The Morin-Cameron GROUP, INC.

February 20, 2024

Ms. Jacki Byerley, Planner
Andover Planning Board
Town Office
36 Bartlett Street
Andover, MA 01810

RE: Initial Peer Review of Stormwater Design
Town Yard Development – Lewis Street
Andover, MA

Dear Ms. Byerley and Board Members,

On behalf of Andover Town Yard, LLC, The Morin-Cameron Group, Inc. (MCG) has provided the following responses to the peer review letter prepared by the Horsley Witten Group (HW) on January 8, 2024. HWG comments are italicized. We offer the following in response to the comments:

1. ***HW Comment:*** *Standard 1 states that no new stormwater conveyances (e.g. outfalls) may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth.*
a. The Applicant has evaluated two design points that will be associated with the proposed residential building. 1) Design Point 1 (DP 1) is an existing stone culvert located under the MBTA rail tracks that pipes stormwater from the former DPW yard to the municipal system in Railroad Street. Under proposed conditions, runoff from subcatchments PS1 and PS1.1 flow to this point by way of a closed drainage system. Runoff from PS1.1 will be routed into an infiltration system prior to being piped to a jellyfish filter BMP which filters water from both PS1.1 and PS1.
2) Design Point 2 (DP 2) is at the southwest corner of the site where stormwater from subcatchment ES2 flows into the municipal system on Pearson Street. Stormwater from the proposed subcatchment PS2 is routed to DP2 via a closed drainage system. The total catchment area directed to DP2 from the site is reduced under proposed conditions and the proposed flow rate does not exceed the existing flow rate.
3) It does not appear that the Applicant will be causing erosion in a wetland.
MCG Response: No response necessary.

2. ***HW Comment:*** *Standard 2 requires that stormwater management systems shall be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates.*
a. The Applicant has provided a HydroCAD model for the existing and proposed stormwater management to determine the peak rate attenuation and runoff volume for the 2-year, 10-

year, 25-year, and 100-year storm events. HW has confirmed the subcatchment areas, the curve numbers, time of concentration flow paths, and the precipitation depths. The values utilized by the Applicant appear reasonable.
MCG Response: No response necessary.

b. The Applicant has proposed an infiltration chamber system in the northern corner of the site. The proposed grades indicate approximately 8 feet of fill above this new system.
HW recommends that the Applicant confirm that the fill over the proposed system is allowable by the vendor.
MCG Response: The maximum allowable cover for the Cultec Recharger 360HD chambers is 12 feet. See Appendix I "Manufacturer Brochures" of the Technical Report. The current cover is approximately 5 feet.

c. The stormwater narrative indicates fill was identified throughout the site. The soil test pits conducted in the vicinity of the infiltration system indicate a possible perched water table. The Applicant has provided a detail for the chamber system on Sheet C7.3. HW recommends that the Applicant include on the detail a requirement to remove any fill identified beneath the chamber system and replace it with clean material having an exfiltration rate of at least 1.08 inches per hour. HW notes that the detail on Sheet C7.3 indicates 64 chamber systems, the plans and the HydroCAD model include 56 chambers.
MCG Response: The Detail Sheet C7.3 has been modified to include the fill removal note and to adjust the note to the correct quantity of chambers. The total number of chambers is 56.

d. HW recommends that the installation of the infiltration system is witnessed by a professional engineer. The Planning Board may choose to make this a condition of approval.
MCG Response: A note stating the inspection requirements has been added to the Detail Sheet C7.3

e. HW recommends that the Applicant include the size of the orifices on the detail of the outlet control system (OCS) on Sheet C7.3. HW notes that the 18-inch outlet of the OCS is listed at elevation 87.7 on the detail but is elevation 87.8 in the HydroCAD model.
MCG Response: The plan has been modified and the Detail Sheet C7.3 has been modified to depict the correct elevation of 91.35.

f. The Applicant has provided a table within the Technical Report that compares the Peak Discharge Rates under existing and proposed conditions for DP1 and DP2. In accordance with Section VI. B. e. (1) of the Andover Stormwater Bylaw the volumes should also be provided. HW recommends that the Applicant provide tables comparing the existing and proposed volumes of stormwater runoff for the project site.
MCG Response: The Technical Report has been updated to depict the existing and proposed volumes of stormwater runoff.

3. *HW Comment: Standard 3 requires that the annual recharge from post-development shall approximate annual recharge from pre-development conditions.*
a. The Applicant states on page 5 of the Technical Report that the site will result in a slight increase in impervious area. The subcatchment summary tables on page 2 of the Technical Report show a slight decrease in the impervious area. HW recommends that the Applicant clarify the values used for the percent of impervious area on page three of the Technical Report.

MCG Response: The values depicted on page 3 of the Technical Report included gravel surface to be impervious area. The Report and HydroCAD have been updated to depict gravel surfaces as pervious areas. The CN vlue used for gravel is 89.

b. HW notes that values listed in the recharge calculations of Appendix D, Standard 3 list includes the gravel surface area. The Applicant has reduced the impervious cover slightly when including the gravel surface but increased it slightly when the gravel is not included. HW recommends that the Applicant provide recharge for the increased impervious surface of 4,514 sf times 0.35 inches per Volume 3, Chapter 1, page 16 of the MSH.
MCG Response: The impervious cover areas have been updated and the volume to be recharged has been confirmed. See the "Stormwater Calculations" in the Stormwater Technical Report.

c. HW was not able to confirm the provided recharge and recommends that the Applicant include the stage storage calculations within the Technical Report. It also appears that the lowest system orifice is set at elevation 87.8. HW recommends that the Applicant confirm the storage.
MCG Response: The plan has been updated and now the lowest orifice is 91.35. The provided recharge is 1,219 cubic feet. A storage table has been attached to the Technical Report for reference. See Appendix D.

4. *HW Comment: Standard 4 requires that the stormwater system be designed to remove 80% Total Suspended Solids (TSS) and to treat 1.0-inch of volume from the impervious area for water quality.*
a. HW recommends that the Applicant include the closed drainage system calculations that correspond to the Rational Calculation Area Plan, Sheet C5.3 for the proposed stormwater design.
MCG Response: The Rational Calculations are attached herewith.

b. HW recommends that the Applicant clarify the impervious area directed towards water quality unit (WQU) 1 and 2.
MCG Response: The plan has been revised and the impervious areas directed towards Water Quality Unit 1 (WQU-1) is the sum of areas CB-3, CB-4 and AD-1; the impervious areas directed towards Water Quality Unit 2 is the sum of areas CB-5, CB-, CB-7, CB-8, CB-9, CB-10, CB-11, AD-23, AD-4, R3, R4 and R5.

c. HW recommends that the Applicant provide documentation from a third-party reviewer that supports the TSS removal rate credited to the proposed water quality units.
MCG Response: The documentation that supports the TSS and TP removal have been attached herewith.

d. HW recommends that the Applicant provide the TSS removal worksheets per the MSH for each of the proposed treatment trains.
MCG Response: The TSS Removal calculations were included in Appendix D of the Technical Report.

5. ***HW Comment:*** *Standard 5 is related to projects with a Land Use of Higher Potential Pollutant Loads (LUHPPL).*
   a. HW recommends that the Applicant confirm that no areas within the proposed site are considered hot spots due to the former land use as the DPW yard.
   MCG Response: The project will comply with the MCP and overseen by a licensed Site Professional.

   b. HW notes that a residential development is not considered a land use of higher potential pollutant load. Therefore, Standard 5 may not be applicable.
   MCG Response: No response necessary.

6. **HW Comment:** *Standard 6 is related to projects with stormwater discharging into a critical area, a Zone II or an Interim Wellhead Protection Area of a public water supply.*
   a. The site does not discharge to a critical area, a Zone II or an Interim Wellhead Protection Area of a public water supply. Therefore, Standard 6 is not applicable.
   MCG Response: No response necessary.

7. ***HW Comment:*** *Standard 7 is related to projects considered Redevelopment. A redevelopment project is required to meet the following Stormwater Management Standards only to the maximum extent practicable: Standard 2, Standard 3, and the pretreatment and structural best management practice requirements of Standards 4, 5, and 6. Existing stormwater discharges shall comply with Standard 1 only to the maximum extent practicable. A redevelopment project shall also comply with all other requirements of the Stormwater Management Standards and improve existing conditions.*
   a. The Applicant is proposing a mixture of a new development and redevelopment with a slight increase of 4,514 sf of impervious cover. The Applicant intends to meet all requirements of the Stormwater Management Standards and does not seek relief under this standard. HW notes that the Applicant must address the comments within this review letter to confirm it meets all requirements.
   MCG Response: All the comments from this letter have been addressed and noted herewith.

8. ***HW Comment:*** *Standard 8 requires a plan to control construction related impacts including erosion, sedimentation or other pollutant sources.*
   a. The Applicant has provided an erosion and sedimentation control plan within the technical report that includes a straw wattle, inlet protection, seeding, dust control, mulching, and netting. Procedures for operating and maintaining the BMPs are also included. HW recommends that the Applicant propose a compost sock instead of a straw wattle and increase the size to be a minimum of 12-inches. HW further recommends that the Applicant list the material to be used for the construction fence.
   MCG Response: The Erosion Control has been updated to depict a compost sock fence and to specify a chain-link fence as the "construction fence". See Sheets C3.0 & C3.1 & C7.0.

   b. HW recommends that the Applicant increase the length of the construction entrance to be a minimum of 50 feet.
   MCG Response: The construction entrance length has been modified. See Sheets C3.0, C3.1 & C7.0.

   c. The proposed project requires land disturbance of greater than 1 acre. Therefore, a Stormwater Pollution Prevention Plan (SWPPP) per the EPA NPDES Construction General Permit will be

required. HW recommends that the Applicant provide a copy of the SWPPP to the Town a minimum of 14 days prior to land disturbance. HW notes that the Applicant has not yet submitted a SWPPP but has stated that it will be submitted prior to any land disturbance. The Planning Board may choose to require receipt of the SWPPP as a condition of approval.
MCG Response: The SWPPP will be submitted to the Town after transfer of title and prior to the beginning of the land disturbance.

9. *HW Comment: Standard 9 requires a Long-Term Operation and Maintenance (O & M) Plan to be provided.*
a. The Applicant has provided a Long-Term O& M Plan in Appendix F of the Technical Report. HW recommends that the O&M Plan be submitted as a separate document signed by the property owner.
MCG Response: The O&M Plan has been updated to include a designated area for the property owner signature, however the Town of Andover currently owns the property; therefore, the signature will only occur after transfer of title.

b. HW recommends that the Applicant include a maintenance log within the O&M Plan.
MCG Response: The O&M Plan has been updated to include a Maintenance Log.

c. HW recommends that the Applicant include requirements for pet waste in the O&M Plan.
MCG Response: The O&M Plan has been updated to include "pet waste" provisions.

d. HW recommends that the Applicant include a simple plan that is drawn to scale and shows the location of all stormwater practices to be inspected and maintained. The plan should also include locations for snow storage.
MCG Response: The O&M Plan has been updated to include a Plan depicting the location of all stormwater practices to be inspected and maintained.

10. *HW Comment: Standard 10 requires an Illicit Discharge Compliance Statement to be provided.*
a. The Applicant has submitted an Illicit Discharge Compliance Statement signed by the Owner's Representative. HW recommends that the Planning Board request receipt of an Illicit Discharge statement signed by the property owner.
MCG Response: The Illicit Discharge Compliance Statement has been updated to include a designated area for the property owner signature, however the Town of Andover currently owns the property; therefore, the signature will only occur after transfer of title.

We trust this information adequately addresses the peer review comments by the Horsley Witten Group about the proposed Town Yard Development Project.

If you have any questions, please do not hesitate to contact our office at (978) 777-8586.

Sincerely,
THE MORIN-CAMERON GROUP, INC.

Scott P. Cameron, P.E.
Vice-President

Attachments

cc: Andover Town Yard, LLC

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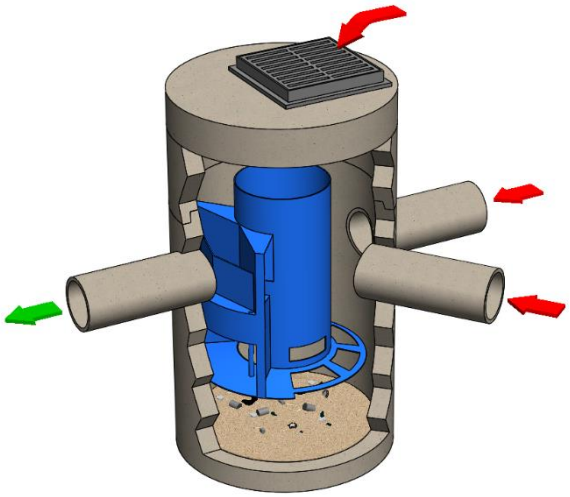
CASCADE separator™

Technical Bulletin 02

Cascade Separator™ Performance Evaluation
Removal Efficiency of 110 µm Sediment Particles

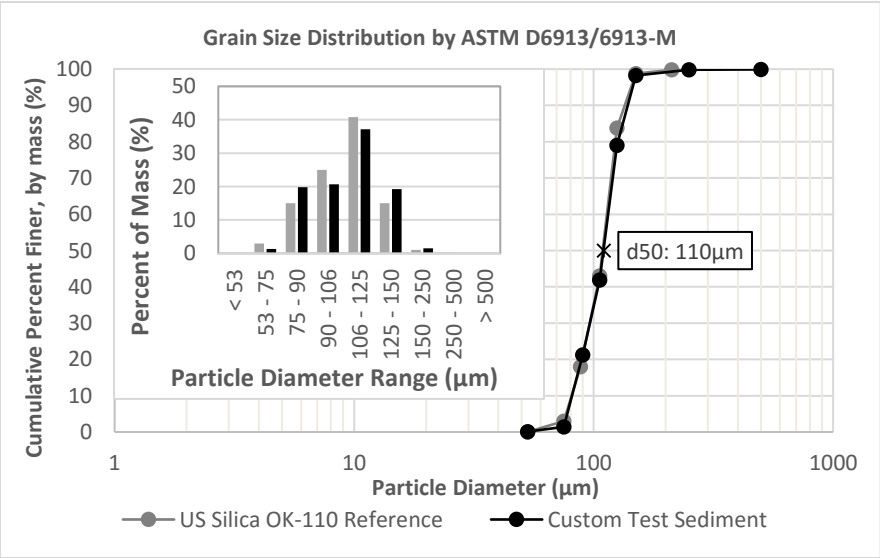
The Product

The Cascade Separator is a hydrodynamic separator designed to protect waterways from stormwater runoff. The separator is commonly used as a standalone stormwater quality control practice and as pretreatment for filtration, detention, infiltration, bioretention, rainwater harvesting systems and Low Impact Development designs. This innovative treatment product excels at sediment capture and retention while also removing hydrocarbons, trash, and debris from stormwater runoff. What makes the Cascade Separator unique is the use of opposing vortices that enhance particle settling and a unique skirt design that allows for sediment transport into the sump while reducing turbulence and resuspension of previously captured material. These two factors allow the Cascade Separator to treat high flow rates in a small footprint, resulting in an efficient and economical solution for any site.



The Evaluation

The Cascade Separator performance evaluation was conducted under independent third-party observation at Contech's state-of-art research laboratory. Sediment removal efficiency was evaluated using a custom ground and whole-grain silica contaminant (SG= 2.65), with a mass median particle diameter (d50) of 110 µm. The test sediment is equivalent to the U.S. Silica OK-110 test standard, which is no longer commercially available. The distribution of both sediment types are shown in the figure below.



The 4-ft Cascade Separator (CS-4) was installed in an aluminum manhole as part of a recirculation test system. Performance evaluation consisted of 3 sediment removal trials at each of the 5 flow rates ranging from 0.3 to 1.5 cfs.

For each sediment removal trial, the target sediment influent concentration was 280 mg/L, which was achieved by dosing the test water with a calibrated dry sediment feed rate. Treated effluent water was grab-sampled and analyzed for suspended solids concentration (SSC).

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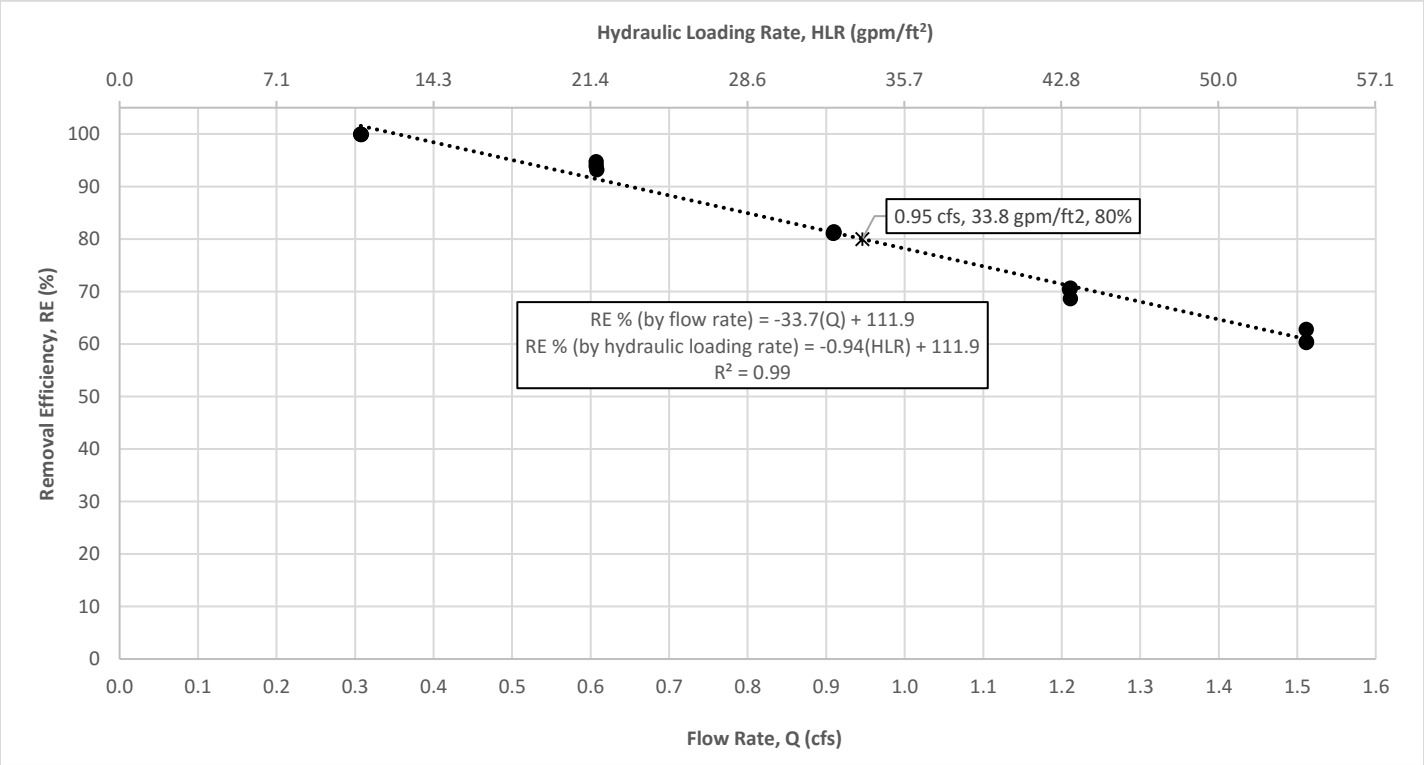
The Results

Testing demonstrated the 4-ft Cascade Separator can achieve > 80% removal of 110 µm sediment at a flow rate (Q) of 0.95 cfs or less. The flow rate of 0.95 cfs corresponds to a hydraulic loading rate (HLR) of 33.8 gpm/ft^2. HLR is defined as flow rate divided by the manhole floor surface area; this parameter can be used to determine the flow rate at 80% removal for all model sizes of the Cascade Separator.

A total of 15 sediment removal trials were performed over 5 flow rates. Results are provided in the table and figure below. Removal efficiency for each sediment removal trial was determined by the following calculation:

$$Removal\ Efficiency\ (\%) = (100\%) \times \frac{Influent\ SSC\ \left(^{mg}/_{L}\right) - Effluent\ SSC\ \left(^{mg}/_{L}\right)}{Influent\ SSC\ \left(^{mg}/_{L}\right)}$$

Flow Rate (cfs)	Hydraulic Loading Rate (gpm/ft^2)	Average Influent SSC (mg/L)	Average Effluent SSC (mg/L)	Average Removal Efficiency (%)
0.3	11.0	264	0	100
0.6	21.7	270	16	94
0.9	32.5	281	53	81
1.2	43.2	275	83	70
1.5	54.0	277	108	61



Note: removal efficiency is 100% for flows less than 0.35 cfs (12.7 gpm/ft^2)

Table 16. Total Zinc and Total Copper Results

Event ID	Sample Type	Total Zn							Total Cu						
		Influent result (mg/L)	Method reporting limit (MRL) (mg/L)	Influent load (g)	Effluent result (mg/L)	Method reporting limit (MRL) (mg/L)	Effluent load (g)	Individual storm reduction (RE) (%)	Influent result (mg/L)	Method reporting limit (MRL) (mg/L)	Influent load (g)	Effluent result (mg/L)	Method reporting limit (MRL) (mg/L)	Effluent load (g)	Individual storm reduction (RE) (%)
4/7/2017	Comp.	0.1450	0.0020	9.1	0.0399	0.0020	2.5	72.5	0.0258	0.0005	1.62	0.0085	0.0005	0.54	66.9
4/12/2017	Comp.	0.0797	0.0020	7.8	0.0317	0.0020	3.1	60.2	0.0126	0.0010	1.23	0.0032	0.0010	0.32	74.3
4/19/2017	Comp.	0.1460	0.0020	2.6	0.0209	0.0020	0.4	85.7	0.0248	0.0005	0.45	0.0032	0.0005	0.06	87.2
4/26/2017	Comp.	0.0875	0.0020	3.8	0.0166	0.0020	0.7	81.0	0.0160	0.0005	0.70	0.0019	0.0005	0.08	87.9
5/13/2017	Comp.	0.0637	0.0020	6.2	0.0423	0.0020	4.1	33.6	0.0109	0.0005	1.06	0.0073	0.0005	0.71	33.4
5/16/2017	Comp.	0.0381	0.0020	6.6	0.0244	0.0020	4.2	36.0	0.0060	0.0005	1.04	0.0036	0.0005	0.62	40.3
6/8/2017	Comp.	1.8900	0.0020	168.9	1.2400	0.0020	110.8	34.4	0.0164	0.0005	1.47	0.0071	0.0005	0.63	57.0
6/15/2017	Comp.	0.2220	0.0020	23.1	0.1040	0.0020	10.8	53.2	0.0230	0.0005	2.39	0.0070	0.0005	0.72	69.7
3/8/2018	Comp.	0.3740	0.0020	34.9	0.0518	0.0020	4.8	86.1	0.0597	0.0005	5.56	0.0172	0.0005	1.60	71.2
3/14/2018	Comp.	0.1300	0.0020	13.9	0.0412	0.0020	4.4	68.3	0.0225	0.0005	2.41	0.0058	0.0005	0.62	74.3
3/16/2018	Comp.	0.0444	0.0020	1.0	0.0282	0.0020	0.6	36.5	0.0180	0.0005	0.40	0.0023	0.0005	0.05	87.1
3/22/2018	Comp.	0.1170	0.0020	13.1	0.0305	0.0020	3.4	73.9	0.1360	0.0005	15.27	0.0040	0.0005	0.45	97.0
3/27/2019	Comp.	0.0675	0.0020	11.8	0.0345	0.0020	6.0	48.9	0.0133	0.0005	2.33	0.0047	0.0005	0.82	64.7
4/5/2019	Peak	0.1100	0.0020	0.5	0.0313	0.0020	0.2	71.5	0.0196	0.0005	0.10	0.0065	0.0005	0.03	66.8
4/13/2019	Peak	0.0826	0.0020	31.8	0.0366	0.0020	14.1	55.7	0.0182	0.0005	7.01	0.0098	0.0005	3.77	46.2
5/18/2019	Peak	0.4560	0.0020	51.3	0.0356	0.0020	4.0	92.2	0.0601	0.0005	6.76	0.0068	0.0005	0.76	88.7
12/7/2019	Comp.	0.1990	0.0020	53.4	0.0815	0.0020	21.9	59.0	0.0167	0.0005	4.48	0.0055	0.0005	1.48	66.9
12/11/2019	Comp.	0.0959	0.0020	10.2	0.0805	0.0020	8.5	16.1	0.0081	0.0005	0.85	0.0070	0.0005	0.74	13.6
12/19/2019	Comp.	0.1500	0.0020	26.3	0.0697	0.0020	12.2	53.5	0.0125	0.0005	2.20	0.0064	0.0005	1.13	48.7
3/30/2020	Peak	0.4050	0.0020	48.6	0.0432	0.0020	5.2	89.3	0.0625	0.0010	7.50	0.0109	0.0010	1.31	82.6
4/20/2020	Peak	0.1310	0.0020	8.1	0.0372	0.0020	2.3	71.6	0.0315	0.0010	1.95	0.0154	0.0010	0.95	51.1
Min		0.0381	0.0020	0.5	0.0166	0.0020	0.2	16.1	0.0060	0.0005	0.10	0.0019	0.0005	0.03	13.6
Max		1.8900	0.0020	168.9	1.2400	0.0020	110.8	92.2	0.1360	0.0010	15.27	0.0172	0.0010	3.77	97.0
Mean		0.2397	0.0020	25.4	0.1010	0.0020	10.7	60.9	0.0292	0.0006	3.18	0.0069	0.0006	0.83	65.5
Median		0.1300	0.0020	11.8	0.0372	0.0020	4.2	60.2	0.0182	0.0005	1.95	0.0065	0.0005	0.71	66.9
Sum				533.2			224.4				66.77			17.41	

Table 21. Basic Treatment TSS results

Total Suspended Solids (TSS)									
Event ID	Sample Type	Influent result (mg/L)	Method reporting limit (MRL) (mg/L)	Influent load (kg)	Effluent result (mg/L)	Method reporting limit (MRL) (mg/L)	Effluent load (kg)	Basic Criteria 1 20-100 mg/l Eff. conc. ≤ 20mg/l	Basic Criteria 2 100-200 mg/l ≥80% RE (%) [a]
3/20/2017	Comp.	51.2	2.0	6.8	19.4	2.1	2.6	19.4	
3/21/2017	Comp.	102.0	2.0	7.1	22.0	2.0	1.5		78.4
4/7/2017	Comp.	201.0	2.0	12.6	30.8	2.0	1.9		84.6
4/12/2017	Comp.	108.0	2.0	10.6	24.4	2.0	2.4		77.4
4/19/2017	Comp.	452.0	2.0	8.2	44.6	2.1	0.8		77.7
4/26/2017	Comp.	257.0	2.3	11.2	10.0	2.4	0.4		95.0
5/13/2017	Comp.	66.0	2.0	6.4	33.2	2.0	3.2	33.2	
5/16/2017	Comp.	24.0	2.0	4.2	6.8	2.0	1.2	6.8	
6/8/2017	Comp.	73.6	2.0	6.6	16.8	2.0	1.5	16.8	
6/15/2017	Comp.	134.0	2.5	13.9	10.4	2.0	1.1		92.2
3/8/2018	Comp.	755.0	3.3	70.4	47.2	2.0	4.4		76.4
3/14/2018	Comp.	181.0	5.0	19.4	27.0	5.0	2.9		85.1
3/16/2018	Comp.	19.0	5.0	0.4	ND	5.0	0.1		
3/22/2018	Comp.	224.0	5.0	25.1	20.0	5.0	2.2		90.0
3/27/2019	Comp.	94.0	5.0	16.4	11.0	5.0	1.9	11.0	
4/5/2019	Peak	171.0	5.0	0.9	23.0	5.0	0.1		86.5
4/13/2019	Peak	117.0	5.0	45.0	25.0	5.0	9.6		78.6
5/18/2019	Peak	254.0	5.0	28.6	20.0	5.0	2.3		90.0
12/7/2019	Comp.	200.0	5.0	53.7	17.0	5.0	4.6		91.5
12/11/2019	Comp.	13.0	5.0	1.4	10.0	5.0	1.1		
12/19/2019	Comp.	91.0	5.0	16.0	31.0	5.0	5.4	31.0	
3/30/2020	Peak	605.0	5.0	72.6	51.0	5.0	6.1		74.5
4/20/2020	Peak	210.0	5.0	13.0	29.0	5.0	1.8		85.5
Min		13.0	2.0	0.4	5.0	2.0	0.1	6.8	74.5
Max		755.0	5.0	72.6	51.0	5.0	9.6	33.2	95.0
Mean		191.4	3.7	19.6	23.2	3.6	2.6	19.7	84.2
Median		134.0	5.0	12.6	22.0	5.0	1.9	18.1	85.1
Lower 95% for RE [b]									82.0
Sum				450.4			59.2		

[a] Influent TSS concentrations capped at 200 mg/L for Basic Criteria 2 RE calculation purposes
[b] confidence interval calculated using TAPE bootstrap confidence interval calculator

6.8.3 Total Phosphorus Performance

Phosphorus Treatment performance goals as defined by the TAPE include meeting all Basic Treatment goals as well as demonstrating at least 50% total phosphorus removal for events with influent concentrations between 0.1 and 0.5 mg/L.

A total of 21 sample pairs were analyzed for compliance with Phosphorus Treatment performance goal. For all events with influent total phosphorus influent concentrations between 0.1 and 0.5 mg/L, the calculated lower one-sided 95% confidence limit (LCL95) for removal efficiency was 70.1%.

The mean and median effluent individual storm reductions for total phosphorus were 74.2% and 74.6% respectively. Total event loadings for qualified total phosphorus sample pairs were 1,034.9 g at the influent and 213.0 g at the effluent, resulting in a SOL efficiency of 79.4%

6.8.4 Ortho Phosphorus Treatment

Ortho phosphorus was evaluated as shown on Table 14. The mean and median effluent individual storm reductions for ortho phosphorus were -22.8% and 0.0% respectively. Total event loadings for ortho phosphorus sample pairs were 45.06 g at the influent and 51.9 g at the effluent, resulting in a SOL efficiency of -15.2%

Table 22. Phosphorus Treatment results

Total Phosphorus							
Event ID	**Sample Type**	**Influent result (mg/L)**	**Method reporting limit (MRL) (mg/L)**	**Influent load (g)**	**Effluent result (mg/L)**	**Method reporting limit (MRL) (mg/L)**	**Total Phosphorus Criteria 0.1 - 0.5 mg/l ≥50% RE (%) [a]**
4/7/2017	Comp.	0.706	0.010	44.3	0.092	0.010	81.6
4/12/2017	Comp.	0.338	0.010	33.0	0.076	0.010	77.5
4/19/2017	Comp.	0.500	0.010	9.0	0.036	0.010	92.8
4/26/2017	Comp.	0.504	0.010	22.0	0.042	0.010	91.6
5/13/2017	Comp.	0.256	0.010	25.0	0.110	0.010	57.0
5/16/2017	Comp.	0.094	0.010	16.3	0.042	0.010	
6/8/2017	Comp.	0.256	0.010	22.9	0.104	0.010	59.4
6/15/2017	Comp.	0.362	0.010	37.6	0.052	0.010	85.6
3/8/2018	Comp.	1.750	0.010	163.1	0.130	0.010	74.0
3/14/2018	Comp.	0.652	0.010	69.7	0.094	0.010	81.2
3/16/2018	Comp.	0.082	0.010	1.8	0.030	0.010	
3/22/2018	Comp.	0.364	0.010	40.9	0.072	0.010	80.2
3/27/2019	Comp.	0.226	0.050	39.5	0.070	0.050	69.1
4/5/2019	Peak	0.337	0.050	1.7	0.092	0.050	72.8
4/13/2019	Peak	0.249	0.050	95.9	0.087	0.050	65.1
5/18/2019	Peak	1.090	0.250	122.7	0.173	0.050	65.4
12/7/2019	Comp.	0.335	0.050	89.9	0.105	0.050	68.7
12/11/2019	Comp.	0.081	0.050	8.5	0.052	0.050	
12/19/2019	Comp.	0.211	0.050	37.1	0.093	0.050	56.2
3/30/2020	Peak	1.050	0.050	126.0	0.092	0.050	81.6
4/20/2020	Peak	0.451	0.050	27.9	0.112	0.050	75.2
Min		0.081	0.010	1.7	0.030	0.010	56.2
Max		1.750	0.250	163.1	0.173	0.050	92.8
Mean		0.471	0.037	49.3	0.084	0.027	74.2
Median		0.338	0.010	37.1	0.092	0.010	74.6
Lower 95% for RE [b]							70.1
Sum				1034.9			

[a] Influent TP concentrations capped at 0.5 mg/L for Total Phosphorus Criteria RE calculation purposes
[b] confidence interval calculated using TAPE bootstrap confidence interval calculator

WASHINGTON STATE DEPARTMENT OF ECOLOGY

January 2021

GENERAL USE LEVEL DESIGNATION FOR BASIC (TSS) AND PHOSPHORUS TREATMENT For Contech Environmental Solutions Jellyfish® Filter

Ecology's Decision:

1. Based on Contech Environmental Solution's application submissions, Ecology hereby issues a General use level designation (GULD) for Basic (TSS) and Phosphorus Treatment for Contech's Jellyfish® Filter:
   - Sized at a hydraulic loading rate of no greater than 0.21 gpm/sf filter surface for hi-flo cartridges and 0.11 gpm/sf filter surface for draindown cartridges

Table 1. Jellyfish® cartridge hydraulic loading rates and sediment capture capacity[1] associated with various filter cartridge sizes.

Cartridge Length	Design Treatment Flow Rate	Design Sediment Mass Loading Capacity
15 inches	Hi-Flo 22 gpm Draindown 11 gpm	Hi-Flo 35 lbs Draindown 17 lbs
27 inches	Hi-Flo 40 gpm Draindown 20 gpm	Hi-Flo 63 lbs Draindown 31 lbs
40 inches	Hi-Flo 60 gpm Draindown 30 gpm	Hi-Flo 93 lbs Draindown 46 lbs
54 inches	Hi-Flo 80 gpm Draindown 40 gpm	Hi-Flo 125 lbs Draindown 63 lbs

[1] Design sediment mass loading capacity based on laboratory testing using silica sediment.

2. Ecology approves Jellyfish® Filter units at the design treatment flow rates shown in Table 1. Total Jellyfish Filter system design treatment capacity is the sum of the design treatment capacity of individual cartridges and must equal or exceed the water quality design flow rate. Calculate the water quality design flow rate that must be treated by an individual treatment system using the following procedures:
    - Western Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using the latest version of the Western Washington Hydrology Model or other Ecology-approved continuous runoff model.
    - Eastern Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using one of the three methods described in Chapter 2.7.6 of the 2019 Stormwater Management Manual for Eastern Washington (SWMMEW) or local manual.
    - Entire State: For treatment installed downstream of detention, the water quality design flow rate is the full 2-year release rate of the detention facility.
3. The GULD has no expiration date but may be amended or revoked by Ecology.

Ecology's Conditions of Use:

Jellyfish® Filter units shall comply with the following conditions:

1. Design, assemble, install, operate, and maintain Jellyfish® Filter units in accordance with Contech's applicable manuals and documents and this Ecology Decision.
2. Contech uses sediment-loading capacity, in conjunction with the water quality design flow rate, to determine the target maintenance interval.
3. Jellyfish® Filters shall conform to specifications submitted to and approved by Ecology.
4. Maintenance: The required inspection/maintenance interval for stormwater treatment devices is often dependent on the efficiency of the device and the degree of pollutant loading from a particular drainage basin. Therefore, Ecology does not endorse or recommend a "one size fits all" maintenance cycle for a particular model/size of manufactured filter treatment device.
    - The Jellyfish® Filter is designed for a target maintenance interval of 12 months. Maintenance includes floatable trash, debris, and oil removal; sediment removal; and the rinsing or replacement of filter cartridges.
    - A Jellyfish® Filter tested in Dundee, OR averaged a 3.2 month maintenance interval. Construction activities were ongoing in the drainage basin and near the monitoring site during the first two years of the study. Monitoring personnel observed significant amounts of roadway sediments and organic debris in the runoff, and TSS concentrations were higher than typical for roadway runoff. The runoff that occurred during the study may be unusual, and the maintenance interval the Jellyfish® Filter required may not be indicative of other, more typical, sites.

- Owner/s operators must inspect Jellyfish® Filter systems for a minimum of twelve months from the start of post-construction operation to determine site-specific inspection/maintenance schedules and requirements. Owners/operators must conduct inspections monthly during the wet season, and every other month during the dry season. (According to the SWMMWW, the wet season in westerns Washington is October 1 to April 30. According to the SWMMEW, the wet season in eastern Washington is October 1 to June 30.) After the first year of operation, owners/operators must conduct inspections based on the findings during the first year of inspections.
- Conduct inspections by qualified personnel, follow manufacturer's guidelines, and use methods capable of determining either a decrease in treated effluent flow rate and/or a decrease in pollutant removal ability.

5. Install the Jellyfish® Filter in such a manner such that flows exceeding the maximum operating rate of the system are bypassed and will not resuspend captured sediment.
6. Discharges from the Jellyfish® Filter units shall not cause or contribute to water quality standards violations in receiving waters.

Applicant: CONTECH Engineered Solutions

Applicant's Address: 11835 NE Glenn Widing Dr
Portland, OR 97220

Application Documents:

- *Jellyfish® Filter Dundee, OR, General Use Level Designation Technical Evaluation Report*, Prepared by CONTECH Engineered Solutions, December 28, 2020
- Application Letter for CULD for Jellyfish Filter - Basic Treatment, Phosphorus Treatment, and Oil Treatment, dated April 27, 2012.
- Letter from Imbrium Systems dated September 4, 2012 regarding the draft CULD/PULD document.
- *TAPE Analysis of Jellyfish Filter UF Field Study Data*, prepared by Stormwater Management Services, LLC.
- *TARP Field Test Performance Monitoring of a Jellyfish Filter JF4-2-1. Performance Monitoring Report for JF4-2-1* Prepared By: University of Florida, Engineering School of Sustainable Infrastructure and Environment (ESSIE), University of Florida, Gainesville, FL 32611. Final Version: 01 November 2011.
- *Jellyfish Filter Systems Evaluation Report in Consideration for Pilot Level Designation (PLD) for Imbrium Systems Corporation*, by Gary R. Minton, PhD, PE, with Resource Planning Associates in Seattle, Washington May 7, 2008 (updated July 1, 2008).

- *NJCAT Technology Verification, Jellyfish Fine Sediment Filter*, by the New Jersey Corporation for Advanced Technology (NJCAT) Program Imbrium Systems Corporation, June 2008

Applicant's Use Level Request:

- General use level designation as a Basic (TSS) and Phosphorus Treatment device in accordance with Ecology's 2019 Stormwater Management Manual for Western Washington.

Applicant's Performance Claims:

Based on results from a laboratory and field-testing, the applicant claims the Jellyfish® Filter, operating at a hydraulic loading rate of no more than 0.21 gpm/sf for hi-flo cartridges and 0.11 gpm/sf for draindown cartridges, is able to remove:

- 80% of total suspended solids (TSS) for influent concentrations greater than 100 mg/L and achieve a 20 mg/L effluent for influent concentrations less than 100 mg/L.
- 50% of total phosphorus for influent concentrations 0.1 to 0.5 mg/L

Recommendations:

Ecology finds that:

- Contech Engineered Solutions has shown Ecology, through laboratory and field testing, that the Jellyfish® Filter is capable of attaining Ecology's Basic (TSS) and Total Phosphorus treatment goals.

Findings of Fact:

<u>Field Testing 2017-2020</u>
Contech completed field testing in Dundee, OR on a Jellyfish® Filter unit containing six 54-inch hi-flo cartridges and one 54-inch draindown cartridge. This combination of cartridges resulted in a design flow capacity of 520 gpm (1.16 cfs). Since Contech conducted the field evaluation they contracted with Herrera Environmental Consultants to provide third party oversight.

- The field evaluation was completed between March 2017 and April 2020. Throughout the evaluation a total of 23 individual storm events (18 flow-weighted composite samples and 5 peak flow grab samples) were sampled to evaluate system performance. All sampled events met the TAPE sampling event qualification criteria, while 21 of the 23 events met the influent requirements for TSS and/or total phosphorus. Peak flows during these 21 events ranged from 26% to 106% of the design treatment capacity of 520 gpm, with a mean peak flow rate of 67% of design.
- Of the 23 TAPE qualified events, 21 met the requirements for TSS analysis (16 flow weighted composite; 5 peak flow grab samples). Influent concentrations ranged from 24 mg/L to 755 mg/L, with a mean concentration of 208 mg/L. Concentrations that exceeded the upper end of TAPE influent range were capped at 200 mg/L prior to calculating the pollutant removal efficiency. For all samples with influent concentrations greater than 100 mg/L the bootstrap estimate of the lower 95 percent confidence limit (LCL95) of the mean TSS reduction was 82%, meeting the 80% performance goal for Basic Treatment. The TAPE bootstrap calculator could not be used on samples with influent concentrations

between 20 mg/L to 100 mg/L due to the limited number of events available (n=6). For these events the mean and median effluent TSS concentrations were 19.7 and 18.1 mg/L respectively, again meeting the 20 mg/L effluent goal for Basic Treatment.

- Of the 23 TAPE qualified events, 18 met the requirements for total phosphorus analysis (13 flow-weighted composite; 5 peak flow grab samples). Influent concentrations ranged from 0.211 mg/L to 1.75 mg/L, with a mean concentration of 0.535 mg/L. Concentrations that exceeded the upper end of TAPE influent range were capped at 0.5 mg/L prior to calculating the pollutant removal efficiency. The LCL 95 mean percent removal goal was 70.1%, meeting the 50% performance goal for Phosphorus Treatment.
- Median particle sized distribution results from three samples showed 20% of sediment >250 μm, 31% of sediment between 62.5 to 250 μm, and 51% of sediment <62.5 μm. This demonstrates the influent to the Jellyfish consisted of primarily silt-sized particles (3.9 to 62.5 μm) and is thus representative of Pacific Northwest Stormwater.
- Contech encountered several unanticipated events and challenges that disrupted the sampling and/or resulted in lost data: the Jellyfish was taken offline twice to avoid atypical sediment loading that was the result of construction within the drainage basin; monitoring was suspended to repair or replace equipment that was damaged from vandalism and extreme weather; and, a cyber-attack on Contech storage drives resulted in a loss of approximately 15% of non-sampled flow and precipitation data.

Field Testing 2010-2011

Results (second-generation membrane filtration cartridges) – University of Florida (Gainesville, FL) installed and tested a Jellyfish JF4-2-1. The University conducted monitoring of the system from May 28, 2010 to June 27, 2011, with runoff from 15.01 inches of rainfall. The monitoring followed the Technology Acceptance Reciprocity Partnership (TARP) field test protocol, per the guidelines of the New Jersey Department of Environmental Projection (NJDEP). The New Jersey Corporation for Advanced Technology (NJCAT), on May 14, 2012 certified the Jellyfish Filter for 80 percent TSS removal.

- The JF4-2-1 operating at a maximum treatment flow rate of 200 gpm provided a median total suspended solids (TSS) removal of 89 percent, and a median suspended sediment concentration (SSC) removal of 99 percent. Influent TSS concentrations ranged from 16.3 to 261.0 mg/L. TSS concentrations in the range of 20-100 mg/L were reduced to less than 20 mg/L for 16 of 17 events. Average TSS removal for influent TSS between 100-200 mg/L was 90 percent.
- Other median pollutant removals included: total phosphorus, 59 percent; total nitrogen, 51 percent; total copper, 90 percent; and total zinc 70 percent.
- Total oil and grease influent concentrations ranged from 0.2 to 4.1 mg/L, with a median removal efficiency of 62 percent.
- No maintenance was required or carried out during the 13-month monitoring period. Curves of head loss versus flow rate were nearly identical for the system with fresh cartridges (beginning of monitoring) and dirty cartridges (end of monitoring period). The sump and filter cartridges captured 166 pounds of dry basis particulate matter.

- Runoff treated by the JF4-2-1 was from a nearby parking lot (approximately 75 percent pavement and 25 percent planting islands). Depending on storm event intensity and wind direction, the drainage area varied from 0.12 to 0.20 acres.

Laboratory Testing and Results

Imbrium conducted testing at the Monteco Limited Research & Development Centre (RDC) in Mississauga, Ontario with third party testing oversight provided by Prof. James Li of Ryerson University in Toronto. The laboratory set-up used a single cartridge fitted into a tank sized to be 1/7 the volume of a full-scale 7-cartridge Jellyfish Filter system. Based on the lab test results:

- A Jellyfish Filter system fitted with a single Jellyfish cartridge or multiple Jellyfish cartridges can remove greater than 86% Sil-Co-Sil 106 (mean particle size 22 microns) within a 95% confidence interval of +/- 1.3% at the system's 100% operating rate with influent sediment concentrations ranging from 100 to 300 mg/L. For systems using 12-inch diameter cartridges, each cartridge containing 91filtration tentacles of 54-inch length, the 100% operating rate is 50 gpm per cartridge operating at 12 inches driving head (i.e., 0.66 gpm/ft2). Each (of the) 91 filtration tentacles is composed of three 18-inch long segments for a total length of 54 inches with 76 ft2 of surface area (first generation membrane filtration cartridges).
- Test runs at 100 mg/L influent concentration resulted in effluent concentrations ranging from 12 to 21 mg/L. Ten of the 11 test runs had effluent less than 20 mg/L (as required for Basic Treatment).
- Sampling of effluent found an average D90 of about 14 microns indicating the Jellyfish Filter System is capable of removing most particles above 15 microns.

Other Jellyfish Filter Related Issues Recommended to be Addressed by the Company:

1. Conduct hydraulic testing to obtain information about maintenance requirements on a site with runoff that is more typical of the Pacific Northwest.

Technology Description: Download at: http://www.conteches.com/products/stormwater-management/treatment/jellyfish-filter

Contact Information:

Applicant: Jeremiah Lehman
Contech Engineered Solutions, LLC.
11815 Glenn Widing Dr
Portland, OR 97220
(503) 258-3136
jlehman@conteches.com

Applicant website: www.conteches.com

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

Ecology: Douglas C. Howie, P.E.
Department of Ecology
Water Quality Program
(360) 407-6444
douglas.howie@ecy.wa.gov

Revision History

Date	Revision
August 2008	PULD granted
January 2012	PULD Extension granted
September 2012	CULD for Basic treatment; PULD for Oil and Phosphorus treatment.
January 2013	Modifications to format document in line with other Use Level Documents, Changes dates for QAPP, TER, and Expiration
August 2014	Revised contact information and due dates for QAPP, TER, and expiration
March 2015	Revised Contact Information to Contech from Imbrium
November 2016	Revised Contech contact information
March 2018	Revised TER delivery and Expiration dates, Changed text from Imbrium to Contech in selected locations
April 2019	Revised TER delivery and Expiration dates
September 2020	Revised TER delivery and Expiration dates
January 2021	GULD Granted