

NJCAT TECHNOLOGY VERIFICATION

StormTrap SurgeSettler™ High Flow Hydrodynamic Separator

StormTrap LLC

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1. Description of Technology

SurgeSettler™ is a manufactured treatment device developed by StormTrap® that improves the quality of stormwater runoff before it enters receiving waterways. SurgeSettler is designed to remove sediment from runoff using inclined tube settling technology. Stormwater enters a vault through an inflow pipe and exits through an outflow pipe that is placed at the same elevation. The vault consists of a forebay, an enhanced settling section and an outlet bay. The forebay contains a structure designed to distribute the flow more evenly through the vault. The enhanced settling section consists of an internal structure that includes enhanced settling packs, weirs and baffles. The outlet bay is an empty space that allows for the water quality treatment flow and bypass flow paths to combine before the water exits the system.

The weirs and baffles in the settling section are at elevations such that floatable material is retained in the forebay at flows up to the bypass points. Bypass occurs at two points: bypass of the middle back baffle and bypass of the left and right back retention bay baffles. At bypass of the middle back baffle, most floatables are pushed into retention bays on each side of the vault while the excess flow travels down a center channel. The retention bays are equipped with weirs that extend above the middle bypass weir. Full internal bypass above the right and left back baffles is possible at extremely high flows, above the rated scour flow at which point floatables can escape. The SurgeSettler can be equipped with a hydrophobic/oleophilic accessory to capture and retain oil as warranted by site-specific concerns.

Water enters through the inlet pipe is split and distributed into the enhanced settling section by the flow wedge at the front of the unit. From there, the water moves into the enhanced settling packs, where it is further divided into many narrow pathways. Despite this, the overall flow direction remains predominantly horizontal through the packs toward the outlet. As the flow passes through the enhanced settling packs, suspended particles settle out, either being captured within the settling packs or falling to the bottom of the sump, where they accumulate. The treated water then continues through the settling packs, recombines in the outlet bay, and exits the system through the outlet pipe.

Figure 1 identifies key SurgeSettler internal components while **Figure 2** and **Figure 3** depict low and high flow operation. Red arrows indicate flow path. The internal components are typically fabricated using plastic or fiberglass parts. The internals are typically housed within a concrete vault structure. Maintenance is performed by accessing the unit in three locations including the forebay, the outlet bay, and a 2' x 2' maintenance access manhole.

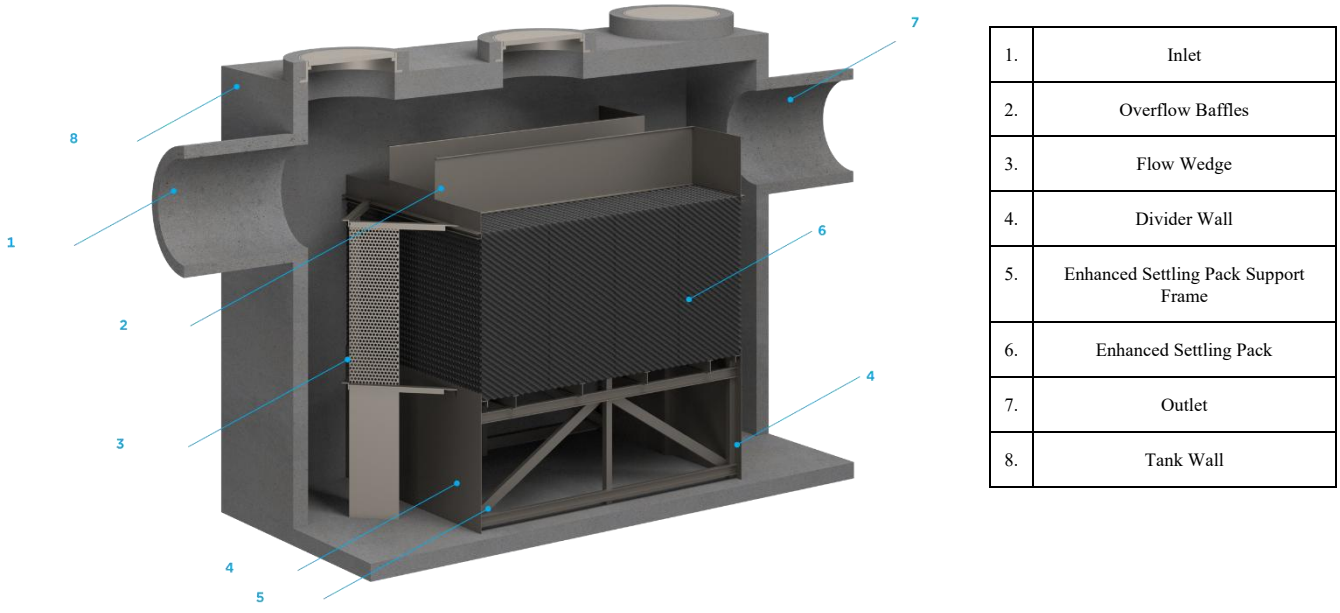


Figure 1 - SurgeSettler Internal Components

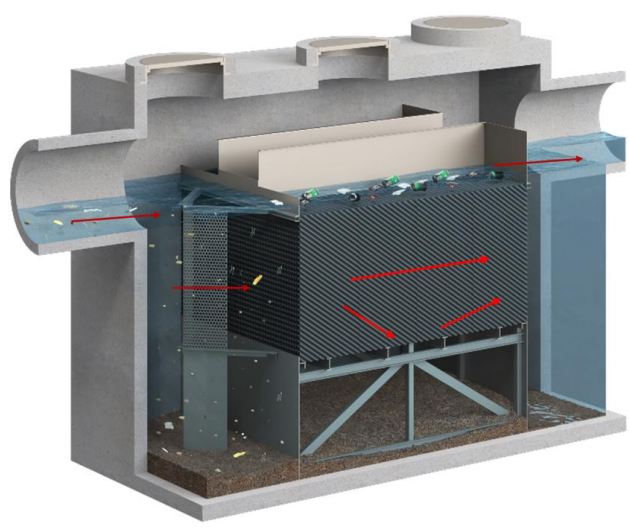


Figure 2 - SurgeSettler Low Flow Operation

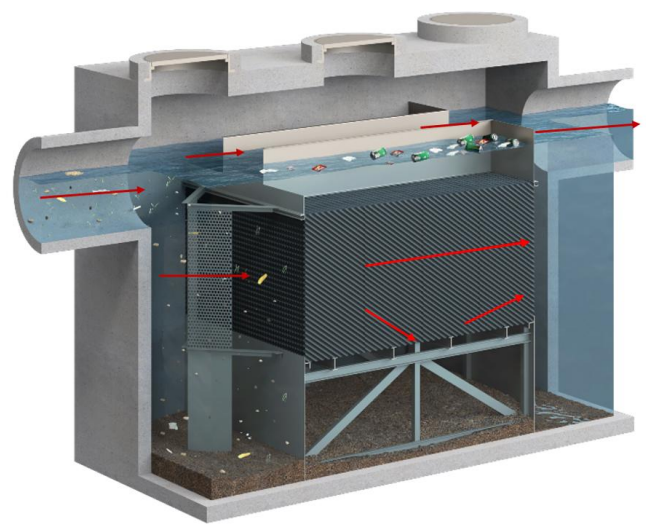


Figure 3 - SurgeSettler High Flow Operation

2. Laboratory Testing

SurgeSettler was evaluated for sediment removal efficiency and scour in accordance with the “New Jersey Department of Environmental Protection Laboratory Protocol to Assess Total Suspended

Solids Removal by a Hydrodynamic Sedimentation Manufactured Treatment Device” (January 1, 2021, Last Updated April 25, 2023). Prior to commencing the testing program, a quality assurance project plan (QAPP) was submitted to and approved by the New Jersey Corporation for Advanced Technology (NJCAT).

Testing was conducted at the StormTrap Research and Development Laboratory Facility in Morris, Illinois under the observation of a third-party witness, Jason Wiesbrock, P.E., Vice President of Space Co., Inc. Mr. Wiesbrock’s credentials were reviewed and approved by NJCAT prior to the start of testing. Water samples collected during testing were analyzed by Gabriel Environmental Services (GES), a NELAP accredited independent laboratory located in Chicago, IL. Sediment particle size distribution (PSD) samples were analyzed by GeoTesting Express, an A2LA, AASHTO, and USACE accredited independent laboratory located in Acton, MA. All samples sent to independent laboratories were accompanied by chain of custody (COC) forms. The third-party witness was present and witnessed the collection of samples, sample labeling, completion of COC forms and preparation of samples for delivery to the laboratory.

2.1. Test Unit

The tested device was a prototype of a commercially available SurgeSettler 6’x14’ unit consisting of internal components housed in a metal vault. In commercial systems, the internal components are typically housed in a concrete vault. The metal vault of the test unit is equivalent to commercial concrete vaults in all key dimensions. The use of a metal vault was proposed for testing convenience, since it allows for the addition of a port that can be used for sediment removal. The test unit was equipped with a 24” diameter access port with an invert 12” above the floor to access the sump to allow for easy recovery of captured sediment. The port contains a plug to maintain a smooth inner wall. Using metal in lieu of concrete did not have an impact on system performance.

Two test units were used during testing: one unit for sediment removal efficiency and hydraulic testing and one unit for scour testing. The SurgeSettler unit used for sediment removal efficiency and hydraulic testing is hereinafter referred to as the West unit. The SurgeSettler unit used for scour testing is hereinafter referred to as the East unit. The two units were identical except that the East unit was taller to accommodate the higher water surface elevations created by the scour flow rates and false floor elevations were set per protocol requirements. **Figure 4** is a profile view of the test unit. **Figure 5** is a plan view of the test unit. Additional dimensions are provided in **Table 1**. This unit had a total sump area of 84 ft² and a *target* maximum treatment flow rate (MTFR) of 7.58 cfs (3402 GPM).

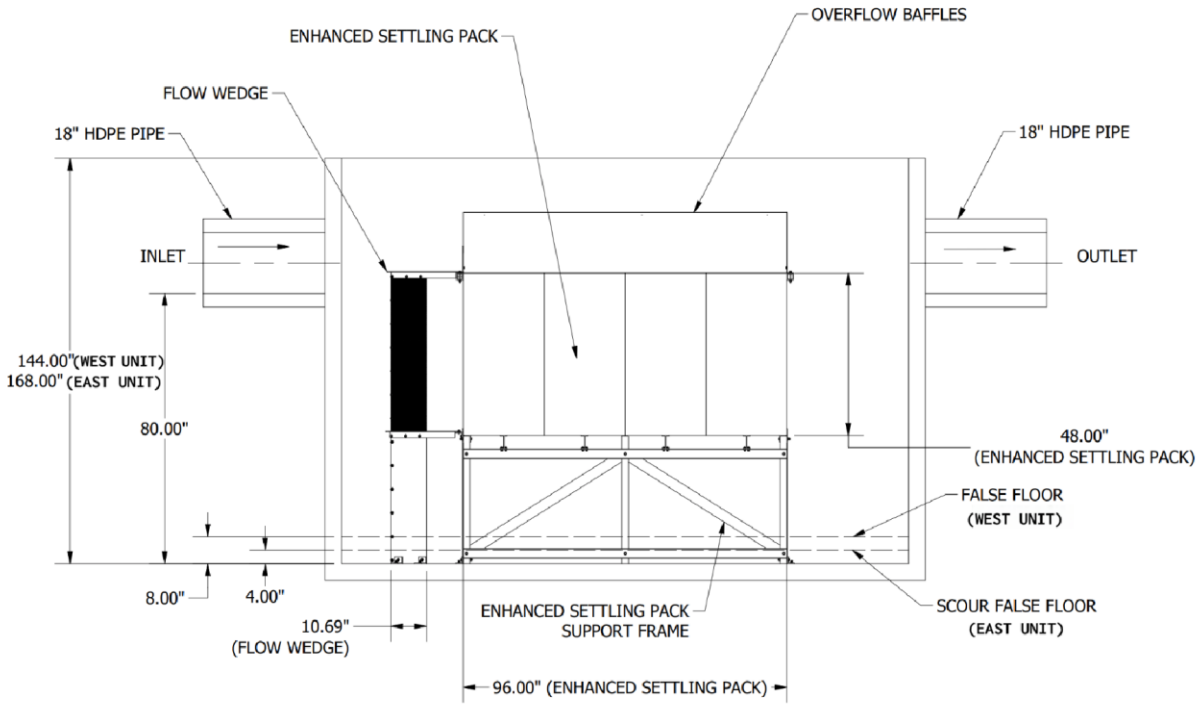


Figure 4 - SurgeSettler Unit Elevations

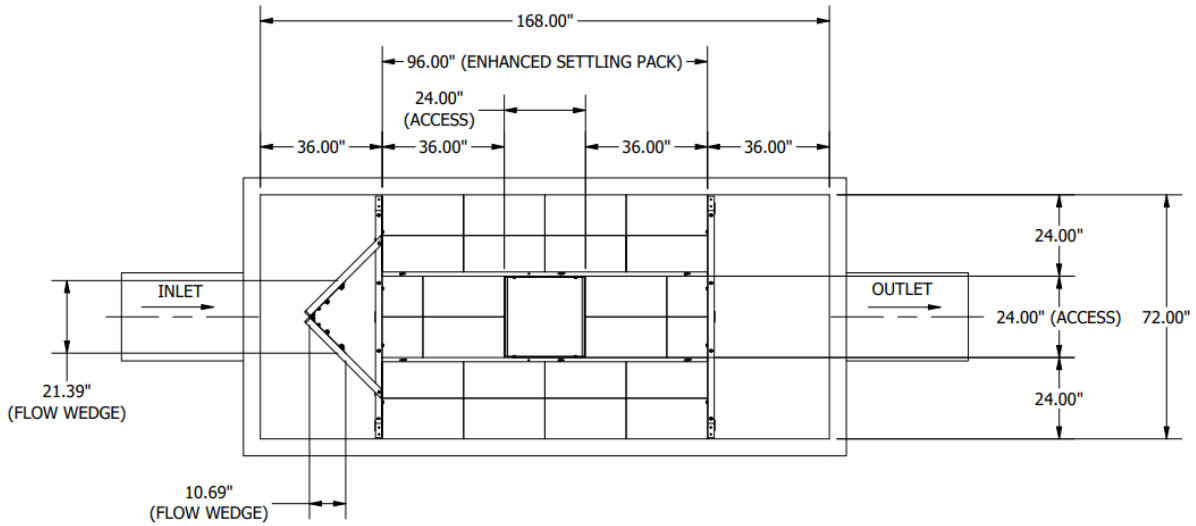


Figure 5 - SurgeSettler Unit Plan View

Table 1- SurgeSettler Dimensions

MTFR (target)		Physical Exterior Dimensions			Physical Interior Dimensions			Effective Treatment Area (ft²)
cfs	GPM	Length (ft)	Width (ft)	Depth (ft)	Length (ft)	Width (ft)	Depth from Invert (ft)	
7.58	3402	15	6.83	12	14	6	6.67	84

2.2 Test Set Up

Test Loop 1, illustrated in **Figure 6**, operated as a recirculating closed looped system, comprised of a test pool (approximate 95,000-gallon capacity), pumps, sediment filter, flow meter, auger feeder, an effluent return channel and the West test unit. The test loop used was capable of moving water at a rate of approximately 4670 GPM (10.4 cfs). Test Loop 1 was used for sediment removal efficiency tests and hydraulic testing from 10% MTFR to 125% MTFR.

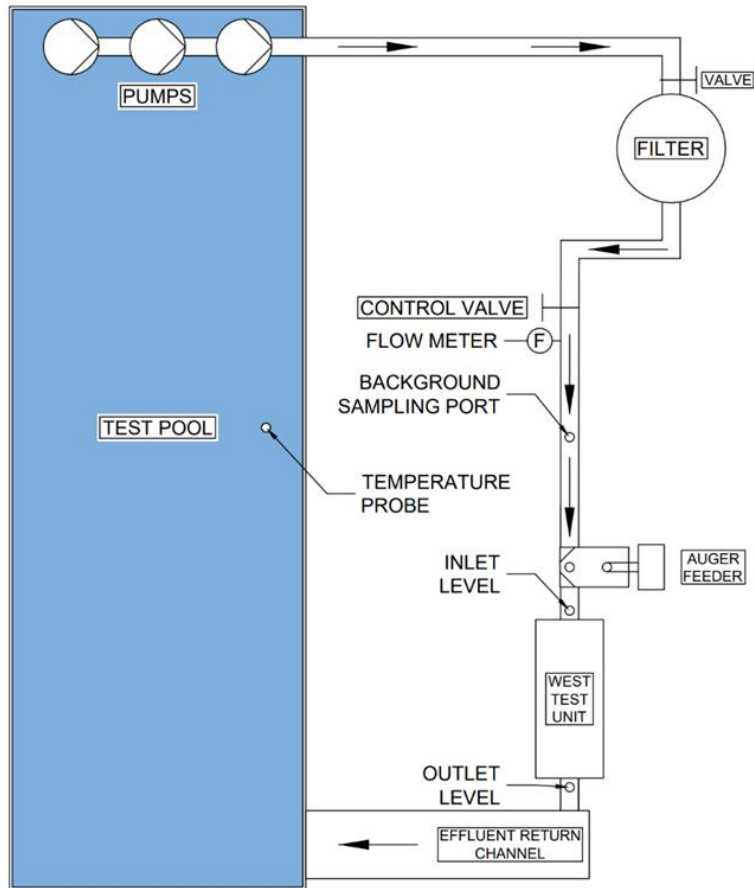


Figure 6 - Test Loop 1 “Low Flow” Laboratory Set Up

Shown in **Figure 7** through **Figure 10** are the sediment addition port (Test loop 1 and 2), background sampling port (Test Loop 1), SurgeSettler access port (Test Loop 1 and 2) and the outlet pipe and effluent return channel Test Loop 1 and 2) respectively.



**Figure 7 - Sediment Addition Port
Loop 1 and 2**



**Test Figure 8 - Background Sampling Port
Test Loop 1**



**Figure 9 - SurgeSettler Unit and Access Port
Test Loop 1 and 2**



**Figure 10 - Outlet Pipe and Effluent Return Channel
Test Loop 1 and 2**

When testing with Test Loop 1, all equipment was calibrated and connected via wired or wireless transmission to the Prosoft data acquisition system which collected and recorded outputs from each instrument. Data collection intervals for each device were input as required by the NJDEP

protocol. The system was synced with a NIST timekeeping device to ensure all data points were accurately timestamped and synchronized into a centralized CSV file.

When configured in Test Loop 1, water was pumped from the test pool using a single or a series of the following pumps to achieving the desired flow rate: Tsurumi Model KTV2-15 2HP Semi-Vortex Dewatering Pump, Tsurumi Model KTV2-55 7.5 HP Semi-Vortex Dewatering Pump, Tsurumi Model KRS822L-61 30HP High Volume Dewatering Pump, Tsurumi Model GSZ2-75-4L 100HP High Volume Dewatering Pump. Water from the test pool was pumped through a 12” PVC pipe into a Fil-Trek Model ELP50-3012-12F-A-15 filter housing containing bag filters with a rating of 1 micron (μm) for flows below 3000 GPM or 25 μm or 50 μm bag filters for flows above 3000 GPM. From the filter housing, the water flowed through a straight horizontal run of 12” diameter PVC pipe.

Flow measurements for Test Loop 1 were taken using a calibrated Krohne Enviromag 2300 C Optiflux KC 2000F electromagnetic flow meter with a measurement accuracy of $\pm 0.1\%$. The flow meter was installed away from flow disturbances on the horizontal run of 12” diameter PVC pipe downstream of the filter vessel, where full flow was achieved. The flow meter was installed in accordance with the manufacturer’s instructions. The flow meter was set to collect data every 30 seconds via the Prosoft data acquisition system.

Background samples were taken from a sampling port in a section of 12” PVC vertical pipe downstream of the flow meter and upstream of the sediment addition point. The background sampling port was fashioned from a $\frac{3}{4}$ ” copper pipe with a 90° fitting placed in the centerline of the vertical pipe with a ball valve to open and close the port. The 18” diameter PVC inlet pipe was connected to the vertical pipe section and was 205” long and installed with a 1.6% slope. The 18” PVC outlet pipe was 60” long and installed with a 1.6% slope. The outlet pipe terminated with a free-fall into an effluent return channel that returned the water directly back into the test pool.

To meet the flow requirements for the 150% MTRF sediment removal efficiency run, additional hydraulic testing, and scour testing, supplemental external pumps, pipes and filter housings were integrated, and the loop configuration was revised as shown in **Figure 11** and **Figure 12**. Test Loop 2 was configured for use with the West unit and Test Loop 3 was configured for use with the East unit. Both Test Loop 2 and Test Loop 3 also operated as a recirculating close looped system comprised of the test pool, pumps, sediment filters, flow meter, auger feeder, and an effluent return channel. Test Loop 2 and Test Loop 3 were capable of moving water at a rate of approximately 8,000 GPM (17.8 cfs).

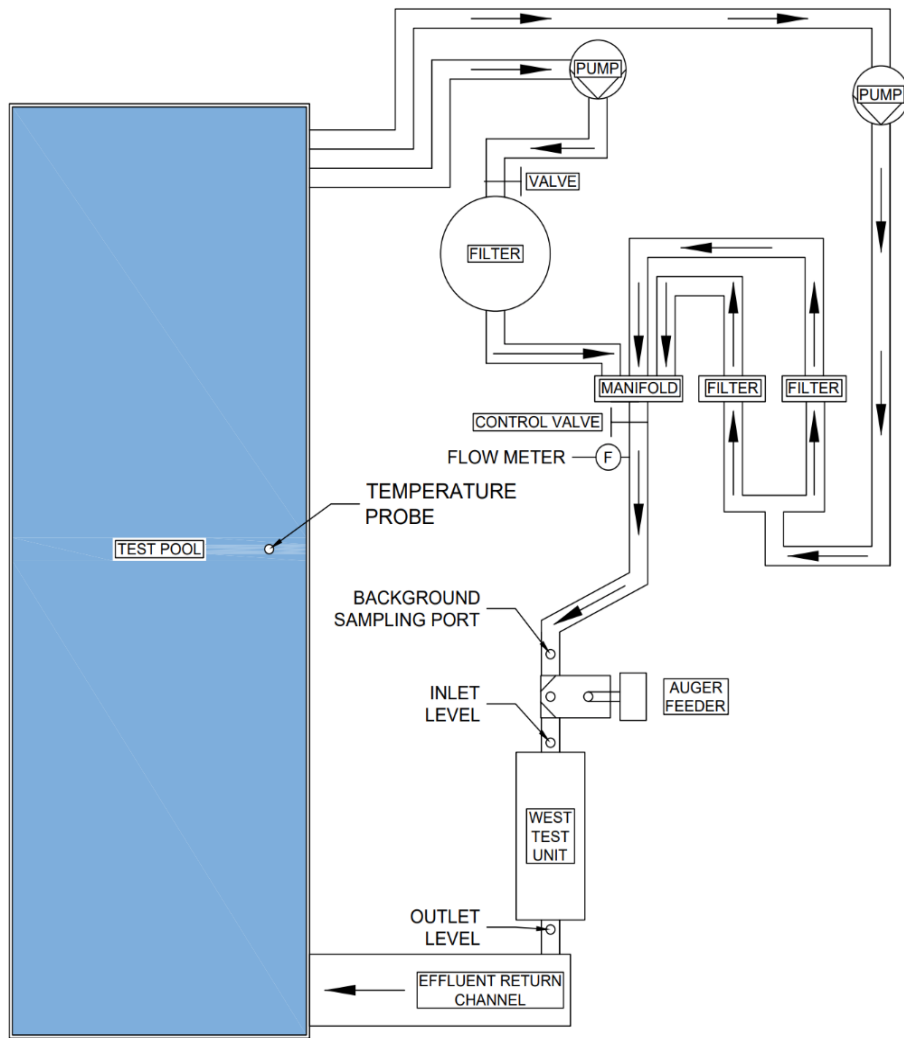


Figure 11 - Test Loop 2 “High Flow” Laboratory Set Up

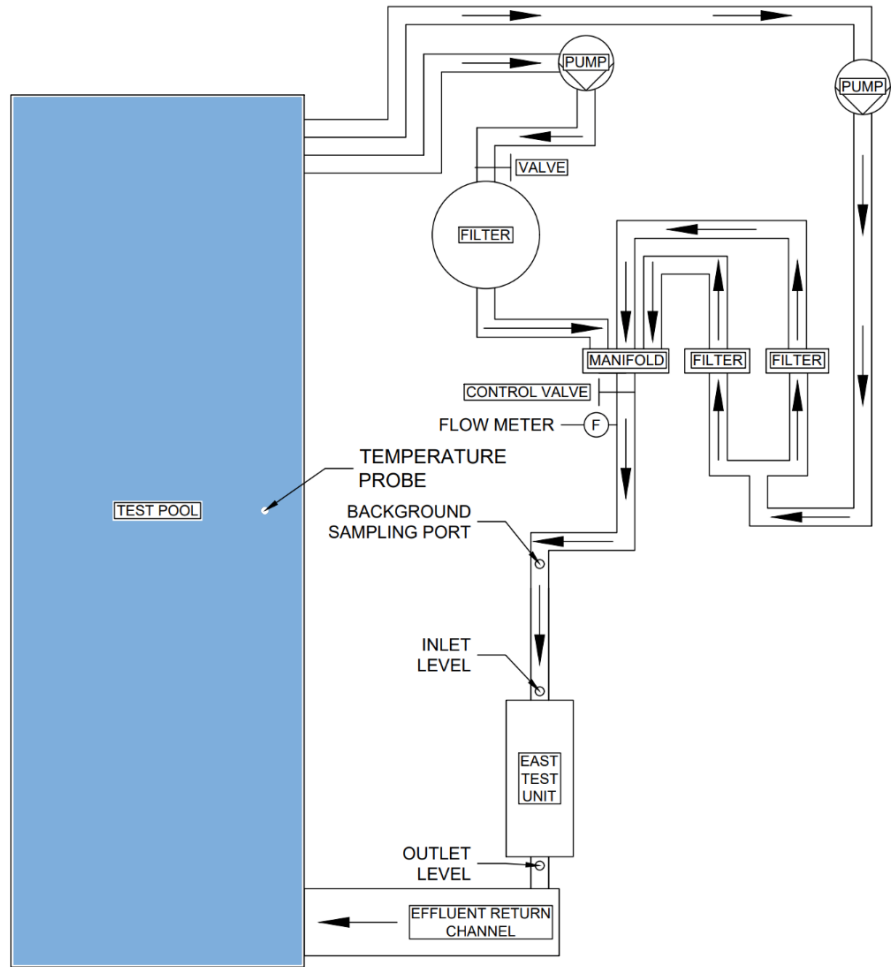


Figure 12 - Test Loop 3 “High Flow” Laboratory Set Up

Shown in **Figure 13** through **Figure 16** are the background sampling port (Test Loop 2), background sampling port (Test Loop 3), SurgeSettler access port (Test Loop 3) and the outlet pipe and effluent return channel (Test Loop 3), respectively.



Figure 13 - Background Sampling Port Test Loop 2



Figure 14 - Background Sampling Port Test Loop 3

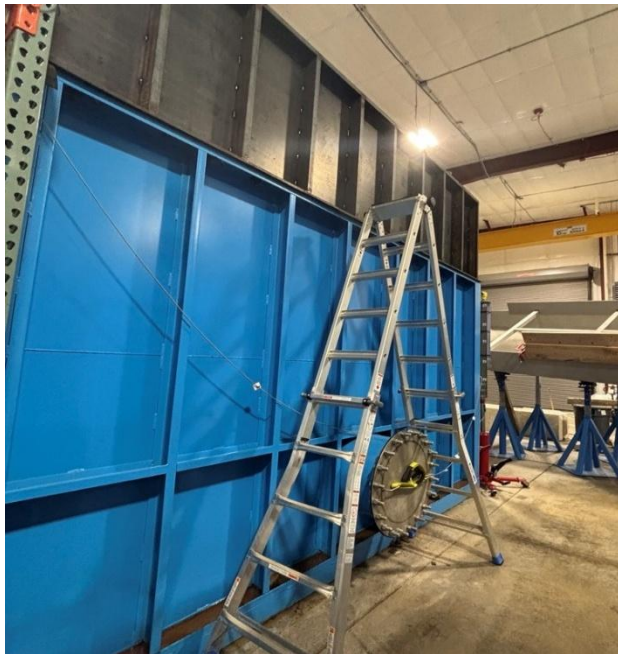


Figure 15 - SurgeSettler Unit and Access Port Test Loop 3



Figure 16 - Outlet Pipe and Effluent Return Channel Test Loop 3

When configured in Test Loop 2 and Test Loop 3, water was pumped from the test pool using two Rain for Rent BBA Pumps Model BA350E D370 with John Deere Engine Model 6068CI550. One 12" HDPE pipe was used to pump water from the test pool through a Fil-Trek Model ELP50-3012-12F-A-15 filter housing containing bag filters with a rating of 25 μm or 50 μm . From the filter housing, a 12" diameter polypropylene flex pipe with non-corrugated interior walls was connected to a valve manifold.

An additional 12" diameter HDPE pipe was installed to convey water from the test pool to a tee connection, which distributed the flow into two 12" diameter polypropylene flexible pipes with a non-corrugated interior. The flex pipes directed water through the following two Rain for Rent Model BF2000 filter housings both installed with 25 μm or 50 μm bag filters. From each filter housing, a 12" diameter polypropylene flex pipe with a non-corrugated interior was connected to the valve manifold. From the valve manifold, water was directed through a single straight horizontal run of 18" diameter HDPE pipe.

Flow measurements for both Test Loop 2 and Test Loop 3 were taken using a calibrated Greyline Transit Time Flow Meter (TTFM) 1.0 with a measurement accuracy of $\pm 1\%$ configured to take readings every 30 seconds. The TTFM 1.0 was not configured for data output to the Prosoft data acquisition system thus data was retrieved directly from the unit's internal datalogger. The TTFM 1.0 was installed on the section of straight 18" HDPE pipe where full flow was achieved to ensure the location complied with manufacturers specifications.

For Test Loop 2, the horizontal run of pipe from the valve manifold was connected to another straight run of 18" HDPE pipe then up to a vertical section of 18" diameter HDPE pipe downstream of the flow meter and upstream of the West unit containing the background sampling port. The inlet pipe was connected to the vertical pipe section. The inlet pipe to the unit was PVC, 18" in diameter, 205" long and installed with a 1.6% slope. The outlet pipe was 18" in diameter, 60" long and installed with an 1.6% slope. The outlet pipe terminated with a free-fall into an effluent return channel that returned the water back to the test pool.

For Test Loop 3, the horizontal run of pipe was connected to a vertical section of 18" diameter HDPE pipe downstream of the flow meter and upstream of the East unit containing the background sampling port. The inlet pipe was connected to the vertical pipe section. The inlet pipe was PVC, 18" in diameter, 205" long and installed with a 1.0% slope. The outlet pipe was 18" in diameter, 60" long and installed with a 1.0% slope. The outlet pipe terminated with a free-fall into an effluent return channel that returned the water back to the test pool.

Sediment Addition and Collection

For all three test loops, sediment addition was done through a funneled port on the crown of the influent pipe 23" upstream of the SurgeSettler unit. The sediment feeder was an Acrison volumetric screw feeder. Sediment feed samples were collected in clean 1L wide-mouth bottles.

Sample Collection

Background samples were collected from the sample ports described above for each test loop. Wide-mouth, 0.5-gallon jars were used for background sample collection. The background sampling port was opened for a minimum of 3 seconds prior to the start of sample collection to flush the sampling port of any accumulated sediment.

For the scour test, effluent samples were taken by hand via grab sampling. Wide-mouth, 0.5-gallon jars were used for effluent sample collection. Removal efficiency was determined by mass recovery; no effluent samples were collected for removal efficiency analysis.

Duplicate samples were collected for background and effluent samples. The primary set was analyzed and reported while the second set was held under refrigerated conditions at the third-party testing laboratory in case there was a need for investigation of any aberrant results.

Water Temperature

Water temperature measurements for all tests were obtained using a temperature probe calibrated against a calibrated Madgetech Microtemp datalogger. Temperature readings were collected every 30 seconds via the Prosoft data acquisition system to ensure the water temperature did not exceed 80.0°F. A Pentair Model ETi 400 heater was used to regulate the test pool temperature. Throughout the duration of all tests completed, the water temperature remained under 80.0°F.

Head loss

The Prosoft data acquisition system was configured to record upstream, downstream and differential water surface elevation measurements every 30 seconds during hydraulics testing. Water surface elevation levels were measured in the influent and effluent pipes to determine head loss across the unit. Piezometer taps were placed on the invert of the influent and effluent pipe one pipe-diameter upstream and downstream of the test unit, respectively. Each piezometer tap was connected to a 6" diameter clear PVC tube with a calibrated Vega VEGAPULS 31 radar level sensor installed to the top of the tube per the manufacturer's specifications. The Vega VEGAPULS 31 radar level sensors measured water surface elevation to a precision of ± 2 mm.

Additional Instrumentation and Measurement

Run and sampling times were measured using a NIST timekeeping device connected to the Prosoft data acquisition system in addition to NIST traceable calibrated stopwatches.

Sediment feed samples, non-ferrous pans, filter bags and calibration sampling jar tare weights were weighed on an Ohaus Ranger 3000 Model R31P3 scale with a precision of 0.1 g. Sediment that was added to the auger feeder and the sediment recorded following each run was weighed on a Cole Parmer IPS-300-400 balance with a precision of 0.02 lbs. Scales were verified each day prior to use using calibrated NIST traceable verification weights.

2.3 Test Sediment

Removal Efficiency Test Sediment

The test sediment used for removal efficiency testing (1-1000 μm) was comprised of high purity silica blended to have a Particle Size Distribution (PSD) that meet the required tolerances specified in Section 4.A. of the test protocol for “TSS Removal Efficiency” as well for Sediment A specifications in ASTM E3317-22 “Standard Specification for Silica-Based Sediments for the Evaluation of Stormwater Treatment Devices.” The test sediments were blended at the StormTrap Research and Development laboratory facility. Internal sediment blend lot numbers used for testing were 24C-02, 25A-04 and 25B-01. Upon completion of blending, three random samples of each sediment lot were taken in accordance with ASTM E3317-22 under third-party observation. The final blended sediment lots were stored in 5-gallon buckets security sealed under the observation of the third-party observer until needed.

The samples for each of the sediment blends were analyzed for PSD by a qualified 3rd party analytical laboratory, GeoTesting in Acton, MA (A2LA, AASHTO, and USACE accredited). Testing was conducted in a manner consistent with 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.” A COC form accompanied all samples analyzed. The test results for each lot of sediment are summarized in **Table 2**, **Table 3**, and **Table 4** below. Test results are shown graphically in **Figure 17**. In instances in which multiple lots of sediment were used, NJDEP specifications were still met as shown in **Table 5** below. Where required, particle size data had been interpolated to allow for comparison to the required particle size. Per “New Jersey Department of Environmental Protection Laboratory Protocol to Assess Total Suspended Solids Removal by a Hydrodynamic Sedimentation Manufactured Treatment Device” (January 1, 2021, Last Updated April 25, 2023), a measured value may be lower than a target minimum percent less than value by up to two percentage points (e.g., at least 3% of the particles must be less than 2 microns in size [target is 5%] provided that the measured d50 value does not exceed 75 microns for total suspended solids (TSS) test removal efficiency PSD.

Table 2 - Particle Size Distribution of 1-1000 μm Test Sediment Lot 24C-02

Particle Size (μm)	Test Sediment Particle Size (% Passing)				NJDEP Specification (Minimum % Passing)
	Sample 1	Sample 2	Sample 3	Average	
1000	99	99	99	99	100
500	95	95	95	95	95
250	92	92	92	92	90
150	72	77	77	75	75
100	57	58	59	58	60
75	51	52	53	52	50
50	47	46	46	46	45
20	37	34	34	35	35
8	18	17	18	18	20
5	12	12	12	12	10
2	6	6	6	6	5

Table 3 - Particle Size Distribution of 1-1000 μm Test Sediment Lot 25A-04

Particle Size (μm)	Test Sediment Particle Size (% Passing)				NJDEP Specification (Minimum % Passing)
	Sample 1	Sample 2	Sample 3	Average	
1000	98	98	98	98	100
500	93	93	94	93	95
250	89	90	90	90	90
150	74	75	77	75	75
100	59	59	60	59	60
75	54	54	55	54	50
50	50	49	50	50	45
20	35	37	35	36	35
8	17	18	18	18	20
5	13	11	11	12	10
2	4	4	5	4	5

Table 4 - Particle Size Distribution of 1-1000 µm Test Sediment Lot 25B-01

Particle Size (µm)	Test Sediment Particle Size (% Passing)				NJDEP Specification (Minimum % Passing)
	Sample 1	Sample 2	Sample 3	Average	
1000	98	98	98	98	100
500	94	93	94	94	95
250	90	89	89	89	90
150	75	75	72	74	75
100	59	59	59	59	60
75	54	54	54	54	50
50	48	48	48	48	45
20	34	32	34	33	35
8	18	18	17	18	20
5	12	12	12	12	10
2	4	4	5	4	5

Table 5 - Particle Size Distribution of 1-1000 µm Test Sediment Combined Lots

Particle Size (µm)	Average Test Sediment Particle Size (% Passing)				NJDEP Specification (Minimum % Passing)
	Lot 24C-02	Lot 25A-04	Lot 25B-01	Average	
1000	99	98	98	98	100
500	95	93	94	94	95
250	92	90	89	90	90
150	75	75	74	75	75
100	58	59	59	59	60
75	52	54	54	53	50
50	46	50	48	48	45
20	35	36	33	35	35
8	18	18	18	18	20
5	12	12	12	12	10
2	6	4	4	5	5

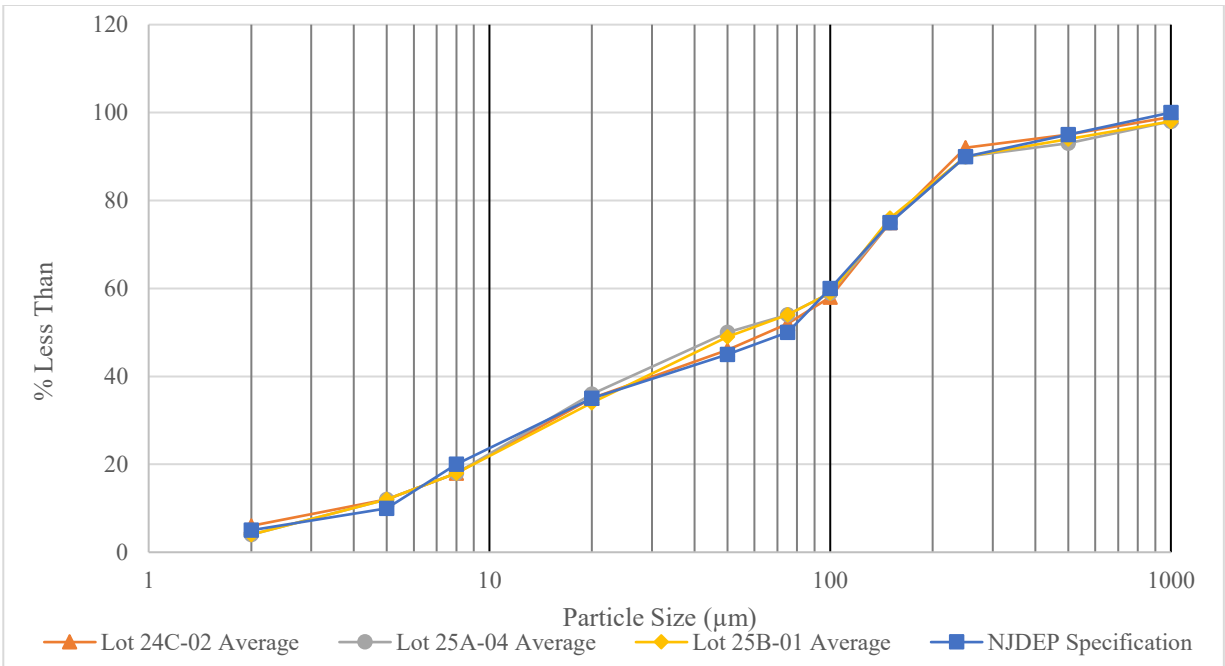


Figure 17 - Particle Size Distribution of 1-1000 μm Test Sediment

The moisture content of the test sediments was also tested at GeoTesting in accordance with ASTM Method D2216-19 “Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass”. The moisture content for all sample lots was <0.28%. This amount of moisture was considered insignificant and therefore no correction for moisture was made for the sediment mass. The median (d_{50}) was 64 μm, 48 μm, and 54 μm respectively for lots 24C-02, 25A-04 and 25B-01, finer than the sediment required by the NJDEP protocol and ASTM E3317-22 for Sediment A. All blended test sediment lots were found to meet the NJDEP and ASTM E3317-22 particle size specifications and were deemed acceptable for use.

Scour Test Sediment

The sediment used for scour testing was also comprised of high purity silica blended to have a Particle Size Distributions (PSD) that meet the required tolerances specified in Section 4.A. of the test protocol for “TSS Removal Efficiency” as well as Sediment C specifications per ASTM E3317-22. The test sediment was blended at the StormTrap Research and Development laboratory facility. Internal lot number 25B-04 was used. Upon completion of blending, three random samples of the sediment blend were taken in accordance with ASTM E3317-22 “Standard Specification for Silica-Based Sediments for the Evaluation of Stormwater Treatment Devices” under third-party observation. The final blended sediment was stored in 5-gallon buckets sealed under the observation of the third-party observer until needed.

The samples were also analyzed by GeoTesting in a manner consistent with 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 for the scour

blend are summarized in **Table 6** below and shown graphically in **Figure 18**. Where required, particle size data had been interpolated to allow for comparison to the required particle size. Per “New Jersey Department of Environmental Protection Laboratory Protocol to Assess Total Suspended Solids Removal by a Hydrodynamic Sedimentation Manufactured Treatment Device” (January 1, 2021, Last Updated April 25, 2023), a measured value may be lower than a target minimum % less than value by up to two percentage points (e.g., at least 3% of the particles must be less than 2 microns in size [target is 5%] provided that the measured d50 value does not exceed 230 microns for sediment scour testing (Sediment C).

Table 6 - Particle-Size Distribution of Scour Test Sediment Lot 25B-04

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	95	95	96	95	90
250	60	60	61	60	55
150	43	44	43	43	40
100	25	26	24	25	25
75	15	17	15	16	10
50	9	10	9	9	0
20	2	5	5	4	0
8	1	1	1	1	0
5	1	1	1	1	0
2	1	1	1	1	0

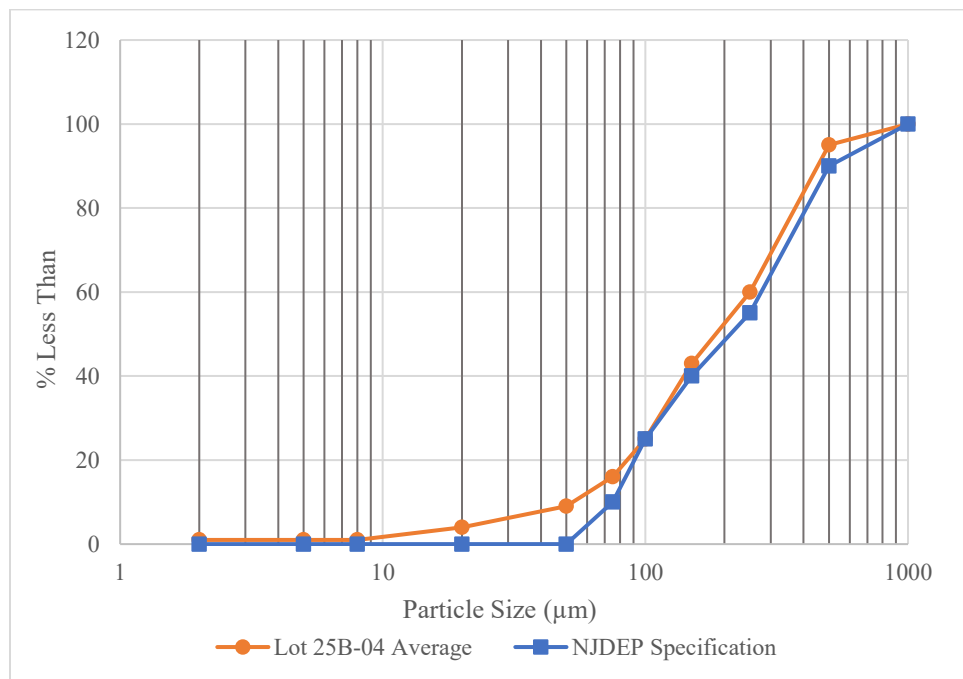


Figure 18 - Particle-Size Distribution of Scour Test Sediment

The moisture content of the test sediment was also tested at GeoTesting in accordance with ASTM Method D2216-19, “Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass”. The moisture content for lot 25B-04 was 0.10%. This amount of moisture was considered insignificant. The median (d_{50}) was 182 μm , finer than the Sediment C specification in ASTM E3317-22. The scour sediment was found to meet the NJDEP and ASTM E3317-22 particle size specification and was deemed acceptable for use.

2.4. Laboratory Proficiency Testing

Background and effluent samples were analyzed for suspended sediment concentration (SSC) in a manner consistent with ASTM D3977-97 “Standard Test Methods for Determining Sediment Concentration in Water”. All samples were labeled and submitted with a chain of custody (COC) form. Samples were analyzed by Gabriel Environmental Services (GES) in Chicago, IL (NELAP accredited).

As GES is not accredited specifically for ASTM D3977-97, a proficiency test was conducted in accordance with Section 3.B Laboratory Proficiency of the NJDEP protocol. Spiked samples were created at the StormTrap Research and Development laboratory facility at a concentration of 20.0 ± 5.0 mg/L and 50.0 ± 5.0 mg/L under observation of the third-party observer. Samples at each known concentration were prepared in triplicate. Results for the six spiked samples are provided below in **Table 7**.

Table 7 - SSC Proficiency Sample Results

Sample Number	Known Sample Concentration (mg/L)	Laboratory Reported Sample Concentration (mg/L)	Percent Recovery	Average Recovery (%)	COV
1	20.4	17.7	86.8	90.8	0.06
2	20.0	20.0	100.		
3	20.7	18.8	90.8		
4	49.3	47.9	97.2	97.5	0.01
5	50.1	48.9	97.6		
6	50.7	49.5	97.6		

The average SSC recovery results were within the $\pm 15\%$ of the two known concentrations and the COV at the two concentration levels was ≤ 0.2 ; therefore, GES passed the Laboratory Proficiency Testing for SSC analysis per ASTM D3977-97.

2.5. Hydraulic Testing

Hydraulic testing of SurgeSettler was conducted on a clean unit, free of sediment, with a false floor installed at 8”, the 50% level of the maximum sediment storage depth. Water flow and corresponding water surface elevation levels were measured in the influent and effluent pipes to determine head loss across the unit. Piezometer taps were placed on the invert of the influent and

effluent pipe one pipe-diameter upstream and downstream of the test unit, respectively. Each piezometer tap was connected to a 6" diameter clear PVC tube 40" in length with a calibrated Vega VEGAPULS 31 radar level sensor installed to the top of the tube per the manufacturer's specifications. Head loss measurements were taken spanning flows from 10 to 200% of the MTRF.

2.6 Sediment Removal Efficiency Testing

A total of seven removal efficiency tests were completed in accordance with the NJDEP protocol. Sediment removal efficiency testing was conducted at 10%, 25%, 50%, 75%, 100%, 125% and 150% of the *target* maximum treatment flow rate (MTRF) of 7.58 cfs. A false floor was installed at 8" above the base of the unit to simulate a 50% sump full condition for all removal efficiency test runs. The flow rates were held within $\pm 10\%$ of the target value with a COV ≤ 0.03 . Flow rates were recorded once every 30 seconds. Flow continued for one detention time after sediment feed was stopped to allow sediment to pass through the unit that may not normally be captured. Water temperature was recorded every 30 seconds and did not exceed 80.0°F during any test run.

A minimum of 25 lbs. of sediment was fed into the unit in each run at a target concentration of 200. mg/L (180. - 220. mg/L). The sediment added during a run was determined by weighing the amount of sediment put into the hopper before and after each run and correcting for the sediment feed calibration samples taken. Both the pre-run and post-run sediment weights were measured to the nearest 0.02 lbs. No sediment was pre-loaded into the test unit for the sediment removal efficiency test runs. Six sediment feed calibration samples were collected and weighed to the nearest 0.1 g at evenly spaced intervals during each run to ensure the feed rate was stable and within the COV limit of ≤ 0.10 per the NJDEP protocol. All feed samples taken were above 20.0 g and collection times did not exceed one minute.

A total of 16 background samples (8 samples taken in duplicate) were collected at evenly spaced intervals during each run. All background samples collected surpassed the 500 mL minimum per the NJDEP HDS protocol. All background samples were security sealed immediately after collection under third party observation. All background samples collected were sent with a COC form to Gabriel Environmental Services for analysis in accordance with ASTM D3977-97.

Following the end of each test run, the unit was decanted and additionally filtered via a pre-weighed 1.0 μm single bag filter. Filtered water was then returned into the test pool. The mass collected within the filter bag was counted towards the total mass collected in the MTD.

For all sediment removal efficiency tests run, the unit was cleaned the following business day under the observation of the third-party observer. Due to this, access points of the unit and filtration equipment were security sealed under third-party observation ensuring that the unit was not tampered with after the test run and prior to cleaning of the unit (**Figure 19**).



Figure 19 - Unit Security Seals

When cleaning, the decanted unit was opened, and any sediment/slurry remaining in the test unit was removed and transferred to pre-weighed nonferrous trays for drying. The filter bag was also removed from the housing and transferred to a pre-weighed nonferrous tray for drying. Any sediment remaining in the influent pipe was also collected, weighed and dried separately from the sediment collected in the sump.

The sediment and filter bag were dried in a vented oven not exceeding 100°C (212°F) until constant weight was obtained when cooled to room temperature, as determined by two successive measurements taken no less than two hours apart. When the oven was in use and unattended, the oven was tagged with a security seal in the presence of the third-party observer. All consecutive weight measurements showed no more than a 0.1% difference in measured mass weighed to a precision of 0.02 lbs.

Removal efficiency was calculated for each MTRF using the following equation:

$$\text{Removal Efficiency (\%)} = \frac{\text{Total Mass Collected in MTD}}{\text{Total Mass Added} - \text{Mass collected in Inlet Pipe}} \times 100$$

All calculations were performed using unrounded intermediate values in accordance with ASTM E29-22 “Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications”. Both observed and calculated values presented in this report are rounded and reported to the nearest unit used in expressing the specification limit according to the NJDEP protocol and ASTM E29-22 guidance.

2.7. Scour Testing

Prior to the start of testing, the false floor was set 4” above the bottom of the unit. Four inches of scour test sediment was loaded into the false floor of the unit and leveled, putting the top of the

sediment 8" above the bottom of the floor. The final height of the sediment was at an elevation equivalent to 50% of the maximum sediment storage capacity of the unit. After the sediment was loaded, the unit was filled with clear water as to not disturb the sediment, to the invert of the effluent pipe. The unit then sat for 95 hours prior to starting the scour test.

The scour test was performed at 17.1 cfs (7687 GPM), over 200% of the target MTFR. During the scour test, the water flow rate and temperature were recorded once every 30 seconds. Testing was commenced by increasing the flow into the system until the target flow rate was achieved within three minutes of starting the test. Background and effluent sampling began one minute after starting flow. An effluent grab sample was taken once every two minutes, until a total of 15 effluent samples (plus 15 duplicate samples) were collected. A total of eight background samples (plus eight duplicate samples) were taken with every off-numbered effluent sample.

3. Performance Claims

Per the NJDEP verification procedure, the following are the performance claims made by StormTrap LLC and/or established via the laboratory testing conducted for the SurgeSettler Hydrodynamic Separator.

Total Suspended Solids (TSS) Removal Rate

The TSS removal rate of SurgeSettler was calculated using the annualized weighted method required by the NJDEP mass capture HDS MTD protocol. Based on an MTFR of 8.32 CFS (3732 GPM), SurgeSettler achieved an annualized weighted TSS removal of 50.0%.

Maximum Treatment Flow Rate (MTFR)

The tested SurgeSettler 6'x14' unit has a surface area of 84 ft² and a maximum treatment flow rate (MTFR) of 8.32 CFS (3732 GPM). This equates to a hydraulic loading rate of 44.43 GPM/ft².

Maximum Sediment Storage Depth and Volume

The maximum storage depth for SurgeSettler 6'x14' unit is 16 inches which equates to 112 ft³ of sediment storage volume. The 50% storage depth is eight inches which equates to 56 ft³ of sediment storage volume.

Effective Treatment/Sedimentation Area

The effective treatment area and effective sedimentation area of the unit tested is 84 ft².

Detention Time and Wet Volume

The detention time of SurgeSettler is dependent on flow rate and model size. For the tested SurgeSettler 6'x14' unit at the MTFR of 8.32 cfs, the detention time is 67 seconds. The wet volume of the tested unit was 560.28 ft³.

Online Installation

Based on the laboratory scour testing, SurgeSettler qualifies for online installation.

4. Supporting Documentation

The NJDEP Procedure 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 StormTrap to be provided to NJCAT or NJDEP upon request.

4.1. Removal Efficiency Testing

The results from all seven runs were used to calculate the overall removal efficiency of SurgeSettler. Sediment removal efficiencies were plotted vs. flow rate to generate a removal efficiency curve from which the MTFR was selected, and an annual weighted removal efficiency was calculated. The total water volume and average flow rate per run were calculated from the data collected from the flow meters. The average influent sediment concentration for each test flow was determined by mass recovery. The amount of sediment fed into the auger feeder hopper during dosing, and the amount remaining at the end of a run, was used to determine the amount of sediment fed during a run. The sediment mass was corrected for the mass of the six feed rate samples taken during the run. The mass of the sediment fed was divided by the volume of water that flowed through the MTFR during dosing to determine the average influent sediment concentration for each run. A summary of the seven test run results is shown in **Table 8** below.

Table 8 - Sediment Removal Efficiency Based on Captured Sediment

% MTFR	10	25	50	75	100	125	150
Total Mass Added (lbs)	38.02	38.96	37.16	41.66	41.70	42.88	43.18
Sediment Retained in Inlet Pipe (lbs)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sediment Delivered to MTD (lbs)	34.53	30.15	28.94	33.19	33.31	35.69	34.85
Sediment Captured in MTD (lbs)	27.49	21.14	16.67	13.81	13.03	12.54	10.86
Removal Efficiency (%)	79.61	70.11	57.62	41.61	39.12	35.13	31.16
Percent of Retained Sediment in Inlet Pipe (%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00

The data collected for each removal efficiency run and the corresponding sampling schedules are presented below: sampling schedule, water flow and temperature, sediment feed rate summary,

10% MTFR Data (Table 9 through Table 12 and Figure 21)

Table 9 - 10% MTFR Sampling Schedule

Run Time (min)	Sampling Schedule	
	Sediment Feed	Background
0.0	1	1
9.3		2
13.0	2	
18.6		3
26.1	3	
27.9		4
37.2		5
39.1	4	
46.5		6
52.1	5	
55.9		7
65.2	6	8
77.5	End of Testing	
MTD Detention Time = 12.3 minutes Sediment Sampling Time = 1 minute		

Table 10 - 10% MTFR Water Flow and Temperature

Run Parameters	Water Flow Rate (GPM)				Maximum Water Temperature (°F)
	Target	Actual	Difference	COV	
	340	340.13	0.04%	0.0002	78.6
QA/QC Limit	-	-	± 10% PASS	≤ 0.03 PASS	≤ 80.0 PASS

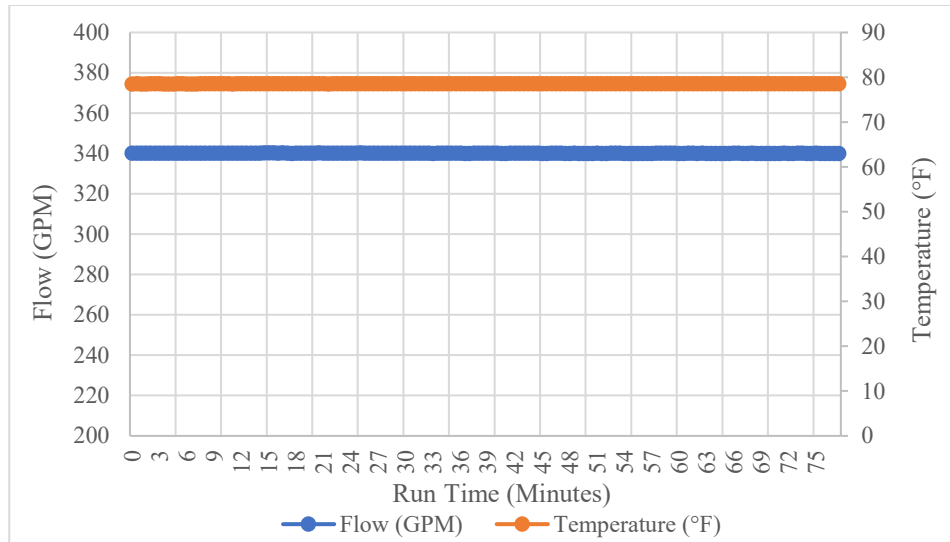


Figure 20 - 10% MFR Water Flow and Temperature Graph

Table 11 - 10% MFR Sediment Feed Rate Summary

Sediment Feed Rate (g/min)		Sediment Mass Recovery	
1	268.6	Starting Weight of Sediment (lbs)	154.96
2	276.6		
3	242.5	Recovered Weight of Sediment (lbs)	116.94
4	271.2		
5	260.1	Mass of Sediment Used (lbs) *	34.53
6	264.6	Volume of Water Through MTD During Dosing (gal)	20,475.51
Average	263.9		
COV	0.045	Average Influent Sediment Concentration (mg/L)	202.
QA/QC Limit	≤ 0.10 PASS	QA/QC Limit	180. - 220. mg/L PASS

*Adjusted for feed rate calibration samples

Table 12 - 10% MTFR Background SSC Results

Sample #	Suspended Sediment Concentration (mg/L) *								QA/QC Limit	
	1	2	3	4	5	6	7	8		
Background	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	≤ 20.0 mg/L PASS

*Detection limit is 2mg/L. All samples < 2 mg/L reported as half the detection limit

25% MTFR Data (Table 13 through Table 16 and Figure 22)

Table 13 - 25% MTFR Sampling Schedule

Run Time (min)	Sampling Schedule	
	Sediment Feed	Background
0.0	1	1
3.7		2
5.2	2	
7.4		3
10.4	3	
11.2		4
14.9		5
15.6	4	
18.6		6
20.9	5	
22.3		7
26.1	6	8
31.0	End of Testing	
MTD Detention Time = 4.9 minutes Sediment Sampling Time = 1 minute		

Table 14 - 25% MTFR Water Flow and Temperature

Run Parameters	Water Flow Rate (GPM)				Maximum Water Temperature (°F)
	Target	Actual	Difference	COV	
		851	851.97	0.1%	0.006
QA/QC Limit	-	-	± 10% PASS	≤ 0.03 PASS	≤ 80.0 PASS

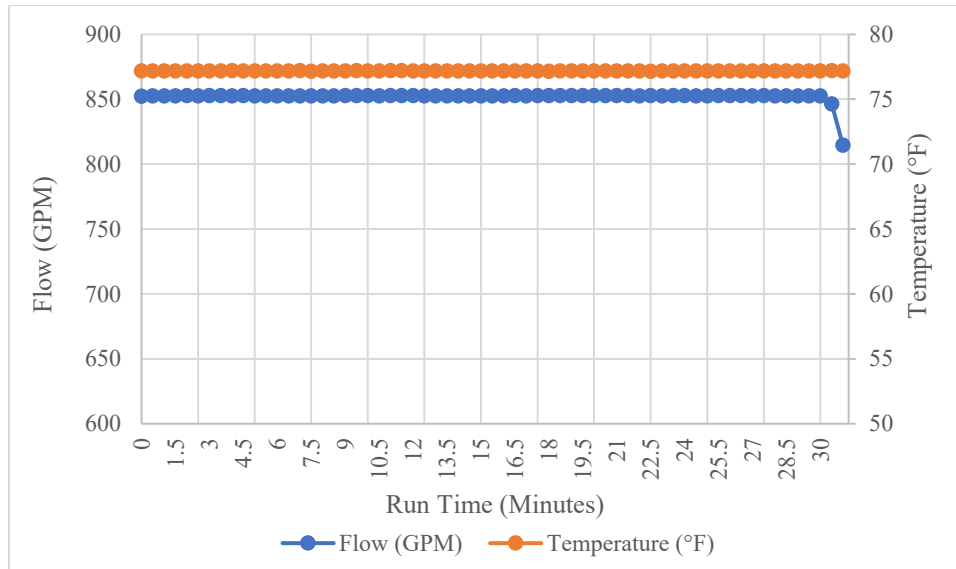


Figure 21 - 25% MTR Water Flow and Temperature Graph

Table 15 - 25% MTR Sediment Feed Rate Summary

Sediment Feed Rate (g/min)		Sediment Mass Recovery	
1	668.0	Starting Weight of Sediment (lbs)	131.39
2	673.3		
3	659.4	Recovered Weight of Sediment (lbs)	92.43
4	673.2		
5	667.7	Mass of Sediment Used (lbs) *	30.15
6	654.6	Volume of Water Through MTD During Dosing (gal)	17,976.50
Average	666.0		
COV	0.01	Average Influent Sediment Concentration (mg/L)	201.
QA/QC Limit	≤ 0.10 PASS	QA/QC Limit	180. - 220. mg/L PASS

*Adjusted for feed rate calibration samples

Table 16 - 25% MTFR Background SSC Results

Sample #	Suspended Sediment Concentration (mg/L) *								QA/QC Limit	
	1	2	3	4	5	6	7	8		
Background	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	≤ 20.0 mg/L PASS

*Detection limit is 2mg/L. All samples < 2 mg/L reported as half the detection limit

50% MTFR Data (Table 17 through Table 20 and Figure 23)

Table 17 - 50% MTFR Sampling Schedule

Run Time (min)	Sampling Schedule	
	Sediment Feed	Background
0.0	1	1
1.9		2
2.6	2	
3.7		3
5.2	3	
5.6		4
7.4		5
7.8	4	
9.3		6
10.4	5	
11.2		7
13.0	6	8
15.5	End of Testing	
MTD Detention Time = 2.5 minutes Sediment Sampling Time = 30 seconds		

Table 18 - 50% MTFR Water Flow and Temperature

Run Parameters	Water Flow Rate (GPM)				Maximum Water Temperature (°F)
	Target	Actual	Difference	COV	
	1701	1701.02	0.001%	0.00008	78.1
QA/QC Limit	-	-	± 10% PASS	≤ 0.03 PASS	≤ 80.0 PASS

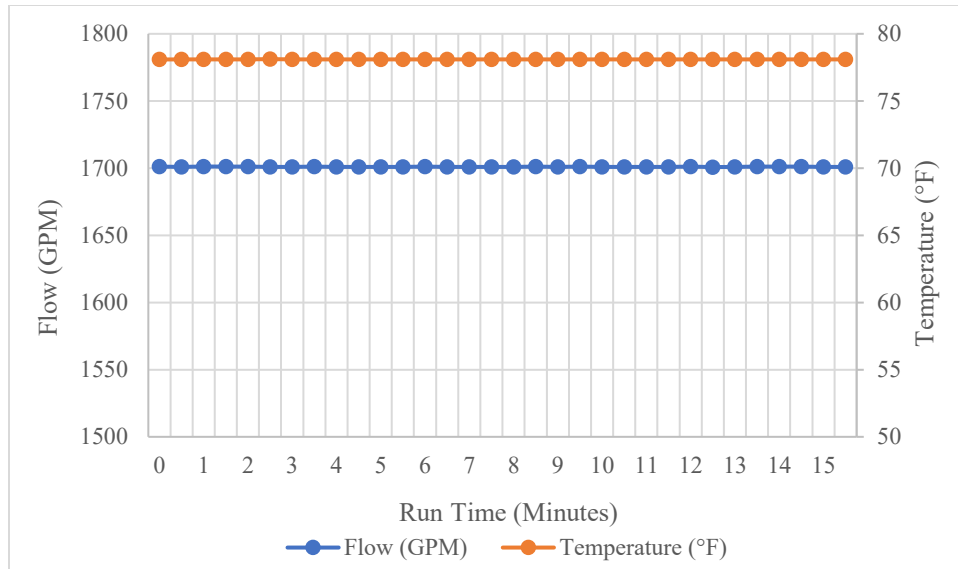


Figure 22 - 50% MTR Water Flow and Temperature Graph

Table 19 - 50% MTR Sediment Feed Rate Summary

Sediment Feed Rate (g/min)		Sediment Mass Recovery	
1	1350.2	Starting Weight of Sediment (lbs)	100.00
2	1217.4		
3	1219.6	Recovered Weight of Sediment (lbs)	62.84
4	1255.2		
5	1331.0	Mass of Sediment Used (lbs) *	28.94
6	1082.8	Volume of Water Through MTD During Dosing (gal)	17,860.69
Average	1242.7		
COV	0.077	Average Influent Sediment Concentration (mg/L)	194.
QA/QC Limit	≤ 0.10 PASS	QA/QC Limit	180. - 220. mg/L PASS

*Adjusted for feed rate calibration samples

Table 20 - 50% MTFR Background SSC Results

Sample #	Suspended Sediment Concentration (mg/L)								QA/QC Limit	
	1	2	3	4	5	6	7	8		
Background	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	≤ 20.0 mg/L PASS

*Detection limit is 2mg/L. All samples < 2 mg/L reported as half the detection limit

75% MTFR Data (Table 21 through Table 24 and Figure 24)

Table 21 - 75% MTFR Sampling Schedule

Run Time (min)	Sampling Schedule	
	Sediment Feed	Background
0.0	1	1
1.4		2
2.0	2	
2.8		3
3.9	3	
4.2		4
5.6		5
5.9	4	
7.0		6
7.9	5	
8.5		7
9.9	6	8
11.5	End of Testing	
MTD Detention Time = 1.6 minutes Sediment Sampling Time = 20 seconds		

Table 22 - 75% MTFR Water Flow and Temperature

Run Parameters	Water Flow Rate (GPM)				Maximum Water Temperature (°F)
	Target	Actual	Difference	COV	
	2552	2543.8	-0.03%	0.02	78.3
QA/QC Limit	-	-	± 10% PASS	≤ 0.03 PASS	≤ 80.0 PASS

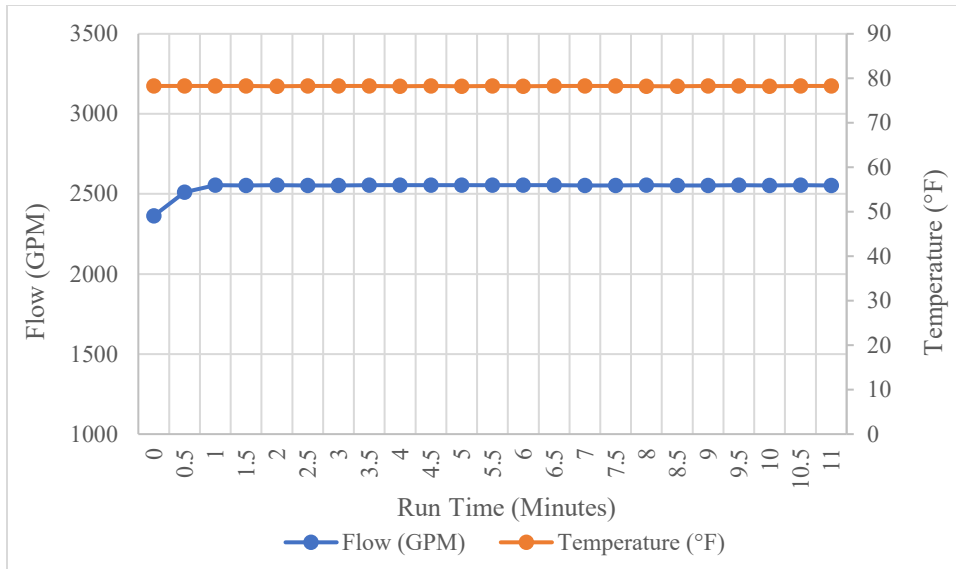


Figure 23 - 75% MTFR Water Flow and Temperature Graph

Table 23 - 75% MTFR Sediment Feed Rate Summary

Sediment Feed Rate (g/min)		Sediment Mass Recovery	
1	1895.4	Starting Weight of Sediment (lbs)	147.80
2	1861.8		
3	1958.4	Recovered Weight of Sediment (lbs)	106.14
4	1797.9		
5	2049.3	Mass of Sediment Used (lbs) *	33.19
6	1961.1	Volume of Water Through MTD During Dosing (gal)	20,943.12
Average	1920.7		
COV	0.046	Average Influent Sediment Concentration (mg/L)	190.
QA/QC Limit	≤ 0.10 PASS	QA/QC Limit	180. - 220. mg/L PASS

*Adjusted for feed rate calibration samples

Table 24 - 75% MTFR Background SSC Results

Sample #	Suspended Sediment Concentration (mg/L)								QA/QC Limit	
	1	2	3	4	5	6	7	8		
Background	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	≤ 20.0 mg/L PASS

*Detection limit is 2mg/L. All samples < 2 mg/L reported as half the detection limit

100% MTFR Data (Table 25 through Table 28 and Figure 25)

Table 25 - 100% MTFR Sampling Schedule

Run Time (min)	Sampling Schedule	
	Sediment Feed	Background
0.0	1	1
1.1		2
1.5	2	
2.1		3
3.0	3	
3.2		4
4.2		5
4.4	4	
5.3		6
5.9	5	
6.3		7
7.4	6	8
8.6	End of Testing	
MTD Detention Time = 1.2 minutes Sediment Sampling Time = 15 seconds		

Table 26 - 100% MTFR Water Flow and Temperature

Run Parameters	Water Flow Rate (GPM)				Maximum Water Temperature (°F)
	Target	Actual	Difference	COV	
		3402	3436.12	1%	0.0005
QA/QC Limit	-	-	± 10% PASS	≤ 0.03 PASS	≤ 80.0 PASS

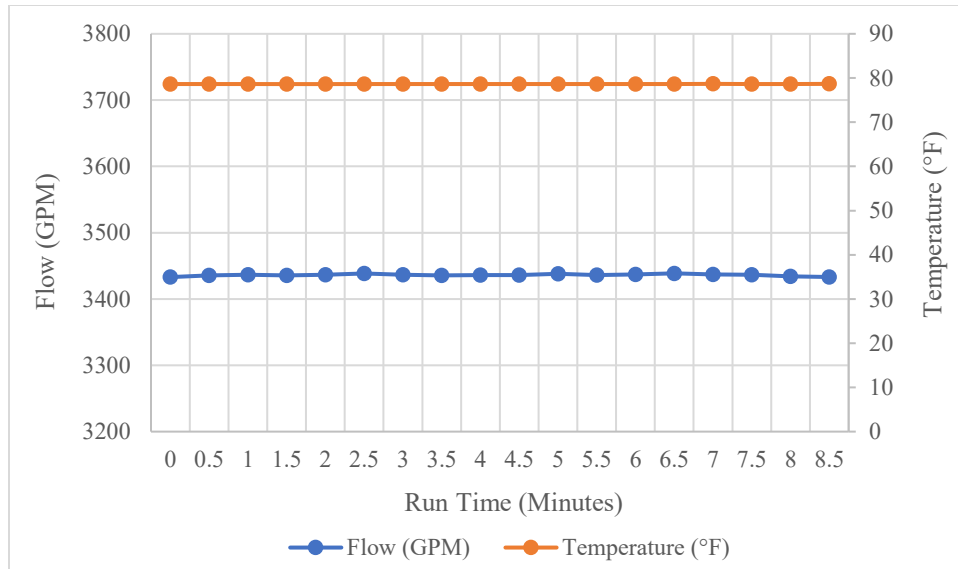


Figure 24 - 100% MTFR Water Flow and Temperature Graph

Table 27 - 100% MTFR Sediment Feed Rate Summary

Sediment Feed Rate (g/min)		Sediment Mass Recovery	
1	2516.4	Starting Weight of Sediment (lbs)	120.68
2	2530.0		
3	2498.0	Recovered Weight of Sediment (lbs)	78.98
4	2616.4		
5	2470.4	Mass of Sediment Used (lbs) *	33.31
6	2590.0	Volume of Water Through MTD During Dosing (gal)	21,132.14
Average	2536.9		
COV	0.022	Average Influent Sediment Concentration (mg/L)	189.
QA/QC Limit	≤ 0.10 PASS	QA/QC Limit	180. - 220. mg/L PASS

*Adjusted for feed rate calibration samples

Table 28 - 100% MTFR Background SSC Results

Sample #	Suspended Sediment Concentration (mg/L)								QA/QC Limit
	1	2	3	4	5	6	7	8	
Background	2.82	2.93	3.86	6.13	5.90	5.56	7.47	8.44	≤ 20.0 mg/L PASS

125% MTFR Data (Table 29 through Table 32 and Figure 26)

Table 29 - 125% MTFR Sampling Schedule

Run Time (min)	Sampling Schedule	
	Sediment Feed	Background
0.0	1	1
0.8		2
1.2	2	
1.7		3
2.4	3	
2.5		4
3.4		5
3.6	4	
4.2		6
4.7	5	
5.1		7
5.9	6	8
6.9	End of Testing	
MTD Detention Time = 1.0 minutes Sediment Sampling Time = 10 seconds		

Table 30 - 125% MTFR Water Flow and Temperature

Run Parameters	Water Flow Rate (GPM)				Maximum Water Temperature (°F)
	Target	Actual	Difference	COV	
		4253	4256.92	0.09%	0.0008
QA/QC Limit	-	-	± 10% PASS	≤ 0.03 PASS	≤ 80.0 PASS

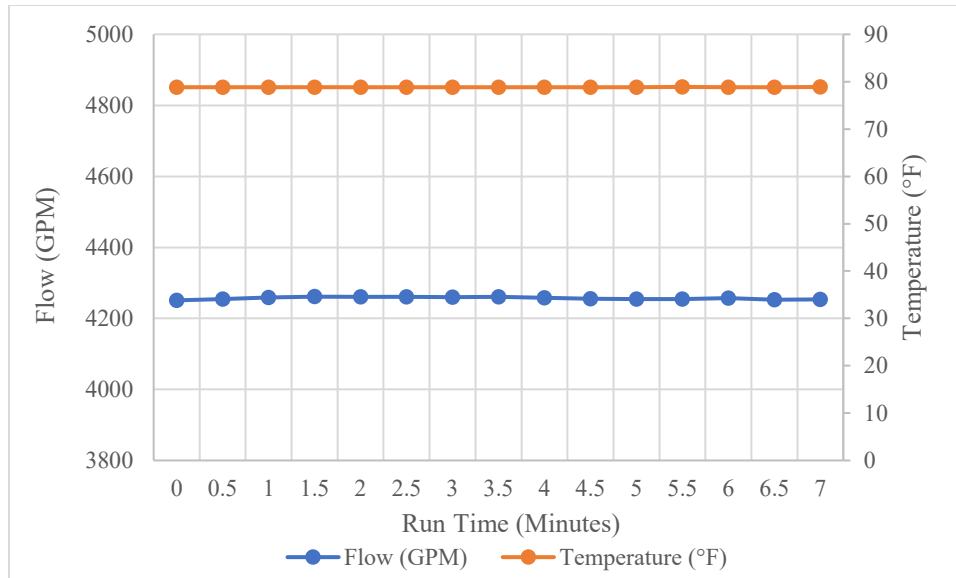


Figure 25 - 125% MTFR Water Flow and Temperature Graph

Table 31 - 125% MTFR Sediment Feed Rate Summary

Sediment Feed Rate (g/min)		Sediment Mass Recovery	
1	3244.8	Starting Weight of Sediment (lbs)	122.49
2	3129.0		
3	3205.8	Recovered Weight of Sediment (lbs)	79.61
4	3301.2		
5	3353.4	Mass of Sediment Used (lbs) *	35.69
6	3326.4	Volume of Water Through MTD During Dosing (gal)	21,568.52
Average	3260.1		
COV	0.026	Average Influent Sediment Concentration (mg/L)	198.
QA/QC Limit	≤ 0.10 PASS	QA/QC Limit	180. - 220. mg/L PASS

*Adjusted for feed rate calibration samples

Table 32 - 125% MTFR Background SSC Results

Sample #	Suspended Sediment Concentration (mg/L)								QA/QC Limit
	1	2	3	4	5	6	7	8	
Background	7.62	8.07	7.90	7.49	8.37	8.95	10.4	13.2	≤ 20.0 mg/L PASS

150% MTFR Data (Table 33 through Table 36 and Figure 27)

Table 33 - 150% MTFR Sampling Schedule

Run Time (min)	Sampling Schedule	
	Sediment Feed	Background
0.0	1	1
0.7		2
1.0	2	
1.4		3
2.0	3	
2.1		4
2.8		5
3.0	4	
3.5		6
3.9	5	
4.2		7
4.9	6	8
5.8	End of Testing	
MTD Detention Time = 0.8 minutes Sediment Sampling Time = 10 seconds		

Table 34 - 150% MTFR Water Flow and Temperature

Run Parameters	Water Flow Rate (GPM)				Maximum Water Temperature (°F)
	Target	Actual	Difference	COV	
	5103	5185.6	2%	0.0008	77.9
QA/QC Limit	-	-	± 10% PASS	≤ 0.03 PASS	≤ 80.0 PASS

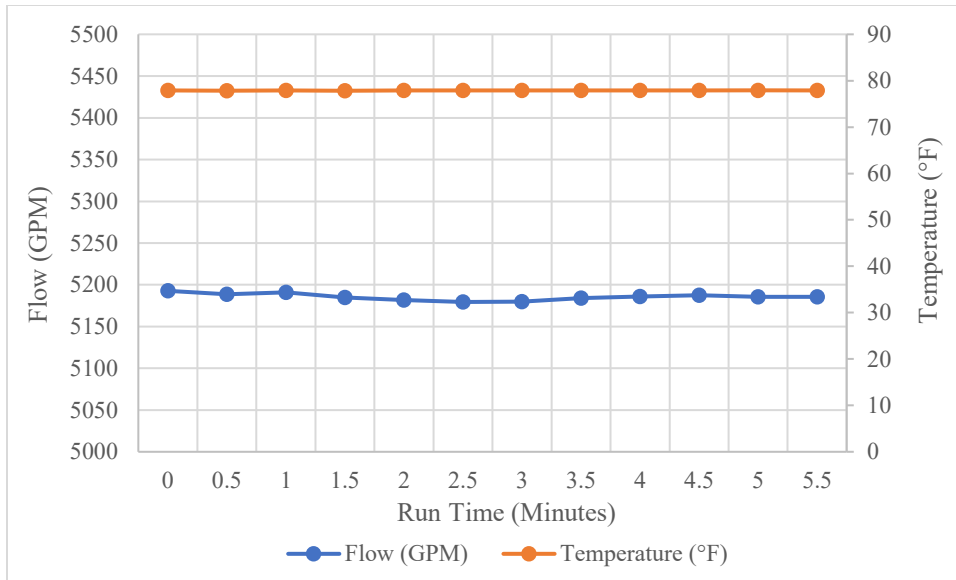


Figure 26 - 150% MTFR Water Flow and Temperature Graph

Table 35 - 150% MTFR Sediment Feed Rate Summary

Sediment Feed Rate (g/min)		Sediment Mass Recovery	
1	3662.4	Starting Weight of Sediment (lbs)	143.50
2	3828.0		
3	3851.4	Recovered Weight of Sediment (lbs)	100.32
4	4003.8		
5	3759.0	Mass of Sediment Used (lbs) *	34.85
6	3562.2	Volume of Water Through MTD During Dosing (gal)	21,088.16
Average	3777.8		
COV	0.041	Average Influent Sediment Concentration (mg/L)	198.
QA/QC Limit	≤ 0.10 PASS	QA/QC Limit	180. - 220. mg/L PASS

*Adjusted for feed samples

Table 36 - 150% MTR Background SSC Results

Sample #	Suspended Sediment Concentration (mg/L)								QA/QC Limit
	1	2	3	4	5	6	7	8	
Background Sample	5.77	5.01	3.16	3.27	3.96	4.40	3.42	4.98	≤ 20.0 mg/L

4.2. Annualized Weighted Removal Efficiency

A plot was made of the seven removal efficiency runs, and a curve of best fit was obtained using a third-order polynomial ($R^2=0.990$) shown below in **Figure 27**. The curve was used to determine the SurgeSettler MTR and the annualized weighted removal efficiency has been calculated using the rainfall weighting factors provided in the NJDEP protocol. For a MTR of 8.32 cfs (3732 GPM), the annual weighted removal is 50.0%, as shown in **Table 37**.

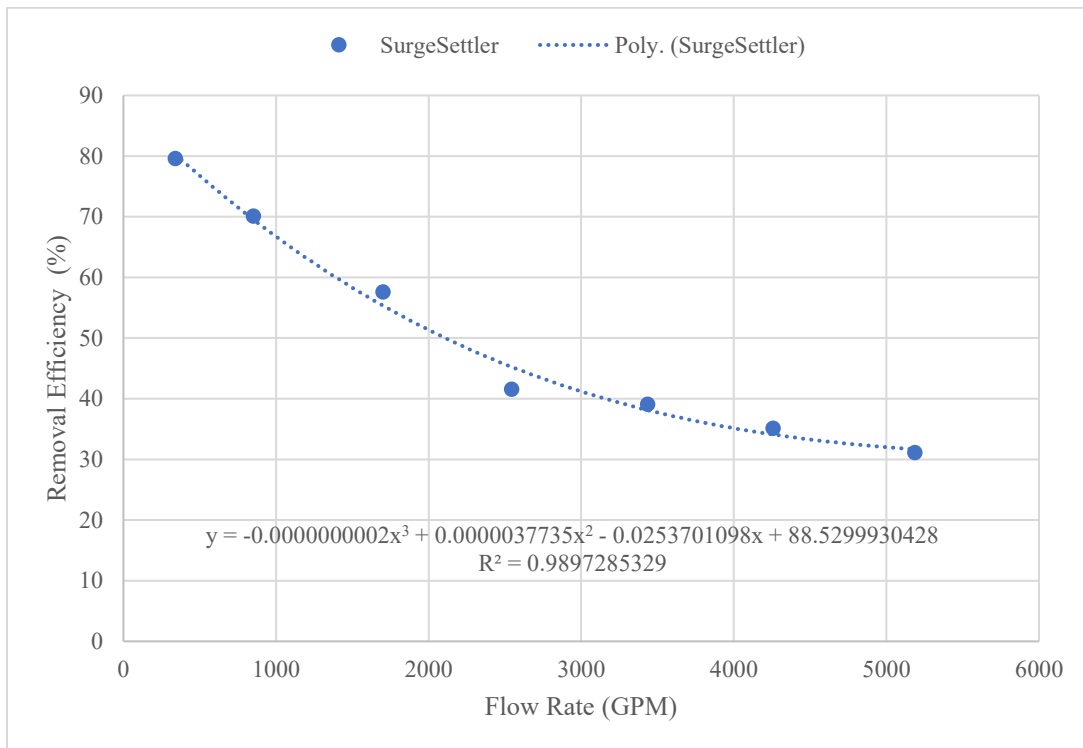


Figure 27- SurgeSettler Removal Efficiency Curve

Table 37 - Annualized Weighted Removal Efficiency

% MTFR	Flow Rate (GPM)	Removal Efficiency (%)	Annual Weighting Factor	Weighted Removal Efficiency (%)
25	933	68.0	0.25	17.0
50	1866	53.0	0.30	15.9
75	2799	42.7	0.20	8.5
100	3732	36.0	0.15	5.4
125	4665	32.0	0.10	3.2
Annualized Weighted Removal Efficiency				50.0

4.3. Scour Testing

Scour testing was conducted in accordance with Section 5 of the NJDEP protocol. Scour testing was performed with the Test Loop 3 configuration (**Figure 12**). In preparation for the scour test, the false floor inside the unit sump was set to a height of 4". The sump was then loaded with scour test sediment. When leveled, the sediment formed a layer 4" thick, so the top of the sediment was 8" above the sump floor. After sediment loading, the sump was filled with clear water. The water was added in such a way as to avoid disturbance of the sediment bed, to the invert of the inlet pipe. The filled SurgeSettler unit was allowed to sit for a total of 95 hours prior to the commencement of the scour test.

Per the calculated MTFR above, the average scour test flow rate had to be at least 16.6 cfs (7464 GPM). Testing was conducted at a flow rate of 17.1 cfs (7687 GPM), 206% of the calculated MTFR. Scour testing began by increasing the flow rate to the target flow within a 3-minute period. Samples were taken after the commencement of conveying clear water through the MTD. The sampling frequency for background and effluent samples is summarized in **Table 38** below. Scour testing flow and temperature data are reported in **Table 39** and **Figure 28** below.

Table 38 - Scour Test Sampling Schedule

Sample/Measurement Taken	Run Time (Minutes)														
	1	3	5	7	9	11	13	15	17	19	21	23	25	27	29
Effluent	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Background	X		X		X		X		X		X		X		X

Table 39 - Scour Test Water Flow and Temperature

Run Parameters	Water Flow Rate (GPM)				Maximum Water Temperature (°F)
	Target	Actual	Difference	COV	
	7532	7687.15	2%	0.001	
QA/QC Limit	-	-	± 10% PASS	0.03 PASS	≤ 80.0 PASS

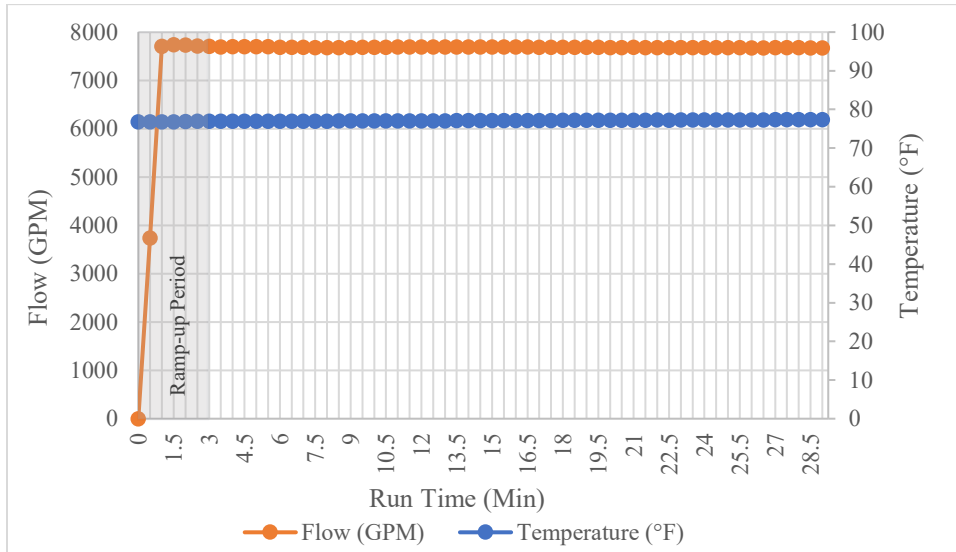


Figure 28 - Scour Test Water Flow and Temperature Graph

The effluent and background SSC results are reported in **Table 40** below. The adjusted effluent concentration was calculated using the following equation:

$$\text{Adjusted Effluent Concentration } \left(\frac{\text{mg}}{\text{L}} \right) = \text{Initial Concentration} - \text{Background Concentration}$$

For effluent samples that did not have a corresponding background sample, the background value was interpolated from the previous and subsequent samples. The average adjusted effluent concentration was 9.31 mg/L at >200% of the MTFR; therefore, SurgeSettler meets the criteria for online use.

Table 40 -Scour Test Suspended Sediment Concentrations

Sample #	Scour Suspended Sediment Concentration (mg/L)														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Effluent	10.2	8.4	7.63	5.49	11.9	15.5	12.4	8.38	17.4	14.7	13.3	14.6	13.2	12.0	10.5
Background	1.00		1.00		1.00		2.58		1.00		3.13		4.54		5.34
Adjusted Effluent	9.20	7.40	6.63	4.49	10.9	13.7	9.82	6.59	16.4	12.6	10.2	10.8	8.66	7.06	5.16
Average Adjusted Effluent Concentration (mg/L)											9.31				

4.4. Hydraulic Testing

Hydraulic testing of SurgeSettler was conducted on a clean unit free of sediment with a false floor installed at 8” above the floor, corresponding to the 50% level of the maximum sediment storage depth. Water flow and corresponding water surface elevation levels were measured in the influent and effluent pipes to determine head loss across the unit. Piezometer taps were placed on the invert of the influent and effluent pipe one pipe-diameter upstream and downstream of the test unit, respectively. Each piezometer tap was connected to a clear PVC 6” diameter 40” tall tube with a calibrated Vega VEGAPULS 31 radar level sensor installed to the top of the tube per the manufacturer’s specifications. Bypass of the back middle baffle was also observed during hydraulic testing which occurred at 2000 GPM while bypass of the right and left back baffle was observed at flows >7000 GPM. Head loss measurements across the span of 10 to 200% of the MTFR are shown in

Table 41 and **Figure 29** below. Flow rates up to 4262 GPM (9.50 CFS) were tested using Test Loop 1. Flows above 9.50 CFS were tested using Test Loop 2. Notably, the piezometers were raised to accommodate higher water surface elevations during testing above 9 cfs. Inlet, outlet and differential elevations were adjusted to reflect this change in piezometer height for the respective tests. The velocity reported in **Table 41** is the upstream velocity.

Table 41 - SurgeSettler Hydraulics

Flow Rate		Velocity	V ² /2g	Water Surface Elevation (in)		
GPM	CFS	Ft/s	(ft)	h _{inlet}	h _{outlet}	Δh
303	0.68	3.54	0.19	2.97	1.46	1.52
859	1.91	3.21	0.16	6.68	3.98	2.70
1704	3.80	2.90	0.13	12.51	5.75	6.76
2545	5.67	3.31	0.17	16.77	7.51	9.26
3861	8.60	4.87	0.37	24.55	8.89	15.65
4262	9.50	5.37	0.45	27.39	9.02	18.37
5176	11.53	6.52	0.66	27.88	8.98	18.90
7619	16.98	9.61	1.43	44.74	10.47	34.27

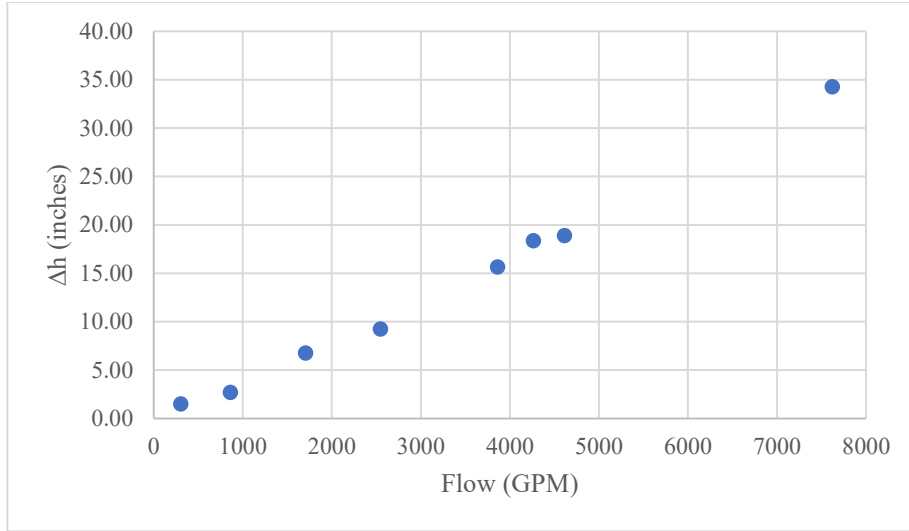


Figure 29- SurgeSettler Head Loss vs Flow Rate

Figure 30 plots head loss versus $v^2/2g$ for full pipe flow for the purpose of calculating the minor loss coefficient, k_L . In flow where the atmospheric pressure is the same upstream and downstream, Bernoulli's equation can be reduced to:

$$\Delta h = k_L \frac{v^2}{2g}$$

Where Δh = head loss (ft)

k_L = head loss (minor loss) coefficient (dimensionless)

V = velocity (ft/s)

g = acceleration due to gravity, 32.174 ft/s²

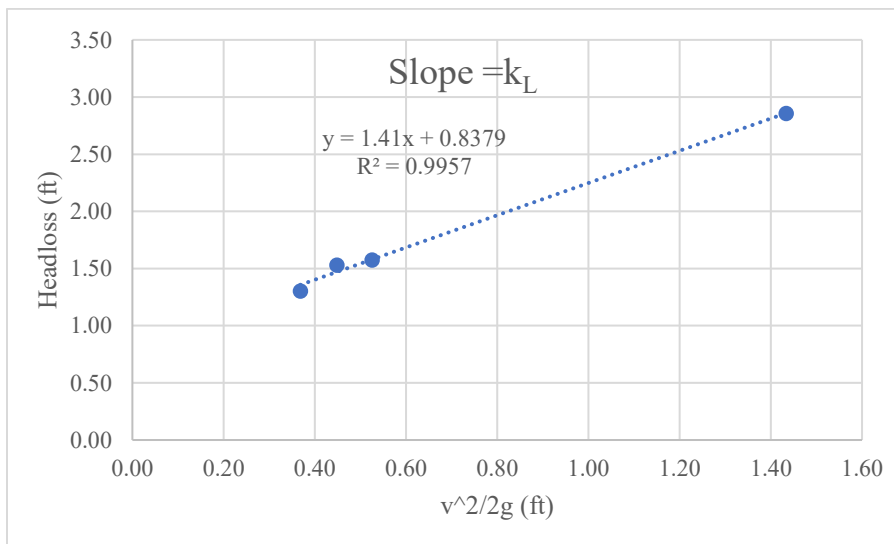


Figure 30 - SurgeSettler Head Loss as a Function of Velocity

4.5. Excluded Results

The NJDEP Verification Procedure requires disclosure and discussion of any data excluded from analysis. Throughout the duration of testing, a total of five runs did not meet the specifications for a passing test per the protocol, and an anomaly occurred during testing for three runs.

During sediment removal test run for the 10% MTFR performed on June 25th, 2025, a sediment feed rate calibration sample had been lower than anticipated thus causing the feed rate COV to surpass the ≤ 0.10 QA/QC limit. Due to this, the run was stopped early as it would not meet the protocol specifications regardless of the final sediment feed rate sample mass. A similar occurrence happened when testing the 50% MTFR on June 23rd, 2025. The sediment feed rate had surpassed the COV limit of ≤ 0.10 at 0.21. The final test that did not comply with the NJDEP specifications was a 125% MTFR test run on 07/08/25. The calculated average influent sediment concentration was lower than the allotted limit of 180.-220. mg/L, at 179. mg/L. Since these tests did not meet the passing criteria set by the NJDEP protocol, they were all rerun. Prior to rerunning any test, the SurgeSettler unit was emptied of sediment and cleaned thoroughly. Retesting for the 10%, 50% and 125% MTFR was completed successfully upon the second run.

During sediment removal test run for the SurgeSettler 25% MTFR performed on June 30th, 2025, all run parameters passed the NJDEP protocol. However, after the test it was observed that the filter bag in the dewatering pump was not seated properly, which would allow unfiltered water to escape. This was an equipment error that could result in lower recovery. Upon calculating the mass recovery from the unit, the result was 57.78%. This confirmed that the equipment error had impacted the results.

When a third-order polynomial was plotted, as required by the protocol, the SurgeSettler sediment removal efficiency curve had an R^2 value of 0.94, below the limit of 0.95 prescribed by the protocol. This confirmed that another test would be required. The 25% MTFR test was re-run after the SurgeSettler unit was emptied of sediment and cleaned thoroughly. Retesting the 25% MTFR resulted in a percent recovery result of 70.11% and a resulting sediment removal efficiency curve with an R^2 value of 0.99, supporting the hypothesis that the original 25% run was an outlier.

During the initial run of SurgeSettler scour testing on September 2nd, 2025, background sample concentrations exceeded the 20.0 mg/L limit set within the NJDEP protocol. The average background concentration of all 8 samples was found to be 47.0 mg/L and 46.4 mg/L for the initial and duplicate sample set, respectively. The average effluent concentration of all 15 effluent samples was 45.9 mg/L and 46.4 mg/L for the initial and duplicate sample set, respectively. Notably, 50 μm bag filters were used for initial scour testing and the test pool was recirculated multiple times throughout the duration of testing. As the background sample concentrations were exceeding limits, filtration modifications were made and the scour test was re-run. Filtration of the test pool and use of 25 μm filters within all filter housings were employed to reduce background sample concentrations to acceptable levels prior to the rerun test. A second scour test run was performed on September 9th, 2025. At approximately 4 minutes into the run, the effluent return

channel collapsed causing the test to be terminated early. The effluent return channel was repaired, and the scour test was performed again. Prior to both retests, the sediment was leveled at 4” and the SurgeSettler unit was refilled with clear water and allowed to settle up to 96 hours.

Additionally, hydraulic testing for the 10% MTFR to 125% MTFR was conducted on August 12th, 2025. When downloading the CSV file from the Prosoft data acquisition system, the water surface elevation measurements were not included in the data file. During the testing, the water surface elevation data was successfully displayed on the human machine interface (HMI), and the programmable logic controller (PLC) was accurately receiving measurements from the instruments. However, the data logger configuration did not include the necessary logic to export the recorded data to a CSV file, resulting in no data being saved. The data logger configuration was updated to export of water surface elevation measurements and the hydraulic testing rerun.

The first background sample for the 150% MTFR run was 37.7 mg/L. This looked like an outlier so all of the duplicate samples were tested and the results were all < 6 mg/L. The result of testing the duplicate sample, 5.77 mg/L, is reported in Table 36. To confirm that 37.7 was an outlier the Grubbs’ test was used, because it is reasonable to assume the data should be normally distributed since it is due to random error. The critical statistic for $\alpha = 0.05$ and $n = 16$ is $G_{crit} = 2.67$. The calculated value was $G = 3.73$. This is greater than the critical value so the null hypothesis was rejected and the value of 37.7 was confirmed as an outlier.

5. Design Limitations

StormTrap’s SurgeSettler is an engineered system designed to meet site-specific requirements. Design parameters and limitations are listed below.

Soil Characteristics

SurgeSettler is an enclosed flow-through system that can be installed and function as intended in all soil types. SurgeSettler units are installed in accordance with ASTM C-891 “Standard Practice for Installation of Underground Precast Concrete Utility Structures”.

Slope of Drainage Pipe

The system was verified with an inlet pipe slope of 1.6%, in accordance with the protocol and both the inlet and outlet pipe elevations were identical. For pipe slopes greater than 10% the StormTrap Design team will evaluate the site-specific parameters.

Height Above Drainage Pipe

As with all HDS systems, the system requires sufficient height above the drainage pipe elevation. The StormTrap Design team will evaluate site-specific parameters to ensure the device operates as tested.

Maximum Treatment Flow Rate

The maximum treatment flow rate (MTFR) for StormTrap SurgeSettler models is based upon the size of the system as shown in **Table A-1**. Systems shall be sized to a hydraulic loading rate of 44.4 GPM/ft² of effective treatment area.

Maintenance Requirements

SurgeSettler systems should be inspected and maintained following the recommendations and guidelines included in the SurgeSettler Operation and Maintenance Manual available at:

<http://stormtrap.com/products/SurgeSettler>

Section 6 of this report includes a detailed description of inspection and maintenance requirements.

Driving Head

SurgeSettler will operate with minimal driving head.

Installation Limitations

StormTrap provides contractors with detailed installation and assembly instructions as well as specific pick weights prior to delivery.

Configurations

SurgeSettler has an internal bypass and can be installed online or offline. The NJCAT/NJDEP verified/certified configuration is a single inlet and outlet at 180 degrees.

Structural Load Limitations

SurgeSettler modules are typically designed for HS-20 loading. Contact StormTrap if alternate design loadings are anticipated or required for site-specific conditions.

Pre-treatment Requirements

SurgeSettler has no pre-treatment requirements.

Depth to Seasonal High-Water Table

SurgeSettler's performance is independent of high groundwater conditions. Contact StormTrap if groundwater is above the system invert for site-specific structural/floatation calculations.

6. Maintenance Plans

The SurgeSettler treatment device, manufactured by StormTrap, is a hydrodynamic separating device designed to capture and store pollutants from stormwater.

SurgeSettler's maintenance frequency is site-dependent and routine inspections are recommended to ensure that the system is functioning as designed. Please contact your authorized StormTrap

representative if you have questions regarding the operation and maintenance of the SurgeSettler system.

Inspection Scheduling

SurgeSettler inspections are important to assess the condition of the system internals to ensure peak performance. The frequency of inspections and maintenance depends on site-specific loading conditions and rainfall frequency. Within the first year of operation, it is recommended that the unit be inspected quarterly to determine the rate of pollutant accumulation to develop a more accurate maintenance schedule. Inspections should be performed during dry weather conditions when no flow is entering the system.

SurgeSettler systems are recommended to be inspected whenever the upstream and downstream catch basins and stormwater pipes of the stormwater collection system are inspected or maintained. If checked on an annual basis, the inspection should be conducted before the stormwater season begins to ensure that the system is functioning properly for the upcoming storm season.

Inspection and Maintenance Equipment

The following equipment is recommended to have during inspections and maintenance:

- SurgeSettler Operation and Maintenance Manual and Inspection Checklist
- Flashlight
- Manhole hook/lifter or pry bar to lift the manhole cover
- Measuring device(s) of sufficient length to reach the bottom of the device's sump
- Proper personal protective equipment
- Adequate traffic control signage
- Pole with skimmer or net (optional for maintenance procedure)
- Vacuum truck or similar trailer-mounted equipment (for maintenance procedure)

Inspection Procedure

Inspections should be done so that a sufficient time has lapsed since the most recent rain event to allow for a static water condition and rainfall is not anticipated to occur during the inspection procedure. SurgeSettler does not require entry into the system for inspection or maintenance; however, if entering the system is deemed necessary, it is prudent to note that before entering any underground storm sewer or underground structure, appropriate OSHA and local safety regulations and guidelines should be followed.

To begin the inspection process, set up the necessary traffic control signage per local ordinances. Open all manhole covers using appropriate equipment and ensure the manhole covers are in a location that would not prohibit the inspection process. Visually inspect the system at all manhole access opening locations.

During the visual inspection, ensure that all components are in working order. An inspection checklist is provided within this guide for ease and reference. If any components are not working, contact your authorized StormTrap representative. After the components are inspected, visually quantify the accumulation of trash, debris, and hydrocarbons within the system by using a measuring device such as a tape measure, grade stick, dipstick, etc.

For sediment accumulation, utilize either a sludge sampler or a sediment pole to measure and document the amount of sediment accumulation. To determine the amount of sediment in the system with a sludge sampler, follow the manufacturer's instructions. If utilizing a sediment pole or similar device, first insert the pole to the top of the sediment layer and record the depth. Then, insert the pole into the bottom of the system and record the depth. The difference in the two measurements corresponds to the amount of sediment in the system. Alternatively, sediment depth can also be determined by taking a measurement from a known and consistent elevation (manhole frame, pipe invert, vertical baffle top, etc.) to the top of the sediment layer. That distance can then be compared to the measurement between the known elevation to the sump floor. The difference between these two measurements will correspond to the sediment layer depth. After completion of the inspection process, ensure that manhole covers are replaced and securely seated in the manhole frame and remove traffic control signage.

Maintenance Procedure

Maintenance should be done such that sufficient time has lapsed since the most recent rain event to allow for a static water condition and rainfall is not anticipated to occur during the duration of the maintenance procedure. To begin the maintenance process, set up the necessary traffic control signage per local ordinances. Open all manhole covers using appropriate equipment and ensure the manhole covers are in a location that would not prohibit the maintenance process.

Visually inspect the system at all manhole access opening locations. During the visual inspection, ensure that all components are undamaged. If any components are not in working order, contact your authorized StormTrap representative. After the components are inspected, remove all accumulated trash, debris, and hydrocarbons stored on the surface of the water using the vacuum hose or pole with an attached skimmer or net.

To remove sediment, insert the vacuum truck's hose in each of the three access openings. The system should be completely drained, and all sediment should be removed from the sump. If excessive sediment or debris buildup occurs within the device, components can be washed with sewer jetting equipment or a spray lance to remove stubborn materials. Particular attention must be taken when spraying the enhanced settling pack. A wide spray nozzle is recommended around the enhanced settling pack to ensure there is no damage to the material. After completing the maintenance procedure, complete a post-maintenance inspection to ensure that all components are in good condition. Ensure that manhole covers are replaced and securely seated in the manhole

frame and remove traffic control signage. Dispose of all pollutants removed during maintenance per local, state, and federal guidelines and regulations.

7. Statements

The following attached pages are signed statements from StormTrap LLC, Spaceco, and NJCAT. These statements are a requirement of the verification process. These statements are a requirement of the verification process. In addition, it should be noted that this report has been subject to public review, and all comments and concerns have been satisfactorily addressed.



December 16, 2025

To: 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

Subject: SurgeSettler Laboratory Verification Report – Manufacturer’s Statement of Compliance

Dr. Magee,

StormTrap has completed verification testing for the SurgeSettler™ Hydrodynamic Separator in accordance with the “New Jersey Department of Environmental Protection Laboratory Protocol to Assess Total Suspended Solids Removal by a Hydrodynamic Sedimentation Manufactured Treatment Device”, dated January 1, 2021, updated April 25, 2023.

As required by the “NJDEP Procedure for Obtaining Verification of a Stormwater Manufactured Treatment Device from New Jersey Corporation for Advanced Technology (NJCAT)”, dated August 4, 2021, this letter serves as StormTrap’s statement that all procedures and requirements identified in the aforementioned protocol and process document were met or exceeded.

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

Sincerely,

A handwritten signature in blue ink that reads 'Greg Williams'.

Greg Williams, PhD., P. Eng.
Director of Water Quality Technology

nice 515.541.4663
na 331.318.5347

us www.stormtrap.com
intl info@stormtrap.com

1287 Wickham Parkway
Romeoville, Illinois 60446

December 16, 2025

RE: StormTrap SurgeSettler High Flow Hydrodynamic Separator Performance Testing

To Whom It May Concern:

Spaceco Inc. was contracted by StormTrap LLC as a 3rd party observer during their SurgeSettler sediment removal testing. The results of this testing will be used by a variety of public and private users to improve the removal of sediment and to capture and store pollutants from stormwater runoff for specific site conditions.

The StormTrap LLC SurgeSettler removal testing took place at the StormTrap Research & Development facility located in Morris, IL. I certify that I was present at the said facility and that I observed this testing from June – December 2025. The results presented in the StormTrap SurgeSettler High Flow Hydrodynamic Separator Testing Report dated December 2025 are accurate and all procedures and requirements stated in the Report were met or exceeded. I confirm that all test data that was collected is included or referenced in the Report.

Considering the above information and on behalf of Spaceco, Inc., I confirm the following:

- that I do not have any conflict of interest in connection with the sediment removal testing;
- that I have not granted, sought, attempted to obtain or accepted and will not grant, seek, attempt to obtain, or accept any advantage, financial 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.

Sincerely,

Spaceco, Inc.



Jason Wiesbrock, P.E.
Vice President

cc: Greg Williams, StormTrap LLC
Jessica Willis, StormTrap LLC



**Rutgers EcoComplex
1200 Florence Columbus Rd
Bordentown, NJ 08505**

January 20, 2026

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,

Based on my review, evaluation and assessment of the testing conducted on the StormTrap SurgeSettler™ High Flow Hydrodynamic Separator, the test protocol requirements contained in the “*New Jersey Department of Environmental Protection Laboratory Protocol to Assess Total Suspended Solids Removal by a Hydrodynamic Sedimentation Manufactured Treatment Device*” (NJDEP HDS Protocol, January 1, 2021- Updated April 25, 2023) were met or exceeded consistent with the NJDEP Approval Process. Specifically:

Test Sediment Feed

The mean PSD of the test sediments comply with the PSD criteria established by the NJDEP HDS protocol. The removal efficiency test sediment PSD analysis was plotted against the NJDEP removal efficiency test PSD specification. The test sediment was shown to be significantly finer than the sediment blend specified by the protocol ($<75 \mu\text{m}$); the test sediment median (d_{50}) was $64 \mu\text{m}$, $48 \mu\text{m}$, and $54 \mu\text{m}$ for lots 24C-02, 25A-04 and 25B-01. The scour test sediment PSD analysis was plotted against the NJDEP scour test PSD specification and shown to meet the protocol specifications. The median (d_{50}) was $182 \mu\text{m}$.

Removal Efficiency Testing

In accordance with the NJDEP HDS Protocol, removal efficiency testing was executed on a SurgeSettler 6 x14 ft. unit comprised of full-scale, commercially available internal components to demonstrate the ability of the StormSettler to remove 50 % of the NJDEP protocol specified test sediment with a 180-degree inlet-outlet configuration.

Scour Testing

The scour testing was conducted at 7687 (17.1 cfs) gpm, which is equal to 206% of the MTFR. The scour test was conducted with the unit preloaded with 4.0" of levelled sediment to the 50% capacity level for each configuration prior to conducting the test. A total of 15 effluent samples were collected throughout the test. The average calculated effluent concentration, adjusted for background, was 9.3 mg/L.

Sincerely,



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

8. References

1. Procedure for Obtaining Verification of a Stormwater Manufactured Treatment Device from New Jersey Corporation for Advanced Technology. August 4, 2021 (Last updated April 25, 2023).
2. New Jersey Department of Environmental Protection Laboratory Protocol to Assess Total Suspended Solids Removal by a Hydrodynamic Sedimentation Manufactured Treatment Device. January 1, 2021.
3. ASTM E3317-22 “Standard Specification for Silica-Based Sediments for the Evaluation of Stormwater Treatment Devices”
4. ASTM D6913-17, “Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis”
5. ASTM D7928-21 “Standard Test Method for Particle-Size Distribution (Gradation) of Fine-Grained Soils Using the Sedimentation (Hydrometer) Analysis”
6. ASTM D3977-97, “Standard Test Methods for Determining Sediment Concentration in Water”
7. ASTM C-891 “Standard Practice for Installation of Underground Precast Concrete Utility Structures”
8. ASTM E29-22 “Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications”

VERIFICATION APPENDIX

Introduction

- Manufacturer - StormTrap LLC, 1287 Windham Parkway, Romeoville, IL 60446
Website: www.stormtrap.com General Phone: (815) 941-4663
- MTD: StormTrap SurgeSettler Hydrodynamic Separator. Verified SurgeSettler models are shown in **Table A-1**.
- TSS Removal Rate: 50%
- Offline or Online Installation

Detailed Specification

- NJDEP sizing and dimensional table is attached as **Table A-1**.
- New Jersey requires that the peak flow rate of the New Jersey Water Quality Design Storm (NJWQDS), 1.25 inches of rainfall in a 2-hour duration, shall be used to determine the appropriate size for the MTD. The SurgeSettler 6'x14' has a maximum treated flow (MTFR) of 8.32 CFS (3732 GPM) which equates to a hydraulic loading rate of 44.43 GPM/ft².
- Pick weights and installation procedures vary with model size. StormTrap provides contractors with project-specific unit pick weights and installation instructions prior to delivery.
- Maximum sediment depth for all units is 16 inches. StormTrap recommends that the units be cleaned when sediment depth reaches 8 inches, representing 50% sediment storage capacity.

The SurgeSettler Operations and Maintenance Manual is provided for each project installation and available at: <http://stormtrap.com/products/SurgeSettler>

- According to N.J.A.C. 7:8-5.5, NJDEP stormwater design requirements do not allow a hydrodynamic separator such as the StormTrap SurgeSettler to be used in series with another hydrodynamic separator to achieve an enhanced TSS removal rate.

Table A-1 SurgeSettler MTFRs, Sediment Removal Intervals, and Standard Dimensions

Model	Model Width (ft)	Model Length (ft)	NJDEP 50% TSS Maximum Treatment Flow Rate (MTFR) (cfs)	Effective Treatment Area (ft ²)	Hydraulic Loading Rate ¹ (gpm/ft ²)	Effective Sedimentation Area (ESTA) (ft ²)	Enhanced Settling Pack Footprint (ft ²)	50% Max. Sediment Storage (ft ³)	Sediment Removal Interval ² (years/months)	Chamber Depth ³ (ft)	Effective Treatment Depth ⁴ (ft)	Aspect Ratio Treatment Depth: Diameter ⁵			
												MTFR: ESTA	Length: Width	SD ⁶ /Width	SD ⁶ /Length
SurgeSettler 6 x 14	6	14	8.32	84	44.43	84	44	56	4 / 48	6.67	6.00	0.10	2.33	1.00	0.43
SurgeSettler 8 x 21	8	21	16.63	168	44.43	168	88	112	4 / 48	6.67	6.00	0.10			
SurgeSettler 10 x 21	10	21	20.79	210	44.43	210	112	140	4 / 48	6.67	6.00	0.10			
SurgeSettler 12 x 24	12	24	28.51	288	44.43	288	160	192	4 / 48	12.5	11.83	0.10	2.00	0.99	0.49
SurgeSettler 12 x 32	12	32	38.01	384	44.43	384	208	256	4 / 48	13.5	12.83	0.10	2.67	1.07	0.40

¹ Hydraulic loading rate is defined as the ratio of MTFR to effective treatment area.

² Sediment removal interval is calculated using the equation presented in Appendix A, Section B of the NJDEP Protocol.

³ Chamber depth is defined as depth from effluent invert to sump floor.

⁴ Effective treatment depth is defined as depth from effluent invert to 50% the sediment storage depth.

⁵ Larger models (>250% MTFR of the tested unit) must be geometrically proportionate to the tested unit (6 x 14 model). A variance of 15% is allowable. For units <250% MTFR (6 x 14) the depth may be equal or greater than the depth of the test unit.

⁶ Standard Depth (SD) is equivalent to Effective Treatment Depth