5	70.6	69.8	68.3	YES
	Background	0.5	1.0	1.4	1.0	0.5		
65	Effluent	75.8	80.3	80.7	81.7	76.7	78.0	YES
	Background	1.1	1.3	1.5	1.0	0.5		
66	Effluent	78.0	77.6	75.1	82.9	82.3	77.9	YES
	Background	2.0	1.5	1.0	1.0	1.0		
67	Effluent	76.7	78.6	78.0	78.7	77.6	76.6	YES
	Background	2.2	1.4	0.5	1.0	1.4		
68	Effluent	67.7	71.7	70.2	74.0	69.6	69.6	YES
	Background	0.5	0.9	1.3	1.4	1.4		
69	Effluent	83.5	88.8	80.8	81.3	84.3	82.2	YES
	Background	1.5	1.6	1.7	1.6	1.4		
70	Effluent	89.3	81.4	76.9	104.8	96.8	88.2	YES
	Background	1.8	1.8	1.7	1.6	1.5		

*Background samples preceded effluent samples by 30 s

Interpolated value

Table 12 Mass Load Capacity Drawdown Losses

Run #	Water Level at End of Run (inches)	Total Water Volume (L)	Average Sediment Concentration of Drawdown Samples (mg/L)	Drawdown Sediment Lost (g)
15	21 3/8	82.6	63.0	5.20
16	21 1/8	81.6	64.6	5.27
17	21 1/8	81.6	69.6	5.68
18	21 3/8	82.6	68.8	5.68
19	21 1/4	82.1	66.6	5.47
20	21 3/8	82.6	72.9	6.02
21	21 3/8	82.6	68.8	5.68
22	21 3/8	82.6	71.5	5.90
23	21 3/8	82.6	70.3	5.80
24	21 3/8	82.6	70.2	5.79
25	21 3/8	82.6	68.6	5.66
26	21 1/2	83.1	73.1	6.07
27	21 3/4	84.0	72.4	6.08
28	21 1/2	83.1	76.7	6.37
29	21 5/8	83.5	72.3	6.04
30	21 1/2	83.1	77.6	6.44
31	21 1/2	83.1	77.4	6.42
32	21 5/8	83.5	81.3	6.79
33	21 1/2	83.1	75.8	6.29
34	21 5/8	83.5	77.7	6.49
35	21 5/8	83.5	84.2	7.03
36	21 3/4	84.0	75.0	6.30
37	21 3/4	84.0	75.7	6.36
38	21 3/8	82.6	71.8	5.92
39	21 1/2	83.1	84.8	7.04
40	21 3/4	84.0	74.1	6.22
41	21 7/8	84.5	74.9	6.33
42	21 5/8	83.5	80.1	6.69
43	21 5/8	83.5	82.5	6.89
44	21 7/8	84.5	75.7	6.40
45	21 1/2	83.1	79.4	6.59
46	21 3/4	84.0	78.8	6.62
47	21 5/8	83.5	84.0	7.01

Table 12 (Cont'd)

Run #	Water Level at End of Run (inches)	Total Water Volume (L)	Average Sediment Concentration of Drawdown Samples (mg/L)	Drawdown Sediment Lost (g)
48	21 5/8	83.5	86.5	7.23
49	21 5/8	83.5	85.1	7.11
50	22 1/4	86.0	91.4	7.85
51	21 5/8	83.5	79.2	6.61
52	22 1/4	86.0	80.0	6.88
53	22 1/8	85.5	81.7	6.98
54	22	85.0	88.6	7.53
55	22	85.0	91.2	7.75
56	21 5/8	83.5	86.3	7.21
57	21 7/8	84.5	92.3	7.80
58	22 1/2	86.9	93.9	8.16
59	21 7/8	84.5	87.7	7.41
60	22 1/4	86.0	102.2	8.78
61	21 5/8	83.5	79.5	6.64
62	22	85.0	82.8	7.04
63	21	81.1	92.7	7.52
64	21 5/8	83.5	80.5	6.72
65	22	85.0	91.0	7.73
66	22 1/8	85.5	111.4	9.52
67	22	85.0	93.2	7.92
68	21 1/4	82.1	81.3	6.67
69	22	85.0	90.9	7.72
70	22 1/4	86.0	82.5	7.09

Table 13 Mass Loading Results

Run #	Avg. Influent SSC [C_I] (mg/L)	Adjusted Effluent SSC [SSC_{Corr}] (mg/L)	Total Water Volume [V_T] (L)	Average Drawdown SSC (mg/L)	Volume of Drawdown Water [V_D] (L)	Run Removal Efficiency (%)	Mass of Captured Sediment (Lbs.)	Cumulative Mass Removal Efficiency (%)
15	395.8	53.3	1,929	63.0	82.6	86.4	1.455	88.2
16	390.7	53.5	1,924	64.6	81.6	86.2	1.428	87.9
17	396.3	55.3	1,928	69.6	81.6	85.9	1.447	87.7
18	401.2	55.7	1,927	68.8	82.6	86.0	1.466	87.6
19	396.0	56.9	1,929	66.6	82.1	85.5	1.440	87.4
20	398.9	57.1	1,926	72.9	82.6	85.5	1.449	87.3
21	402.8	57.2	1,919	68.8	82.6	85.7	1.460	87.2
22	404.1	58.0	1,923	71.5	82.6	85.5	1.465	87.0
23	403.0	58.7	1,926	70.3	82.6	85.3	1.460	86.9
24	398.9	59.6	1,925	70.2	82.6	85.0	1.438	86.8
25	393.7	60.1	1,917	68.6	82.6	84.6	1.408	86.7
26	427.4	62.9	1,929	73.1	83.1	85.2	1.548	86.6
27	399.3	58.1	1,937	72.4	84.0	85.3	1.454	86.5
28	405.0	59.6	1,921	76.7	83.1	85.1	1.460	86.5
29	430.4	67.1	1,926	72.3	83.5	84.4	1.542	86.4
30	421.4	65.4	1,931	77.6	83.1	84.4	1.514	86.3
31	419.7	63.6	1,928	77.4	83.1	84.7	1.511	86.2
32	422.3	64.7	1,929	81.3	83.5	84.5	1.518	86.1
33	413.4	64.8	1,926	75.8	83.1	84.2	1.478	86.1
34	409.8	64.0	1,933	77.7	83.5	84.2	1.471	86.0
35	404.5	64.2	1,928	84.2	83.5	83.9	1.443	85.9
36	414.5	66.3	1,926	75.0	84.0	83.9	1.477	85.9
37	388.4	63.6	1,931	75.7	84.0	83.5	1.380	85.8
38	385.0	59.7	1,924	71.8	82.6	84.4	1.378	85.7
39	398.5	65.6	1,925	84.8	83.1	83.3	1.409	85.7
40	393.6	68.4	1,931	74.1	84.0	82.5	1.383	85.6
41	380.9	60.9	1,946	74.9	84.5	83.9	1.370	85.5
42	409.1	68.4	1,931	80.1	83.5	83.2	1.448	85.4
43	391.5	63.8	1,927	82.5	83.5	83.5	1.389	85.4
44	406.3	66.3	1,936	75.7	84.5	83.6	1.449	85.3
45	420.2	68.9	1,938	79.4	83.1	83.5	1.499	85.3

Table 13 (Cont'd)

Run #	Avg. Influent SSC [C_I] (mg/L)	Adjusted Effluent SSC [SSC_{Corr}] (mg/L)	Total Water Volume [V_T] (L)	Average Drawdown SSC (mg/L)	Volume of Drawdown Water [V_D] (L)	Run Removal Efficiency (%)	Mass of Captured Sediment (Lbs.)	Cumulative Mass Removal Efficiency (%)
46	410.3	67.8	1,939	78.8	84.0	83.3	1.462	85.2
47	423.7	69.3	1,932	84.0	83.5	83.5	1.507	85.2
48	411.4	66.9	1,933	86.5	83.5	83.5	1.465	85.2
49	423.5	77.5	1,932	85.1	83.5	81.6	1.473	85.1
50	431.0	75.5	1,945	91.4	86.0	82.3	1.521	85.0
51	422.2	68.5	1,926	79.2	83.5	83.7	1.499	85.0
52	408.8	74.1	1,945	80.0	86.0	81.8	1.434	84.9
53	424.4	86.2	1,951	81.7	85.5	79.7	1.456	84.8
54	416.2	71.6	1,947	88.6	85.0	82.6	1.476	84.7
55	425.8	75.0	1,946	91.2	85.0	82.2	1.502	84.7
56	427.1	73.7	1,931	86.3	83.5	82.6	1.502	84.6
57	427.9	75.7	1,942	92.3	84.5	82.1	1.505	84.6
58	440.0	80.3	1,952	93.9	86.9	81.6	1.545	84.5
59	403.7	71.3	1,945	87.7	84.5	82.2	1.423	84.5
60	401.1	69.1	1,947	102.2	86.0	82.4	1.419	84.4
61	405.3	69.5	1,928	79.5	83.5	82.7	1.426	84.4
62	402.0	69.8	1,944	82.8	85.0	82.5	1.421	84.4
63	400.0	71.8	1,933	92.7	81.1	81.8	1.395	84.3
64	371.2	68.3	1,926	80.5	83.5	81.5	1.284	84.3
65	419.1	78.0	1,939	91.0	85.0	81.3	1.456	84.2
66	415.3	77.9	1,942	111.4	85.5	80.9	1.438	84.2
67	410.6	76.6	1,940	93.2	85.0	81.2	1.425	84.1
68	365.5	69.6	1,917	81.3	82.1	80.8	1.249	84.1
69	418.6	82.2	1,944	90.9	85.0	80.3	1.440	84.0
70	403.9	88.2	1,945	82.5	86.0	78.2	1.355	83.9
Cumulative Mass Removal Efficiency (Runs #1-69)						84.0%		
Captured Sediment Mass (Runs #1-69)						90.255 lbs.		

Figure 9 Cumulative Removal Efficiency vs Cumulative Mass Loading

4.3 Test Setup Maintenance

Before the start of Run 36, the water in the storage tanks was diluted to reduce the background sediment concentration in the system. This was done by pumping approximately 1/3 of the water volume in the storage tanks directly to waste. The water was replaced with clean potable water. This maintenance had no impact on the BioPod™ HF test setup.

5. Design Limitations

Required Soil Characteristics

The BioPod™ HF is suitable for installation in all soil types.

Slope

The BioPod™ HF is typically recommended for installation with no slope to ensure proper, consistent operation. Often, the top piece can be installed to meet finished grade. Steep slopes should be reviewed by Oldcastle engineering support.

Maximum Flow Rate

The maximum flow rate for the BioPod™ HF is 4.25 GPM/ sq. ft. of media surface area.

Allowable Head Loss

There is an operational head loss associated with each BioPod™ HF device. The head loss will increase over time due to increased sediment loading. The maximum head loss for the BioPod™ HF is 6 inches above the top of the mulch surface. Site specific treatment flow rates, pipe diameters and pipe slopes are evaluated to ensure there is appropriate head for the system to function properly.

Maintenance Requirements

For all successful stormwater quality control systems, effective performance requires regular and proper maintenance. Maintenance frequency and requirements are dependent on the conditions and pollutant loading of each site. In general, it is recommended that inspections and/or maintenance be conducted on a regularly occurring basis to ensure continued functionality of the system. Maintenance activities could also be required in the case of an extreme rainfall event, chemical spill or heavier than anticipated pollutant loading.

Installation Limitations

The BioPod™ HF has few installation limitations. The BioPod™ HF is typically delivered to the site with all internal components, including the StormMix™ HF media, installed. The contractor is then responsible for installation of the system following any requirements that would apply for any precast concrete structure. This typically includes preparing the appropriate excavation and base layer; providing and using the appropriate lifting equipment to unload and set the BioPod™ HF vault components; providing and connecting the inlet and outlet piping; and following the construction plans for selection of backfill material and placement. The contractor is also responsible for protecting the BioPod™ HF from construction runoff until site construction is complete. Oldcastle Precast provides full-service technical design support throughout the life of a project.

Configurations

The BioPod™ HF is available in multiple configurations. The BioPod™ HF can be installed above, at, or below grade and comes in a variety of precast concrete sizes, allowing maximum design flexibility.

Structural Load Limitations

The BioPod™ HF structure is typically located adjacent to a roadway and therefore the precast base is designed to handle HS-20 traffic loads. For deeper installations or installations requiring a greater load capacity the system will be designed and manufactured to meet those requirements. Oldcastle provides full-service technical design support throughout the life of a project and can help ensure the system is designed for the appropriate structural load requirements.

Pre-treatment Requirements

The BioPod™ HF does not require pre-treatment.

Limitations in Tailwater

Tailwater conditions may impact the amount of driving head available to the BioPod™ HF and thus may impact the operation and/or lifecycle of the system. Specific project conditions should be assessed as part of the design process.

Depth to Seasonal High-Water Table

The operation of the BioPod™ HF is typically not impacted by the seasonal high-water table. However, the high-water table may impact the buoyancy of the concrete vault. Specific project conditions should be assessed as part of the design process.

6. Maintenance Plans

Maintenance Overview

State and local regulations require all stormwater management systems to be inspected on a regular basis and maintained as necessary to ensure performance and protect downstream receiving waters. Without maintenance, excessive pollutant buildup can limit system performance by reducing the operating capacity and increasing the potential for scouring of pollutants during periods of high flow. The BioPod™ HF may require periodic irrigation to establish and maintain vegetation. Vegetation will typically become established about two years after planting. Irrigation requirements are ultimately dependent on climate, rainfall, and the type of vegetation selected. The BioPod™ HF Inspection & Maintenance Manual is available at:

https://oldcastleinfrastructure.com/wp-content/uploads/2025/05/6-A-045_BioPod-High-Flow-Operations-and-Maintenance-Manual_WEB.pdf.

Inspection Equipment

- The following equipment is helpful when conducting BioPod™ HF inspections:
- Recording device (pen and paper form, voice recorder, iPad, etc.)
- Suitable clothing (appropriate footwear, gloves, hardhat, safety glasses, etc.)
- Traffic control equipment (cones, barricades, signage, flagging, etc.)
- Manhole hook or pry bar
- Flashlight
- Tape measure

Inspection Procedures

- When the BioPod™ HF unit is equipped with an external bypass, inspect the inlet chamber and outlet chamber and note whether there are any broken or missing parts. In the unlikely event that internal parts are broken or missing, contact Oldcastle Storm Water at (888) 965-3227 to determine appropriate corrective action.
- Note whether the curb inlet or inlet pipe is blocked or obstructed.
- When the unit is equipped with an internal bypass, observe, quantify and record the accumulation of trash and debris in the inlet chamber. The significance of accumulated trash and debris is a matter of judgment. Often, much of the trash and debris may be removed manually at the time of inspection if a separate maintenance visit is not yet warranted.
- If it has not rained within the past 24 hours, note whether standing water is observed in the biofiltration chamber.
- Finally, observe, quantify and record presence of invasive vegetation and the amount of trash and debris and sediment load in the biofiltration chamber. Erosion of the mulch and biofiltration media bed should also be recorded. Often, much of the invasive vegetation and trash and debris may be removed manually at the time of inspection if a separate maintenance visit is not yet warranted. Sediment load may be rated light, medium or heavy depending on the conditions. Loading characteristics may be determined as follows:

    - *Light sediment load* - sediment is difficult to distinguish among the mulch fibers at the top of the mulch layer; the mulch appears almost new.
    - *Medium sediment load* - sediment accumulation is apparent and may be concentrated in some areas; probing the mulch layer reveals lighter sediment loads under the top 1" of mulch.
    - *Heavy sediment load* - sediment is readily apparent across the entire top of the mulch layer; individual mulch fibers are difficult to distinguish; probing the mulch layer reveals heavy sediment load under the top 1" of mulch.

Maintenance Indicators

Mulch acts as a prefilter to protect the StormMix™ HF media from sediment loading and subsequent loss of hydraulic capacity. As runoff carries sediment into the BioPod™ HF biofiltration chamber, the sediment will accumulate on top of the mulch layer and then, over time, begin to work its way down through the mulch and eventually into the media bed. Mulch replacement should be performed when the mulch layer is full of sediment, but the StormMix™ HF media is still relatively clean. Maintenance personnel should observe sediment accumulation on the surface of the mulch layer and then dig down into the mulch and potentially into the media bed to the point where the mulch or media appears relatively clean.

Maintenance Equipment

The following equipment is helpful when conducting BioPod™ HF maintenance:

- Suitable clothing (appropriate footwear, gloves, hardhat, safety glasses, etc.)
- PPE as required for entry
- Traffic control equipment (cones, barricades, signage, flagging, etc.)
- Manhole hook or pry bar
- Flashlight
- Tape measure
- Rake, hoe, shovel and broom
- Bucket
- Pruners
- Vacuum truck (optional)
- Socket

Maintenance Procedures

Maintenance should be conducted during dry weather when no flow is entering the system. All maintenance may be conducted without entering the BioPod™ HF structure. Once safety measures such as traffic control are deployed, the access covers may be removed, and the following activities may be conducted to complete maintenance:

- Remove all trash and debris from the inlet manually or by using a vacuum truck as required.
- Remove all trash and debris and invasive vegetation from the BioPod™ HF biofiltration chamber manually or by using a vacuum truck as required.
- If the sediment load is medium or light but erosion of the filter media bed is evident, redistribute the mulch with a rake or replace missing mulch as appropriate. If erosion persists, rocks may be placed in the eroded area to help dissipate energy and prevent recurring erosion.
- If the sediment load is heavy, remove the mulch layer using a hoe, rake, shovel, and bucket, or by using a vacuum truck as required. If the sediment load is particularly heavy, inspect the surface of the StormMix™ HF media once the mulch has been removed. If the media appears clogged with sediment, remove and replace one or two inches of StormMix™ HF media prior to replacing the mulch layer[2].
- Prune vegetation as appropriate and replace damaged or dead plants as required.
- Replace the tree grate and/or access covers and sweep the area around the BioPod™ HF to leave the site clean.

[2] No-Float cypress mulch should be used in the BioPod™ HF

- All material removed from the BioPod™ HF during maintenance must be disposed of in accordance with local regulations. In most cases, the material may be handled in the same manner as disposal of material removed from sump catch basins or manholes.

Natural, shredded hardwood mulch should be used in the BioPod™ HF. Timely replacement of the mulch layer according to the maintenance indicators described above should protect the StormMix™ HF media below the mulch layer from clogging due to sediment accumulation. However, whenever the mulch is replaced, the BioPod™ HF should be visited 24 hours after the next major storm event to ensure that there is no standing water in the chamber. Standing water indicates that the StormMix™ HF media below the mulch layer is clogged and must be replaced. Please contact Oldcastle Infrastructure at (800) 579-8819 to purchase StormMix™ HF media.

7. Statements

The following attached pages are signed statements from the manufacturer (Oldcastle Infrastructure), the independent witness (Plouffe Consulting), and NJCAT. These statements are a requirement of the verification process.

In addition, it should be noted that this report has been subjected to public review (e.g., stormwater industry) and all comments and concerns have been satisfactorily addressed.

Oldcastle Infrastructure
A CRH COMPANY

7000 Central Park, Suite 800
Atlanta, GA 30328

oldcastleinfrastructure.com

Dr. Richard Magee, Sc.D., P.E. BCEE
Executive Director
New Jersey Corporation for Advanced Technology
c/o Center for Environmental Systems
Stevens Institute of Technology
One Castle Point on Hudson
Hoboken, NJ 07030

August 06, 2025

Subject: Manufacturer's Statement of Compliance for Stormwater Laboratory Verification Report

Dear Dr. Magee,

Oldcastle Infrastructure has completed verification testing for the BioPod™-HF in accordance with the "New Jersey Department of Environmental Protection (NJDEP) Laboratory Protocol to Assess Total Suspended Solids Removal by a Filtration Manufactured Treatment Device", dated January 14, 2022 (updated April 25, 2023). As required by the "NJDEP Procedure for Obtaining Verification of a Stormwater Treatment Device from New Jersey Corporation for Advanced Technology (NJCAT)", dated August 4, 2021, this letter serves as Oldcastle Infrastructure's statement that all procedures and requirements identified in the aforementioned protocol and process document were met or exceeded.

All testing of our 2 X 4 BioPod™-HF system was completed at our laboratory in Mississauga, ON under the constant supervision of Dr. Pierre Plouffe of Plouffe Consulting. Test sediment particle size analysis was completed by Bureau Veritas in Mississauga, ON, and suspended sediment concentration in water was completed by OSTECH Incorporated in Etobicoke, ON.

If you have any questions or comments regarding the verification report, please do not hesitate to contact me.

Sincerely,

Joe Costa
Senior Scientist & Quality Manger

Plouffe Consulting
1316 Sir David Dr.
Oakville, ON, Canada
L6J 6V5

August 7, 2025

Dr. Richard Magee, Sc.D., P.E. BCEE
Executive Director
New Jersey Corporation for Advanced Technology
℅ Center for Environmental Systems
One Castle Point on Hudson
Hoboken, NJ 07030

Dear Dr. Magee,

Re: Third Party Observation of Performance Qualification of the Oldcastle Infrastructure BioPod™ HF

I am writing to confirm that I, Dr. Pierre-Yves Plouffe, President of Plouffe Consulting, observed the performance qualification of the Oldcastle Infrastructure BioPod™ HF at the Oldcastle facility in Mississauga, Canada in June and July 2025. All tests were conducted in accordance with the "New Jersey Department of Environmental Protection Laboratory Protocol to Assess Total Suspended Solids Removal by a Filtration Manufactured Treatment Device; January 14, 2022 (last updated April 25, 2023).

Plouffe Consulting is an independent corporation that has no conflict of interest in relation to the NSBB® device. I affirm that I and Plouffe Consulting have no financial, competing interests or personal interests that could potentially influence or bias my judgment or actions in any way. I have thoroughly assessed my affiliations, financial interests, and other relevant factors, and I am confident that I have fulfilled my responsibilities objectively and ethically.

I confirm that I and Plouffe Consulting have not granted, sought, attempted to obtain or accepted and will not grant, seek attempt to obtain or accept any advantage, financially or in kind, to or from any party whatsoever, constituting an illegal or corrupt practice, either directly or indirectly, as an incentive or reward relating to the outcome of the testing.

Please do not hesitate to contact me if you require any further clarification or information regarding my independence and absence of conflicts of interest.

Sincerely,

PYPlouffe

Pierre-Yves Plouffe, Ph.D.
President
Plouffe Consulting
(647)291-9549
Pierre.Plouffe@Cogeco.ca

Center for Environmental Systems
Stevens Institute of Technology
One Castle Point
Hoboken, NJ 07030-0000

August 18, 2025

Gabriel Mahon, Chief
NJDEP
Bureau of Non-Point Pollution Control
Division of Water Quality
401 E. State Street
Mail Code 401-02B, PO Box 420
Trenton, NJ 08625-0420

Dear Mr. Mahon,

My review, evaluation and assessment covered the performance testing conducted on a commercially available 2 X 4 BioPod™ HF with External Bypass biofiltration chamber from June - July 2025 at the Oldcastle Water Lab located in Mississauga, Ontario. Since testing was carried out in-house, all test activities were conducted under the observation of a 3rd party witness, Dr. Pierre Plouffe of Plouffe Consulting. The test protocol requirements contained in the "*New Jersey Department of Environmental Protection Laboratory Protocol to Assess Total Suspended Solids Removal by a Filtration Manufactured Treatment Device*" (NJDEP Filtration Protocol, January 14, 2022) were met or exceeded**.** Specifically:

Test Sediment Feed

The test sediment used for the removal efficiency study (1-1000 µm) was a custom blend of commercially available silica sediments that was blended by Oldcastle Infrastructure; this particular batch was lot # A005-034. The sediment was blended in four separate batches. Three composite sediment samples were formed by taking sediment samples from the top and bottom of the mixing drum, all in different locations, for each batch. Each of the three composite samples was reduced in size using a riffle splitter. Sediment sampling was performed under the observation of the 3rd party witness. Following the sampling, the sediment was stored in two 50-gallon drums lined with 6-mil plastic liners. The drums were security sealed until used. The three composite sediment samples were sent to Bureau Veritas in Mississauga, ON for particle size analysis using the methodology of ASTM D6913-17, "Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis" and ASTM D7928-21 "Standard Test Method for Particle-Size Distribution (Gradation) of Fine-Grained Soils Using the Sedimentation

(Hydrometer) Analysis". With a d_{50} of 66 µm, the test sediment was finer than the sediment required by the NJDEP test protocol (75 µm).

Removal Efficiency (RE) Testing

Fourteen (14) removal efficiency test runs were completed in accordance with the NJDEP test protocol. The target flow rate and influent sediment concentration were 17.0 gpm and 200 mg/L for the removal efficiency testing. The BioPod™ HF achieved a cumulative removal efficiency of 88.3% for runs 1 through 10 and 88.4% for the 14 runs. The temperature for all test runs did not exceed 80 degrees Fahrenheit.

Sediment Mass Loading Capacity

Mass loading capacity testing was conducted as a continuation of removal efficiency testing for an additional 56 runs. Mass loading test runs were conducted using identical testing procedures and flow rate target as those used in the removal efficiency runs, except that the influent sediment concentration was increased to 400 mg/L. Testing continued until the run removal efficiency dropped below 80% at run 70. The BioPod™ HF achieved a cumulative mass removal efficiency of 83.9% over the 70 runs. The temperature for all test runs did not exceed 80 degrees Fahrenheit.

The total sediment mass captured by the BioPod™ over 69 runs was 90.3 lbs. This is equivalent to a sediment mass loading capacity of 22.6 lbs/ft^2 of EFTA.

Test Setup Maintenance

Before the start of Run 36, the water in the storage tanks was diluted to reduce the background sediment concentration in the system. This was done by pumping approximately 1/3 of the water volume in the storage tanks directly to waste. The water was replaced with clean potable water. No other maintenance was performed on the test setup.

Scour Testing

No scour testing was performed on the BioPod™ since it is designed for offline installation.

Sincerely,

Richard S. Magee, Sc.D., P.E., BCEE
Executive Director

8. References

1. Procedure for Obtaining Verification of a Stormwater Manufactured Treatment Device from New Jersey Corporation for Advanced Technology. August 4, 2021.

2. New Jersey Department of Environmental Protection Laboratory Protocol to Assess Total Suspended Solids Removal by a Filtration Manufactured Treatment Device. January 14, 2022. (Last updated April 25, 2023)

3. OWL Laboratory Notebook 002, pp. 24 - 25.

4. OWL Laboratory Notebook 005, pp. 107 - 140.

VERIFICATION APPENDIX

Introduction

- Manufacturer **–** Oldcastle Infrastructure, 7000 Central Parkway, Suite 800, Atlanta, GA 30328. Phone: (888) 965-3227. Website: www.oldcastleinfrastructure.com
- MTD – Standard BioPod™ HF dimensions are shown in **Table A-1**.
- TSS Removal Rate – 80%
- Off-line installation

Detailed Specification

- Oldcastle BioPod™ HF maximum treatment flow rates (MTFRs) and maximum allowable inflow drainage areas are attached as **Table A-1**.
- For a reference maintenance plan, download the Oldcastle NSBB® Operation and Maintenance Manual at: https://oldcastleinfrastructure.com/wp-content/uploads/2025/05/6-A-045_BioPod-High-Flow-Operations-and-Maintenance-Manual_WEB.pdf
- According to N.J.A.C. 7:8-5.5, NJDEP stormwater design requirements do not allow the BioPod™ HF system to be used in series with a settling chamber (such as a hydrodynamic separator) or a media filter (such as a sand filter) to achieve an enhanced TSS removal rate.

Table A-1 BioPod™ HF Model Sizes and New Jersey Treatment Capacities

Configuration	Dimensions (ft)	Media Surface Area (ft^2)	Effective Sedimentation (Filtration) Area[1] (ft^2)	MTFR[2] (CFS)		MTFR:EFTA (GPM/ft^2)	Drainage Area[3] (acres)
				GPM	CFS		
BioPod™ HF Planter	2 X 4	8	8	34	0.076	4.25	0.30
	4 X 4	16	16	68	0.151	4.25	0.60
	4 X 6	24	24	102	0.227	4.25	0.90
	4 X 8	32	32	136	0.303	4.25	1.20
	4 X 12	48	48	204	0.454	4.25	1.81
	5 X 10	50	50	213	0.473	4.25	1.88
	6 X 8	48	48	204	0.454	4.25	1.81
	6 x 12	72	72	306	0.681	4.25	2.71
	7 X 15	105	105	446	0.993	4.25	3.95
	8 X 12	96	96	408	0.908	4.25	3.61
	8 X 16	128	128	544	1.211	4.25	4.81
BioPod™ HF with External Bypass	2 X 4	4	4	17	0.038	4.25	0.15
	4 X 4	8	8	34	0.076	4.25	0.30
	4 X 6	16	16	68	0.151	4.25	0.60
	4 X 8	24	24	102	0.227	4.25	0.90
	4 X 12	40	40	170	0.378	4.25	1.50
	5 X 10	40	40	170	0.378	4.25	1.50
	6 X 8	36	36	153	0.341	4.25	1.35
	6 x 12	60	60	255	0.568	4.25	2.26
	7 X 15	98	98	417	0.927	4.25	3.69
	8 X 12	80	80	340	0.757	4.25	3.01
	8 X 16	96	96	408	0.908	4.25	3.61
BioPod™ HF with Integral Bypass Tray	4 X 6	20.86	20.86	89	0.197	4.25	0.78
	4 X 8	28.86	28.86	123	0.273	4.25	1.09
	4 X 12	44.86	44.86	191	0.424	4.25	1.69
	6 X 6	32.86	32.86	140	0.311	4.25	1.24
	6 X 8	44.86	44.86	191	0.424	4.25	1.69
	6 X 10	56.86	56.86	242	0.538	4.25	2.14
	6 X 12	68.86	68.86	293	0.651	4.25	2.59
	8 X 16	124.86	124.86	531	1.181	4.25	4.70

1. Since the treatment system is a horizontal filter, media surface area (MSA) equals effective sedimentation area (ESA) equals effective filtration treatment area (EFTA).
2. MTFR is based on 4.25 GPM/ft^2 of effective filtration treatment area.
3. Drainage area is based on 22.6 lb/ft^2 (90.3 lb/4 ft^2) of effective filtration treatment area and the equation in the NJDEP Filtration Protocol Appendix, where drainage area is calculated based on 600 lbs. of mass contributed per acre of drainage area annually.