# A Guide to Stormwater Manufactured Treatment Devices

Approved by TNSA Board of Directors
TNSA President:
Date: 5/21/2020

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Disclaimer: This document was prepared by members of the Tennessee Stormwater Association and intended for guidance and educational purposes. This document by no means endorses one protocol over another, nor does it endorse one product over another.

# Statement of Purpose

The mission of the Tennessee Stormwater Association is to assist members with their local efforts to comply with State and Federal clean water laws; including stormwater regulations through EPA and TDEC. TNSA's goal is to protect and improve the quality of waters of Tennessee though the exchange of information and knowledge regarding design, construction, maintenance, administration and operation of stormwater facilities. TNSA membership is composed of designated Municipal Separate Storm Sewer Systems (MS4s) including local governments (city and county), universities, military installations, and other entities such as TN Department of Transportation (TDOT). Associate members include environmental advocacy groups, non-profits, Tennessee State, sub-state or federal government entities. Private sector membership is available to for-profit engineering, environmental, scientific and management firms or other organizations with an interest in stormwater.

TNSA members may serve on various committees to help TNSA comply with its mission and obtain its goals. The Manufactured Best Management Practices (BMP) Evaluation Committee is a TNSA committee which works to disseminate education to the TNSA membership regarding manufactured treatment devices and develop toolkits to assist MS4s accomplish permit requirements and establish program goals.

The purpose of this document is to provide information to Municipal Storm Separate Sewer System (MS4) program staff regarding Stormwater Manufactured Treatment Devices (MTDs). Specifically, the information provided herein compiles and summarizes the most commonly accepted field and laboratory testing protocols for MTDs. Summaries and examples of each protocol have been provided in an effort to assist MS4 staff with plan review and decision making processes. As testing protocols and technologies advance, it is important for MS4 communities to stay abreast of the most up-to-date information. Therefore, this document may be revised, as necessary, in an effort to best serve the TNSA membership and MS4s in Tennessee.

## Introduction

Stormwater Manufactured Treatment Devices (MTDs) are designed to remove a variety of pollutants from stormwater runoff including, but not limited to, suspended sediment, nutrients, free floating oil, grease, floatables, metals, and hydrocarbons through gravitational settling and trapping of pollutants or through the use of filter materials. MTDs can be an effective stormwater treatment tool, especially in ultra-urban areas where land is limited. These solutions are also an important tool in the toolbox where additional site constraints, such as high groundwater, contaminated or poorly infiltrating soils, utility conflicts, or the presence of karst topography, make implementing other compliance tools, like green infrastructure stormwater control measures (SCMs), difficult. MTDs may also be utilized as part of a treatment train by serving as pretreatment prior to other proprietary and non-proprietary SCMs. Pollutant removal efficiencies are variable and dependent on device specific sizing as well as a number of factors including storm size, rainfall intensity, influent pollutant concentrations, and particle size of pollutants. Performance is dependent on design and frequency of inspection and maintenance practices.

Three common types of MTDs will be discussed within this guidance document: Hydrodynamic separation (HDS) devices, filtration systems, and biofiltration systems.

### Hydrodynamic Separation Devices (HDS)

Hydrodynamic separation devices (HDS) are permanent, post-construction, flow-through, water quality treatment devices with baffles, weirs, plates, or other flow directing features to remove suspended and settleable pollutants from stormwater runoff. Pollutant removal is typically achieved through the use of settling, separation, and swirling techniques (Figures 1-3).

A Stormwater Equipment Manufacturer's Association (SWEMA) fact sheet on HDS states that:

> "The primary advantages of HDS include good capture of sand and grit at relatively high surface loading rates, a small footprint, capture of floatable pollutants, capture of oil and fuel spills, and relatively simple and low cost maintenance. Additionally, since HDS are typically installed underground, treatment can be provided without consuming valuable developable land. Internal bypass features also reduce the total system footprint since additional manholes and diversions structures are not required for external bypassing of very high flow rates during the most intense storms. HDS are very effective pretreatment for other BMPs, such as stormwater ponds, bioretention, filter devices, detention structures, and infiltration, and can significantly extend the maintenance interval for these downstream measures (*Hydrodynamic*)."

TSS and floatables capture is sensitive to the flow rate and detention time within the device; a longer detention time results in better removal of pollutants. Generally, HDS provides relatively low and variable capture of fine particulates (< 50 microns) and particulate-bound pollutants (metals, nutrients, hydrocarbons) that are concentrated on the fine particle fractions, except at low surface loading rates during low intensity storms and during inter-event settling periods. HDS can be conservatively sized with a larger structure to provide additional detention time and improved capture of the fine particulate fractions. Neutrally buoyant pollutants (specific gravity similar to water, typically organic particulates) are difficult to remove with HDS unless they contain a screening mechanism.

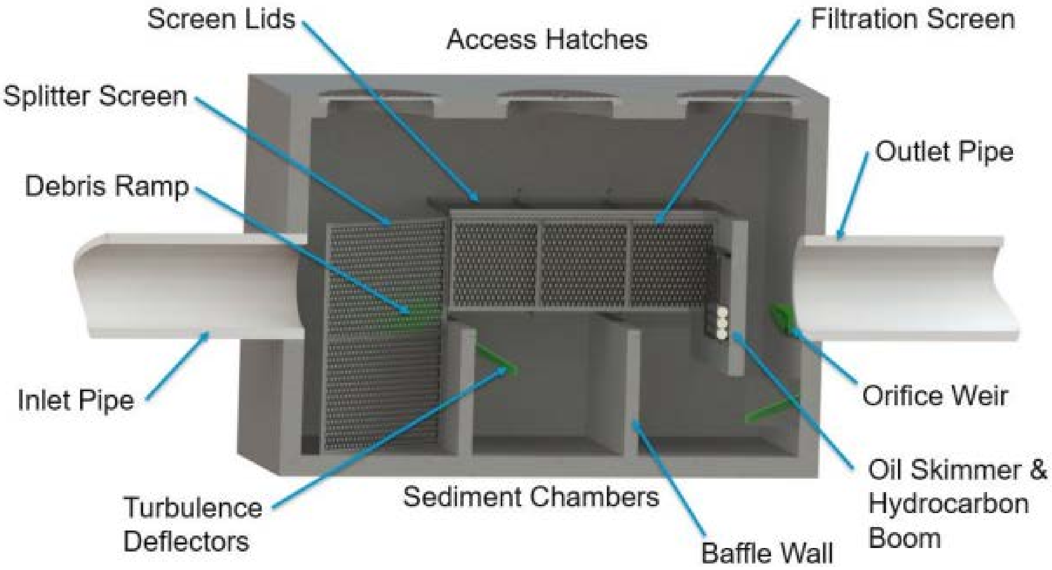

Figure 1. Example of Internal Components of a Type of Separator Style Hydrodynamic Separation Device (HDS).

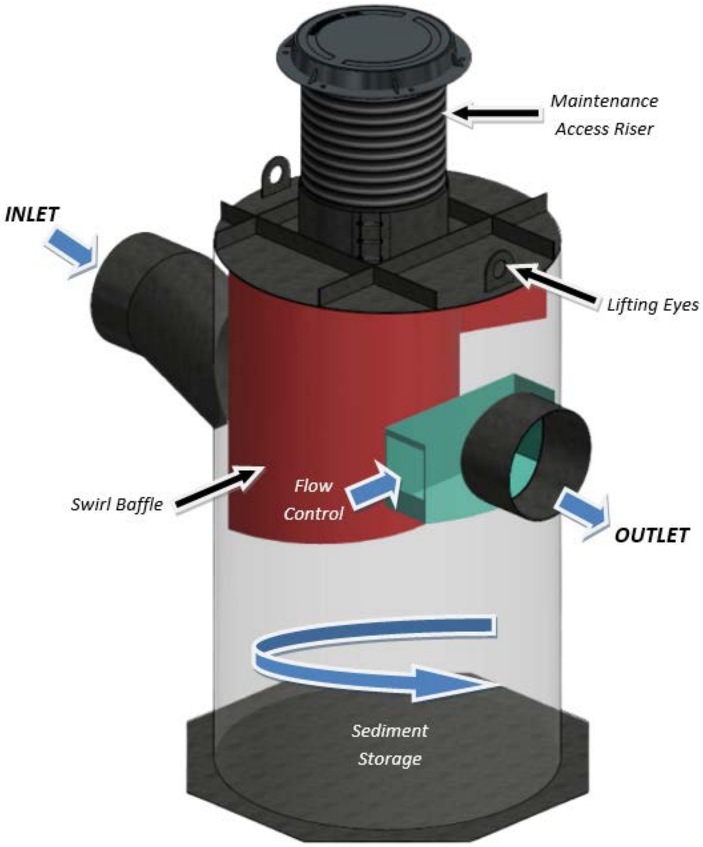

Figure 2. Example of Internal Components of a Type of Swirling Style Hydrodynamic Separation Device (HDS).

Figure 3. Example of a Hydrodyamic Separation Device (HDS) in the Field.

## Filtration Systems

Innovative media and membrane filtration systems are commonly deployed to treat stormwater runoff. Filtration systems contain one or more chambers that utilize a settling area and/or filtration system to remove specific pollutants like sediment, nutrients, metals, and oil. Filtration Systems tend to be more effective at removing common stormwater pollutants than settling technologies, such as hydrodynamic separators, and are commonly utilized as standalone practices or as polishing systems in treatment train configurations. While performance varies by media type and gradation, filtration systems are known to effectively capture finer sediments, and some specialized media effectively target dissolved pollutants, such as metals and phosphorus. These devices may include a high flow bypass structure for storm events larger than the designed water quality treatment event in order to prevent resuspension of settled pollutants (Figures 4 and 5).

A SWEMA fact sheet on filtering practices states:

> "Manufactured filtration systems are usually housed within rectangular vault or round manhole structures. Many technologies incorporate sumps or chambers to encourage sedimentation within the structure in order to reduce loading on the filtration media or membrane which reduces the overall maintenance frequency and cost for the technology. Manufactured filtration systems often utilize a customized gradation of filtration media or porous membranes to remove stormwater pollutants. Common media include expanded perlite, zeolite and sand as well as other specialized media to target soluble pollutants through chemical processes. Media is generally housed in removable cartridges or compartments within a concrete vault or manhole structure. Flow enters the system and passes through the media where solids are physically filtered from the flow stream and soluble pollutants attach to specialized media when deployed (*Stormwater Filtration)*."

Performance of media filtration devices is highly dependent on the gradation, depth, and type of media; the hydraulic loading rate; and pollutant characteristics. Media filters utilized for stormwater treatment are able to remove fine silt particles, soluble metals, and nutrients when reactive media is used. Finer gradations of media are capable of removing more pollutants, but they must operate at a lower hydraulic loading rate to avoid premature clogging and excessive maintenance. In practice, many media filters can treat higher flows than they are commonly designed for short durations, but it is essential that longevity is considered when designing media filters to avoid frequent maintenance requirements. Generally speaking, filtration systems tend to require a larger foot print than other flow-through treatment practices because of the need to maintain lower hydraulic loading rates to ensure both performance and longevity.

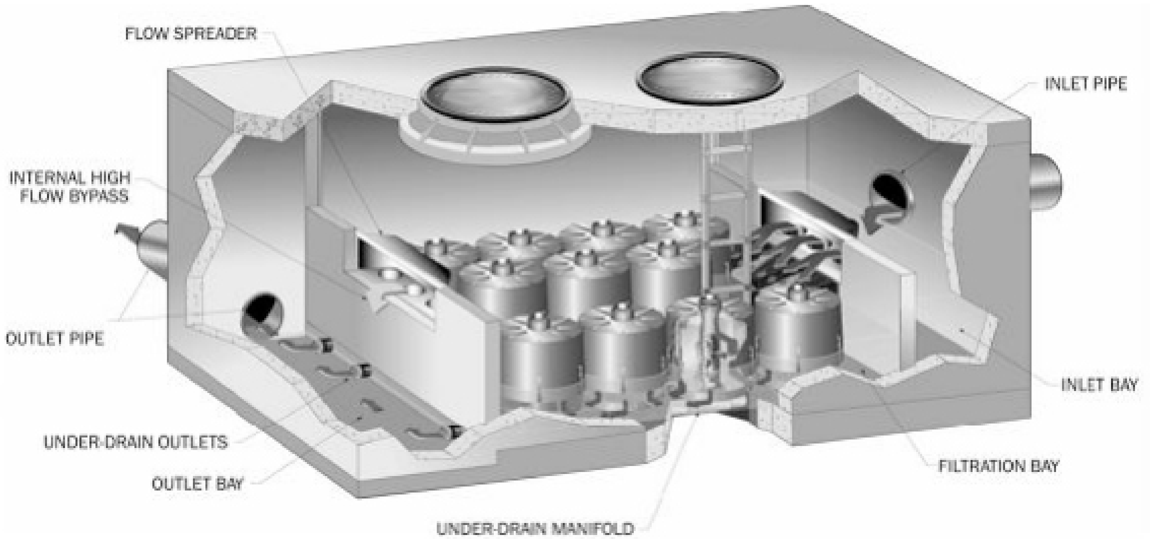

Figure 4. Example of Internal Components of a Type of Media Filtration System.

Figure 5. Example of a Filtration System in the Field.

## **Biofiltration Systems**

Biofiltration systems are intended to function and operate similarly to traditional bioretention practices (Figures 6 and 7). Many, though not all, utilize a proprietary, engineered media that infiltrates faster than traditional bioretention media blends. The higher flow rate allows these devices to optimize their treatment surface area and yield a smaller overall footprint, allowing them to be distributed throughout a site, as needed. These systems may also incorporate a high flow bypass for storm events larger than the designed water quality treatment event in order to prevent the re-suspension of settled pollutants. Generally, these devices do not need a pretreatment component. Vegetation is a critical component of any biofiltration system. Since biofilters are natural systems, proper irrigation must be provided to ensure survival of the plant and microbial community during drought conditions.

A SWEMA fact sheet on biofilters, i.e. tree box filters, states:

> “Physical, chemical and biological processes all play a role in long term performance. The primary treatment mechanisms used in tree box filters are inert and reactive filtration, coupled with various inter-storm treatment processes, such as microbial- and phytoremediation. The majority of particulates or particulate-bound contaminants are removed in and on the surface of the media. Organic material within the media is primarily responsible for dissolved contaminant removal. Contaminant degradation and assimilation by microbes and plants provide adsorption site regeneration. Ponding space above the media bed provides driving head and allows for the capture of trash and debris (*Tree Box*).”

The primary advantages of biofilters include consistent performance from known and vetted media blends, standardized designs, ease of construction, and simple, cost-effective maintenance. Biofilters are highly adaptable for most developments due to a small footprint, shallow elevation, and minimal driving head requirements. Multiple configuration options allow for flexibility in addressing various site requirements. Where infiltration is not feasible, biofilters are often a good solution for green infrastructure designs.

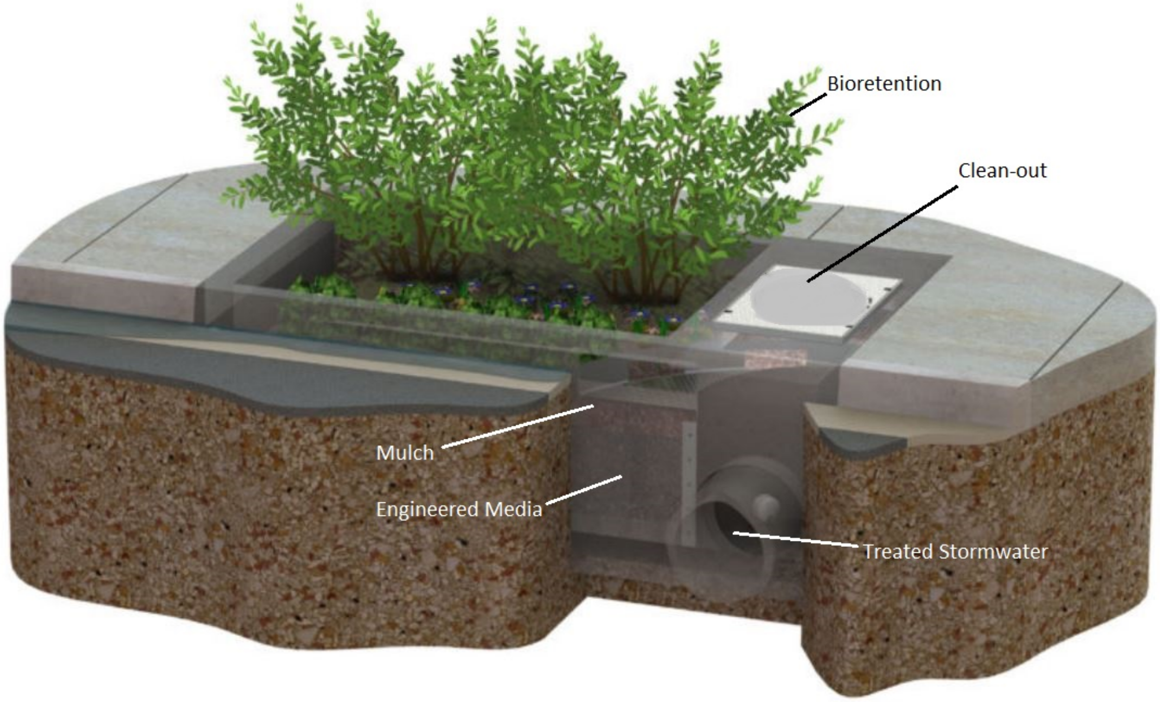

Figure 6. Examples of Internal Components of a Biofiltration System

Figure 7. Example of a Biofiltration System.

## **Addressing the Need for Standardized Testing Protocols**

There is currently an effort underway to address the lack of a national MTD testing and verification program. Led by the Water Environment Federation (WEF) and a diverse group of industry professionals, the National Stormwater Testing and Evaluation for Products and Practices (STEPP) initiative seeks to create consistent test protocols and data analysis techniques, encourage innovation in emerging technology, meet the growing need for affordable but effective stormwater treatment tools, and provide greater performance certainty to the regulated community. The two most recognized and widely accepted MTD performance evaluation programs are Washington State's Technology Assessment Protocol-Ecology (TAPE) and the New Jersey Department of Environmental Protection's (NJDEP) laboratory protocol for HDS and Filters, are discussed herein. These two programs will form the foundation of the initial national program, making them critical components of this guidance document. The TAPE program is a field-based MTD testing program while the NJDEP program is based on laboratory testing of MTDs.

## Laboratory Testing Protocols

Laboratory testing of MTDs is generally performed under a set of defined guidelines or protocols to ensure uniformity of results for those tested. Variables can be isolated and controlled allowing for multiple pollutant loading scenarios to be simulated during a single set of trials. Laboratory testing provides the ability to replicate tests allowing for side by side comparison of MTDs. Examples of controlled parameters in a laboratory testing process may include water temperature, particle size distribution of the influent test sediment, injection rate of test sediment, and flow rate introduced to the device. Common pitfalls associated with lab testing include sediment that is inconsistent with that found in actual stormwater runoff and artificial hydrographs.

## Summary of New Jersey Department of Environmental Protection (NJDEP) Manufactured Treatment Device (MTD) Certification Protocol

### Background

The state of New Jersey utilizes an 80% total suspended solids (TSS) water quality standard. With appropriate testing, MTDs can be utilized as a stormwater best management practice. Prior to 2013, New Jersey maintained a two-step process for the certification of MTDs- 1) a laboratory testing component completed in accordance with a NJDEP specific laboratory protocol and 2) a field test component completed in accordance with the TARP Tier II field testing protocol. In 2013 (January 2013), NJDEP moved to an entirely laboratory based process to evaluate TSS removal effectiveness of these technologies. Now, for a MTD to be installed on development projects in New Jersey, the technology must gain certification through a prescriptive sedimentation (hydrodynamic separation) or filtration (filters) protocol overseen by NJDEP in compliance with the Stormwater Management rules, N.J.A.C. 7:8.

The New Jersey Stormwater rules further establish that MTDs may be used to meet the regulatory requirements provided the pollutant removal rates are first verified by the New Jersey Corporation for Advanced Technology (NJCAT) and subsequently certified by NJDEP. The NJDEP certification process requires successful completion of technical and regulatory standards in addition to the reporting of those results in a published NJCAT Verification Report. Not all technologies receiving verification are eligible to pursue NJDEP certification when the testing methods deviated from the 2013 testing protocol.

### NJDEP Hydrodynamic Separator (HDS) Protocol

NJDEP does not view HDS technologies as a primary treatment practice and limits the effective TSS removal percentage of these technologies to 50%. The protocol identifies the maximum treatment flow rate (MTFR) that a technology can convey while still treating the peak flow rate from the water quality storm. Included within the protocol is a scour testing component to ensure previously captured sediment is not re-suspended during peak flows for online installation. Some HDS systems incorporate an internal bypass mechanism, allowing flows above the treatment flow to be internally bypassed in the HDS system and the device to be installed online. These devices treat low flows, bypass peak flows around treatment components, and discharge both through a single outlet.

There are benefits to an online system. In retrofit applications, they can be installed in an existing drainage line or manhole with minimal disturbance to surrounding areas. There are also advantages to having the bypass weir integral to the treatment system's internal components. In particular, the device would come with the weir set to the correct height to minimize installation error. If an HDS system does not incorporate an internal bypass weir, the system should be placed offline.

A designer may choose to place a treatment device offline for other reasons. For very high flow rates, an external bypass structure will scale better than trying to upsize a treatment structure. Likewise, the weir crest length in a bypass structure is typically longer than in an online treatment system. This increases the available cross-sectional flow area, allowing more flow to bypass at a lower hydraulic grade line. This is beneficial on sites with hydraulic limitations.

## NJDEP Filtration Protocol

Filters operate with different removal mechanisms and capture finer particles than their HDS counterparts. As such, these technologies must demonstrate greater removal of TSS during the testing process. The objective of laboratory testing of a filtration MTD is to establish a baseline for treatment performance (removal efficiency) and anticipated life cycle of the filtration MTD (Sediment Mass Loading Capacity). Certification as a standalone practice with 80% TSS removal is awarded if the technology achieves equal to or greater than 80% TSS removal over the course of testing runs. With finer particle removal comes a concern for occlusion of the practice. In order to account for a filter technology's ability to handle expected annual sediment loads without premature clogging, this protocol requires an evaluation of the mass a filter can capture before occluding up to 10% hydraulic capacity loss or exceeding available driving head. Online use is prohibited without passage of a scour test. An offline system is defined as one in which only the MTFR is routed into the filtration MTD and all flows in excess of the MTFR are diverted around the MTD via an upstream bypass or diversion.

The sizing and scaling of a Filter MTD differs from an HDS. A full-scale, commercially available unit can be tested, but a single cartridge is allowable if the effective filtration treatment area is equal to or less than the ratio utilized in commercially available units.

The test configuration determines critical parameters such as:

1. Ratio of Effective Filtration Treatment Area to Effective Sedimentation Area;
2. The ratio of wet volume to effective filtration treatment area;
3. Flow rate per unit surface area of filtration media (gpm/ft$^2$) at the MTFR;
4. Flow rate (gpm) per standard or draindown cartridge or module at MTFR, if applicable;
5. Minimum and maximum driving head;
6. Depth of media; and
7. Media composition and gradation.

## Role of NJCAT

NJCAT is a public/private partnership with a specific goal of helping companies bring new environmental and energy technologies to the marketplace. NJCAT verification reports are a core component of the verification/certification process in New Jersey. However, NJCAT will verify MTDs that do not meet NJDEP's protocol. All verification reports, including historic verifications completed under the previous NJDEP protocol, can be found in the verification database on NJCAT's website. NJDEP separately maintains a database of certified technologies.

## Differences between NJDEP Certification and NJCAT Verification

Table 1 below highlights key distinctions between NJDEP Certification and NJCAT Verification. This information is important for stormwater program managers to consider when establishing an evaluation program based on New Jersey stormwater rules or utilizing reciprocity to govern the use of MTDs locally.

### NJDEP Certification

NJDEP establishes the testing protocols and is responsible for the protocols and process document that outlines the certification process and administers the program. Those documents were developed in partnership with a stakeholder group consisting of MTD providers, stormwater professionals, NJDEP, and NJCAT. The stakeholder group continues to meet regularly to discuss new issues and plan the future of the program. NJDEP will only certify MTDs in full compliance with the protocol. Certification provides assurance that the MTD will perform as tested. A certification may stipulate conditions of an approval, such as sizing, land use, or structural components. Only MTDs holding NJDEP Certification can be specified in New Jersey. It should be noted that, in accordance with amendments to the Stormwater Management rules at N.J.A.C. 7:8, certain MTDs are considered to be green infrastructure (GI) in the State of New Jersey. GI MTDs must still be certified through the NJDEP protocol described herein.

### NJCAT Verification

While NJDEP is responsible for the testing protocols and program administration, NJCAT's role is one of implementer. NJCAT works with the manufacturer throughout the testing process. Once testing is complete, NJCAT works with independent reviewers to evaluate all of the results to ensure accuracy and protocol compliance. NJCAT also administers the public comment and conflict resolution built into the program. NJCAT will issue verification reports for MTDs eligible for NJDEP Certification and for those that have been tested against other standards not fully compliant with the NJDEP protocols.

Table 1. NJDEP and NJCAT Comparison

| | NJDEP | NJCAT |
|---|---|---|
| Establishes and administers the laboratory testing protocol to assess total suspended solids (TSS) removal in the evaluation of MTDs | ✓ | ☐ |
| Requires testing must be conducted or overseen by an independent 3rd Party | ✓ | ☐ |
| Establishes regulatory standards for the design of MTDs and their maximum allowable pollutant removal rates (50% for Hydrodynamic Sedimentation, 80% for Filtration) | ✓ | ☐ |
| Requires MTD performance testing to be conducted with the NJDEP Test Sediment Particle Size Distribution (PSD) | ✓ | ☐ |
| Prescribes a standardized unit scaling methodology to ensure consistent pollutant removal efficiencies across MTD model sizes | ✓ | ☐ |
| Evaluates and verifies MTD test data to verify that the performance claim is supported by the laboratory performance. Not all NJCAT verifications are eligible for NJDEP certifications. | ☐ | ✓ |
| Provides verification for MTDs that may not fully meet the NJDEP standards | ☐ | ✓ |

## Field Testing Protocols

Field testing is generally performed under a prescribed set of guidelines. The location, duration, and monitoring of the device during testing are regular parts of field testing. A benefit of field testing is that the performance of the MTD is based on results gathered from the field; a "real world test". Filters, in particular, are known to occlude more quickly when subjected to actual stormwater runoff versus being evaluated in a laboratory setting with silica sediments. Additionally, there is not currently any widely accepted laboratory protocol to evaluate MTDs for nutrients or metals removal. A common challenge associated with field testing includes the inability to replicate the testing conditions exactly across storm events or at different test sites. In other words, there is less control over test conditions and variables.

## Summary of Washington State TAPE Certification Program

### Background

The Washington State Department of Ecology (Ecology) administers a peer-reviewed and fee-based certification program for emerging stormwater treatment technologies that includes manufactured treatment devices (MTDs). This certification process and testing protocol is referred to as the Technology Acceptance Protocol – Ecology program (TAPE, August 2018).

### Use Level Designations

The TAPE program includes three Use Level Designations that are summarized in Table 2 below. The highest certification level is General Use Level Designation (GULD) which may be obtained via a TAPE-compliant and independent field test conducted in either the Pacific Northwest or at an approved Stormwater Technology Evaluation Facility. The University of New Hampshire Stormwater Center in Durham, New Hampshire is such an approved facility.

### TAPE Performance Goals

Ecology's stormwater manuals specify pretreatment, basic, dissolved metals, phosphorus, and oil treatment performance goals in Volume V, Chapter 3, of the Stormwater Management Manual Western Washington (Ecology 2012a) and Chapter 5, Section 1 of the Stormwater Management Manual Eastern Washington (Ecology 2018c). Ecology uses the same goals within the TAPE program. Basic treatment approval via TAPE is equivalent to Tennessee's 80% TSS standard, but it's important to be aware of the other constituent goals and water quality parameters as additional pollutant reductions are sought at the state and local level.

Pretreatment: Pretreatment generally applies to sites using infiltration or to extend performance of a downstream facility. To be approved for pretreatment, 50 percent removal of total suspended solids with an influent concentration range of 100 mg/L to 200 mg/L must be achieved. For influent concentration less than 100 mg/L the effluent goal is 50 mg/L total suspended solids. Samples with influent concentrations greater than the range may be included by artificially setting the value at the upper end of the concentration range prior to completing the pollutant removal efficiency calculations. If samples with concentrations that are greater than the influent concentration range are provided, they must include all valid samples that are greater than the range.

Oil Treatment: Oil and grease in stormwater runoff can be in the form of fuels, motor oil, and cooking oil, among others. To be approved for oil treatment through TAPE, a technology must achieve a daily average total petroleum hydrocarbon effluent concentration no greater than 10 mg/L with a maximum of 15 mg/L for discrete (grab) samples.

Basic Treatment: Basic treatment via TAPE targets TSS removal and requires 80 percent removal of TSS for an influent concentration range of 100 mg/L to 200 mg/L. For influent concentration less than 100 mg/L the effluent goal is 20 mg/L total suspended solids. Samples with influent concentrations that are greater than the range may be included by artificially setting the value at the upper end of the concentration range prior to completing the pollutant removal efficiency calculations. If samples with concentrations that are greater than the influent concentration range are provided, they must include all valid samples that are greater than the range.

Enhanced Treatment: Heavy metals are dangerous to the health of fish. Enhanced treatment goals via TAPE target dissolved metals in the form of copper and zinc. To be approved for enhanced treatment, the technology must meet the basic treatment goal of 80 percent TSS removal in addition to 30 percent removal of dissolved copper for influent concentration range of 0.005 mg/L to 0.02 mg/L and 60 percent removal of dissolved zinc for influent concentration range of 0.02 mg/L to 0.30 mg/L. Samples with influent concentrations that are greater than the range may be included by artificially setting the value at the upper end of the concentration range prior to completing the pollutant removal efficiency calculations. If samples with concentrations that are greater than the influent concentration range are provided, they must include all valid samples that are greater than the range.

Phosphorus Treatment: Phosphorus is a nutrient commonly found in stormwater. Phosphorus in stormwater can generally be divided into the fraction associated with sediment (particulate phosphorus) and the fraction dissolved in water (dissolved phosphorus). Total phosphorus is the sum of both and includes the total amount of phosphorus in both organic and inorganic forms. To be approved for phosphorus treatment via TAPE, a technology must meet the basic treatment goal of 80 percent TSS as well as 50 percent total phosphorus removal for an influent concentration range of 0.1 to 0.5 mg/L as well as achieving basic treatment. Samples with influent concentrations greater than the range may be included by artificially setting the value at the upper end of the concentration range prior to completing the pollutant removal efficiency calculations. If samples with concentrations greater than the influent concentration range are provided, they must include all valid samples that are greater than the range.

The TAPE performance goals do not address capital costs, costs for operation & maintenance (O&M), or costs for material disposal, but applicants are encouraged to provide this supplemental information in their Technical Evaluation Report. Washington Ecology also approves technologies as functionally equivalent to best management practices (BMPs) included in the State’s stormwater management manuals. Functionally equivalent technologies have not passed through the TAPE protocol.

TAPE is a Washington State protocol. Performance must be demonstrated through testing at field sites in the Pacific Northwest or at pre-approved testing sites located in other parts of the United States. The protocol is designed to evaluate flow-through best management practices (BMPs) with relatively short detention times. It may not be suitable for all stormwater treatment technologies. However, several other states, counties, and cities use TAPE certification to determine whether to allow installation of a technology within their jurisdiction.

Table 2. TAPE Use Level Designations (ULD)

| ULD | Minimum data required for ULD | Time Limit (months) | Maximum number of installations in WA State | Field testing required under ULD |
|---|---|---|---|---|
| Pilot | Laboratory | 30 | 5 | A minimum of one site indicative of or located in Pacific Northwest, all sites installed in WA must be monitored |
| Conditional | Field data required, laboratory data may supplement | 30 | 10 | A minimum of one site indicative of or located in Pacific Northwest |
| General | Field data required, laboratory data may supplement | Unlimited | Unlimited | None |

Table 3. TAPE Performance Goals for TSS

| Performance Goal | Influent Range | Treatment Criteria |
|---|---|---|
| Basic Treatment | < 100 mg/L TSS | Effluent goal ≤ 20 mg/L TSS |
| | 100-200 mg/L TSS | ≥ 80% TSS removal |
| | > 200 mg/L TSS | > 80% TSS removal |

# Conclusion

MTDs are a subtype of stormwater control measures (SCMs). Since their original introduction as a stormwater treatment tool, MTD options have evolved from simple swirl/vortex devices to include advanced screening, filtration, and biofiltration solutions. Improved innovation requires the need for additional guidance on how to evaluate the effectiveness of MTDs.The purpose of this document is to provide the MS4 community with a resource to assist local programs seeking to include MTDs in their stormwater treatment toolbox and develop sound policy around their utilization. There continues to be a growing body of performance data on MTDs becoming available. Broader acceptance of this information will strengthen stormwater programs by allowing for the robust evaluation of MTDs and enable programs to become less reliant on solutions that have not demonstrated the necessary pollutant removal performance required to be in compliance with stormwater regulations across Tennessee.

This document was developed by members of the Tennessee Stormwater Association's Manufactured Best Management Practices (BMP) Evaluation Committee. The process included collaboration among MS4 staff, private sector consultants, and MTD vendor professionals. This collaboration is instrumental to ensure the most accurate information is provided in a manner that is valuable to MS4 staff. The most commonly accepted field and lab testing protocols ~~has~~ have been compiled and summarized in this document. The information provided will give the MS4 community with a resource to assist local programs seeking to include MTDs in their stormwater treatment toolbox and develop sound policy around their utilization.

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# Appendices

## Appendix A
MTD Submittal Form and Checklist for MS4 Plan Review Staff

## Appendix B
Online Resources

# MTD Submittal Form and Checklist

| **Manufacturer Information** | |
|---|---|
| Name | |
| Address/Location | |
| Web Page | |
| Contact Name | |
| Telephone Number | |
| Fax Number | |
| Contact Email Address | |

| **MTD Information** | | | |
|---|---|---|---|
| Submittal Type | HDS ☐ | Filter ☐ | |
| Specific MTD Name and Model Number | | | |
| Required Treatment Flow Rate (CFS) | | | |
| If Inline, Peak Flow Capacity (CFS) | | | |
| Designed Site Specific Peak Flow Rate (CFS) | | | |
| Designed Site Specific Treatment Flow Rate (CFS) | | | |
| Written description of Manufacturer's Quality Control Program provided? | Yes ☐ | No ☐ | |
| Instructions on proper assembly and maintenance of the MTD provided? | Yes ☐ | No ☐ | |
| Certification that the MTD performs to the minimum performance standards under the specific conditions stated in the MTD specification? | Yes ☐ | No ☐ | |
| Detail drawing for each MTD submitted signed by registered PE? | Yes ☐ | No ☐ | |

| **Performance Evaluation Testing** | | | |
|---|---|---|---|
| Protocol Certification | NJEDP ☐ | TAPE ☐ | Other ☐ (specify below in grey) |
| Approved Treatment Rate (CFS) | | | |
| Desired Treatment Rate (CFS) | | | |
| Approved Removal Efficiency (%) | | | |
| Independent 3rd Party Testing Evaluator | | | |
| Test Facility Name | | | |
| Test ID | | | |
| Test Date | Report Date | | |
| Signature of 3rd party evaluator included on report? | Yes ☐ | No ☐ | |
| Max Flow Rate at which 80% removal efficiency is achieved | | | |
| Testing Hydraulic Loading Rate | | | |
| Particle Size Distribution (PSD) used | | | |
| Concentration of PDS (mg/L) | | | |
| Total Suspended Solids (TSS) removal efficiency (%) | | | |

## Appendix B – Online Resources

National Stormwater Testing and Evaluation for Products and Practices (STEPP)
https://wefstormwaterinstitute.org/program/stepp/

New Jersey Department of Environmental Protection (NJDEP)
https://www.njstormwater.org/treatment.html

New Jersey Corporation for Advanced Technology (NJCAT)
http://www.njcat.org/verification-process/technology-verification-database.html

Tennessee Stormwater Association
https://www.tnstormwater.org/

Washington State Technology Assessment Protocol – Ecology (TAPE)
https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Stormwater-permittee-guidance-resources/Emerging-stormwater-treatment-technologies