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The Evolution of Hydrodynamic Separators (HDSs)

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Introduction

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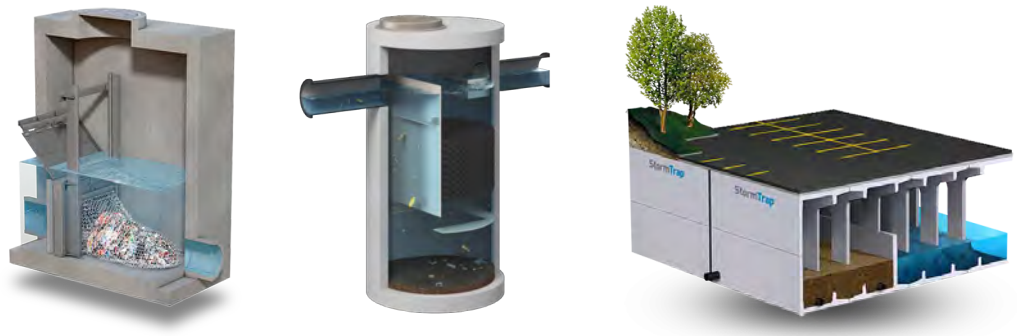
The Evolution of Hydrodynamic Separators

Manufactured Treatment Devices for Stormwater Management

- Provides water quality treatment with verified performance in compact footprints
- Various technologies commonly utilized across the country depending on the pollutant removal targets
    - Gross solids, sediments, nutrients
    - Trash capture, hydrodynamic separation (HDS), and filtration



What is HDS?

HDS has become one of the most common treatment technologies used in all regions

- Sediment removal in a small footprint with low headloss and easy maintenance

Primary treatment method is gravity settling

- Stokes Law: the smaller the particle, the slower it falls
- Slow the water and lengthen the flow path to promote settling

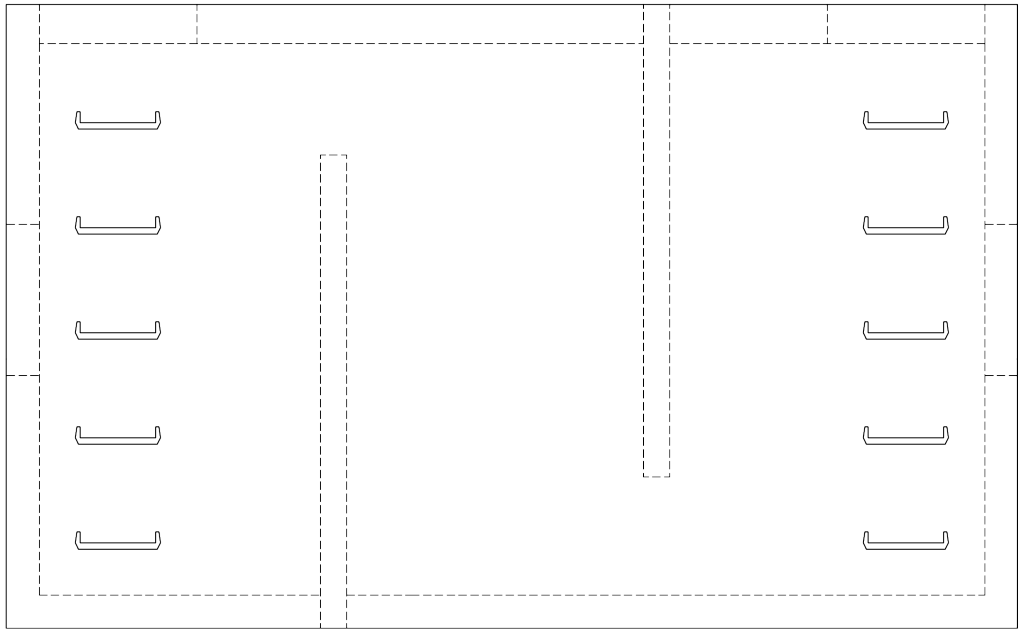
The HDS story begins with ponds…but ponds require a large footprint

- With the need for a more confined footprint, HDS was born
- Manufacturers' challenge is to provide large settling times in the smallest footprint possible

HDS – 1st Generation

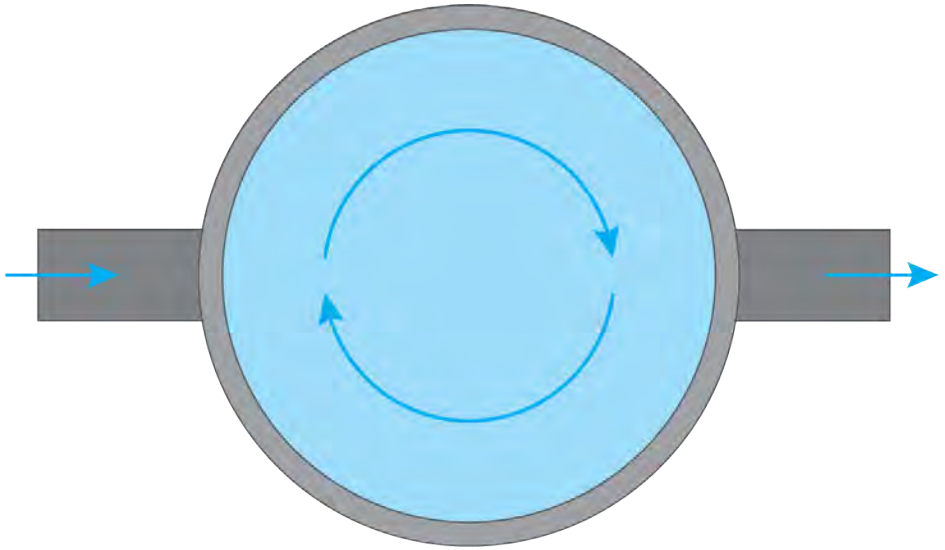
First HDS were settling vaults that used flow modifiers

- Forced flow to traverse more of the available volume
- Baffles from the floor - trap sediment
- Baffles from the ceiling - trap floatables



HDS – 2nd Generation

- Begin using more complex flow modifiers to create a swirl motion
- Allowed efficient use of round structures
  - 3ft – 12ft diameter manholes
  - Low WQ flows, more cost-effective than vault-based baffle systems
- Target particles sizes of >50 microns
- Con to “swirl” units: higher headloss



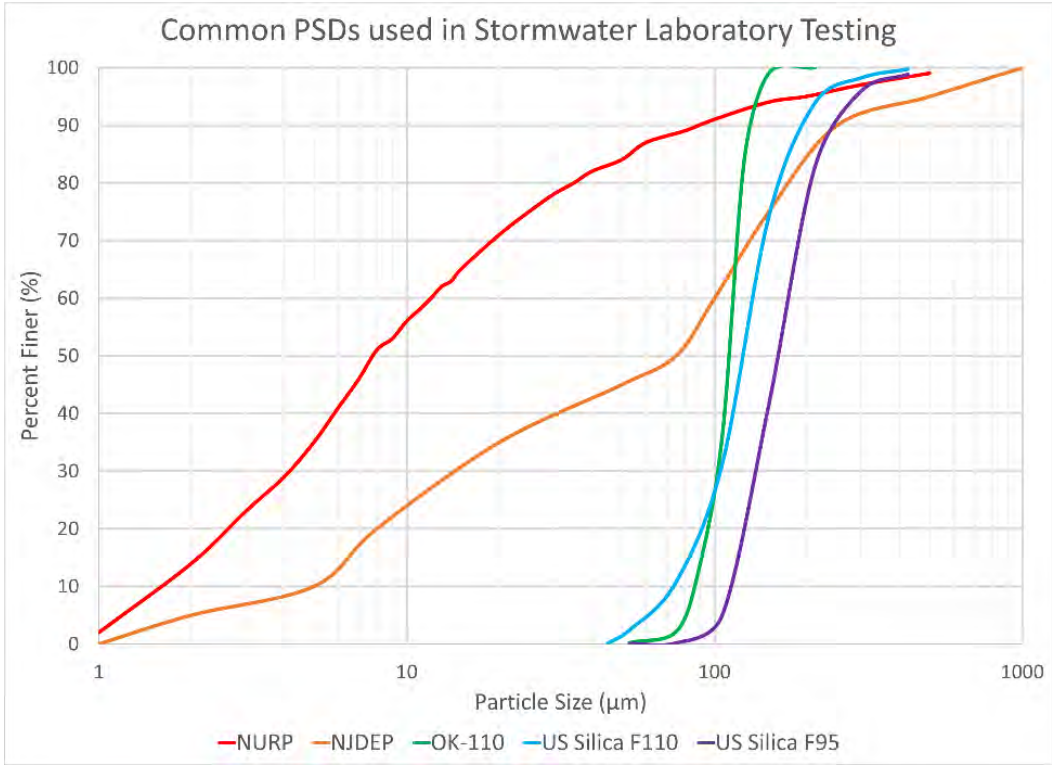
HDS – 3rd Generation

- Utilizes plate settling technology in lieu of swirl action
- Technology has been used in wastewater treatment for decades
- Reduces distance particles must fall instead of providing more time for particles to fall
    - Allows particles to be captured in a shorter time
- Pros: low headloss, reduced scour

Effectively Sizing an HDS Unit

Key factors for performance and sizing

- Performance targets
- Particle size distribution
- Pollutant concentration
- Water quality flow calculation
- Verification



The NJDEP and TAPE Testing Protocols a Primer

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NJDEP & TAPE

- The New Jersey Department of Environmental Protection (NJDEP) and Washington Department of Ecology Technology Assessment Protocol – Ecology (TAPE) are state sponsored testing programs that are regulatory requirements
    - This explains their longevity
- Both programs require **verification** and provide **certification**
- Many other jurisdictions accept one or both certifications

Understanding the NJDEP Protocols

The Purpose of the NJDEP Program

- The first New Jersey Department of Environmental Protection (NJDEP) protocols were published in 2003.
    - One for HDS, and one for filters
- This is a laboratory protocol designed to provide a common testing program that all systems would follow, so that all the technologies could be evaluated on a common basis.
    - Read the protocol once and you know how every system was tested
    - Apples to apples

Following the NJDEP Program

- Testing is done at an independent lab or at an in-house lab with an independent observer
- Verification is done by the New Jersey Corporation for Advanced Technology (NJCAT)
    - The process includes a public comment period
- Those technologies that follow the protocol, meet the requirement and get verified are then certified for sale and use in the state of NJ by NJDEP

Updates

- Understanding of the science of SCMs and some analytical techniques improved over time and the protocol was updated in January 2013
- Time marched on and the protocols were updated once again in January 2021
    - The updates to the filter protocol were very minor

Why the 2021 Change

To quote NJDEP:

- “The NJDEP laboratory testing protocols for Hydrodynamic Sedimentation MTDs (January 1, 2021) and Filtration MTDs (January 14, 2022) were both revised to strengthen the 2013 protocols and **capture lessons learned from protocol implementation.** … demonstrate compliance with the mass capture sediment testing requirement in the 2021 protocol, since it was decided that this approach yields a more accurate comparison of MTD performance.”

- http://www.njcat.org/verification-process/technology-verification-database.html

Where are the 2021 Reports?

- Due to circumstance, incl. COVID, the 2021 protocol was not put into force until January 2022
- A grace period was allowed so that more recent 2013 HDS verifications did not need to be re-done until the end of 2024
    - This largely explains why there is currently only 1 HDS (StormSettler) certified to the 2021 protocol, with one on the way
- There are 11 HDS that have not re-verified
- The filter protocol changes were small enough that re-testing was not required

Important Things to Know About NJDEP Results

- They were all obtained using a relatively fine PSD
- d_{50}= 75 µ
- 20% < 8 µ

Particle diameter (µ)	% Finer
1000	100
500	95
250	90
150	75
100	60
75	50
50	45
20	35
8	20
5	10
2	5

Important Things to Know About NJDEP HDS Results

- The NJDEP results are reported as a weighted annual removal
- The calculation involves multiplying expected flow rates by the expected probability of that flow in a year
- If you call the flows A-E the equation is:
- %R=0.25A+0.30B+0.20C+0.15D+0.10E

Flow (% MTFR)	Weight factor
25	0.25
50	0.30
75	0.20
100	0.15
125	0.10

Important Things to Know About NJDEP HDS Results

- The weighted average means that a device that reports 50.4% removal with an MTFR = 1.41 cfs does not get 50.4% removal at 1.41 cfs
    - Removal at 1.41 cfs (100% MTFR) is 34.8%, but the system is not designed to operate at that flow all the time

Details of the NJDEP Filter Protocol

- Uses the same PSD as the HDS protocol
- All tests are at one flow rate, the reported rate
    - No weighted average
- Must achieve at least 80% removal for 10 runs, then continue loading until failure
    - Failure is loss of removal or excess headloss

Understanding the TAPE Protocols

The Purpose of the TAPE Program

- Like NJDEP, TAPE has HDS and filter protocols
- Unlike NJDEP the protocols require field test results
    - The HDS protocol is rarely used or referenced
- Also, unlike NJDEP, TAPE reports on other contaminants besides PSD
    - Esp. P, Cu & Zn
- The purpose of the program is to provide realistic (for WA) results
    - No two tests are alike, but the results should be realistic
    - Apples to oranges

Following the TAPE Program

- Testing is done at an approved field site, under the observation of a third party
  - Approved sites are usually hybrids with access to real rain and sediment but lab-like set-up and instrumentation
- Verification is done by an independent Board of External Reviewers
  - No public comment period
- Companies that follow the protocol and meet the requirements are given a General Use Designation (GULD) and can be sold in the state of WA

Updates

- The TAPE protocol is currently in the process of being updated to assess the longevity of filters
    - Looking at the issue of representativeness by requiring more than one site
- Nothing official yet

Important Things to Know About TAPE

- The TAPE Program is much more complicated than NJDEP
- There are three use levels: Pilot, Conditional & General
- There are six types of treatment: Pre-, Oil, Basic, Enhanced, Phosphorous and Construction

- The equivalent of NJDEP HDS is a GULD for Pretreatment
- The equivalent of NJDEP Filter is a GULD for Basic treatment
- The most common is a GULD for Enhanced Treatment

- It is generally considered the gold standard for filters
- No direct comparison to NJDEP filter reports
- Reports are very difficult to compare to each other
    - Natural variability in field tests

Overview / Updates on the STEPP Program

Seth Brown, PE, PhD | Executive Director

National Municipal Stormwater Alliance

Agenda

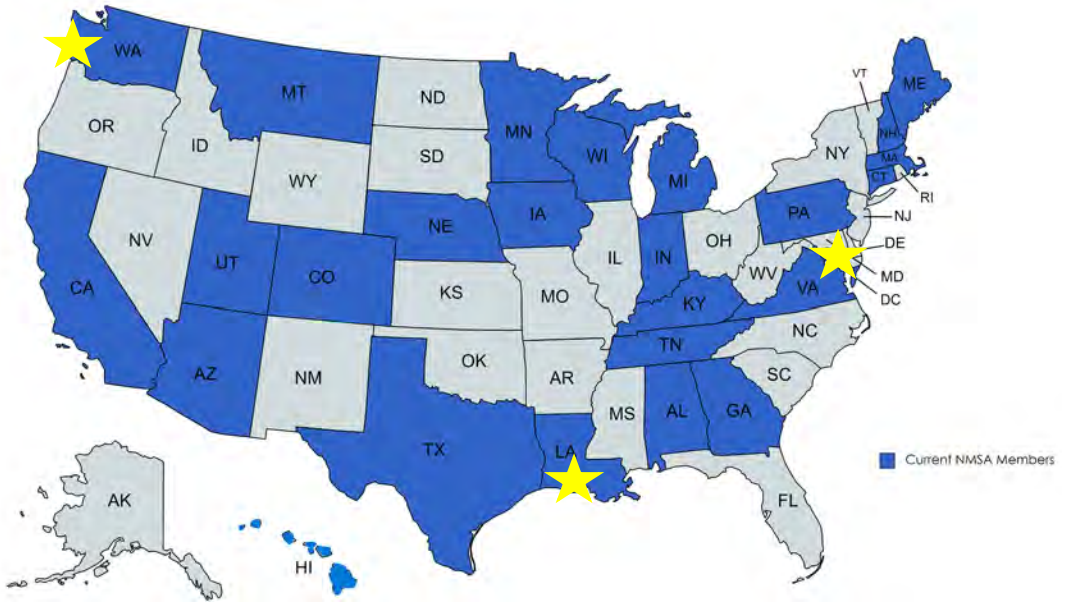
- Background on NMSA
- Background on STEPP
- What does STEPP Do and How Does it Work?
- Engagement/Outreach – Survey Results
- STEPP Updates
- Q&A

Overview of National Municipal Stormwater Alliance (NMSA)

- **Who / What is NMSA?**
  - A national coalition focusing solely on MS4s
  - Members are organizations, not individuals
- **Motivation for Formation**
  - To represent MS4 permittees at the national level by providing a **unified voice**
  - To lead changes in regulation both **proactively and reactively**
  - To **connect and unite** MS4 programs
  - To promote stormwater as a **resource**
  - To improve the **public image of stormwater**
  - To create opportunities for **multi-benefit and multi-use stormwater projects**
- **Vision for Organization**

Membership

- **State / regional groups of MS4 permittees**
- **25** state groups currently members of NMSA
  - In discussion with several more
  - Over 4,400 MS4s in network
- **3 MS4s** (Washington, DC; Baton Rouge, LA; Thurston County, WA)
- **26** Affiliate Members



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Background on STEPP

A Simple Question…

How well do stormwater products and practices work?

Problem Statement

There is no national organization that provides consistent, technical/credible and objective testing and verification of stormwater practices and products.

Stormwater Testing and Evaluation of Products and Practices (STEPP)

Goal: Develop a national testing/evaluation and verification program for stormwater products **and** practices

- Increase overall performance
- Create level/higher playing field
- Provide greater confidence in performance of stormwater systems
- Improve water quality

STEPP Center of Excellence (CoE)

The National Center for Stormwater Testing and Evaluation

- The home for the STEPP initiative within NMSA
- Promotes the development of performance testing standards and third-party verification of stormwater products and practices
- STEPP CoE Chair is Jay Holtz
- STEPP CoE Director is Seth Brown

Background

2012-2016 – Led by Water Environment Federation (WEF)

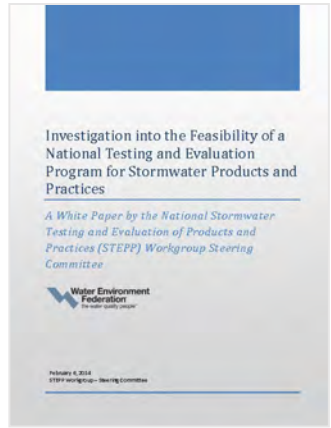
- Initial investigation
- Feasibility White Paper
- WERF STEPP framework report published (**EPA support here**)

2017-2020 – Led by WEF

- Establishment of consortium of interested groups
  - ASTM, ITRC, NJ, WA, WRF
- ASTM initiating development of lab testing standards based upon NJCAT/NJDEP lab protocols
- Initiated engagement with State of Minnesota

2021 – Led by NMSA

- Accelerating the development and ultimate launch of STEPP



Principles of STEPP

- Reduce cost and time to get to market
- Built upon Washington TAPE and NJCAT
- Focus on **verification**
- Recruitment
  - Need to get states and others on board

- Equity
  - Public domain **and** MTDs
- Café Plan Approach
  - Lab and Field options
- Continual Improvement
  - Program will evolve over time
  - Incorporate new scientific techniques & evaluation tools

What Does STEPP Do and How Does it Work?

What Does / Does Not STEPP Do?

What does STEPP do?

- Promotes the generation of testing standards for stormwater infrastructure
- Oversees testing of stormwater products and practices following testing standards
- Verifies that testing standards were followed
- Provides technical support to users to understand context of verified data

What does STEPP NOT do?

- Perform testing
- Certify products or practices

Verification vs. Certification

Verification

- Test performance of products/practices in a standard way

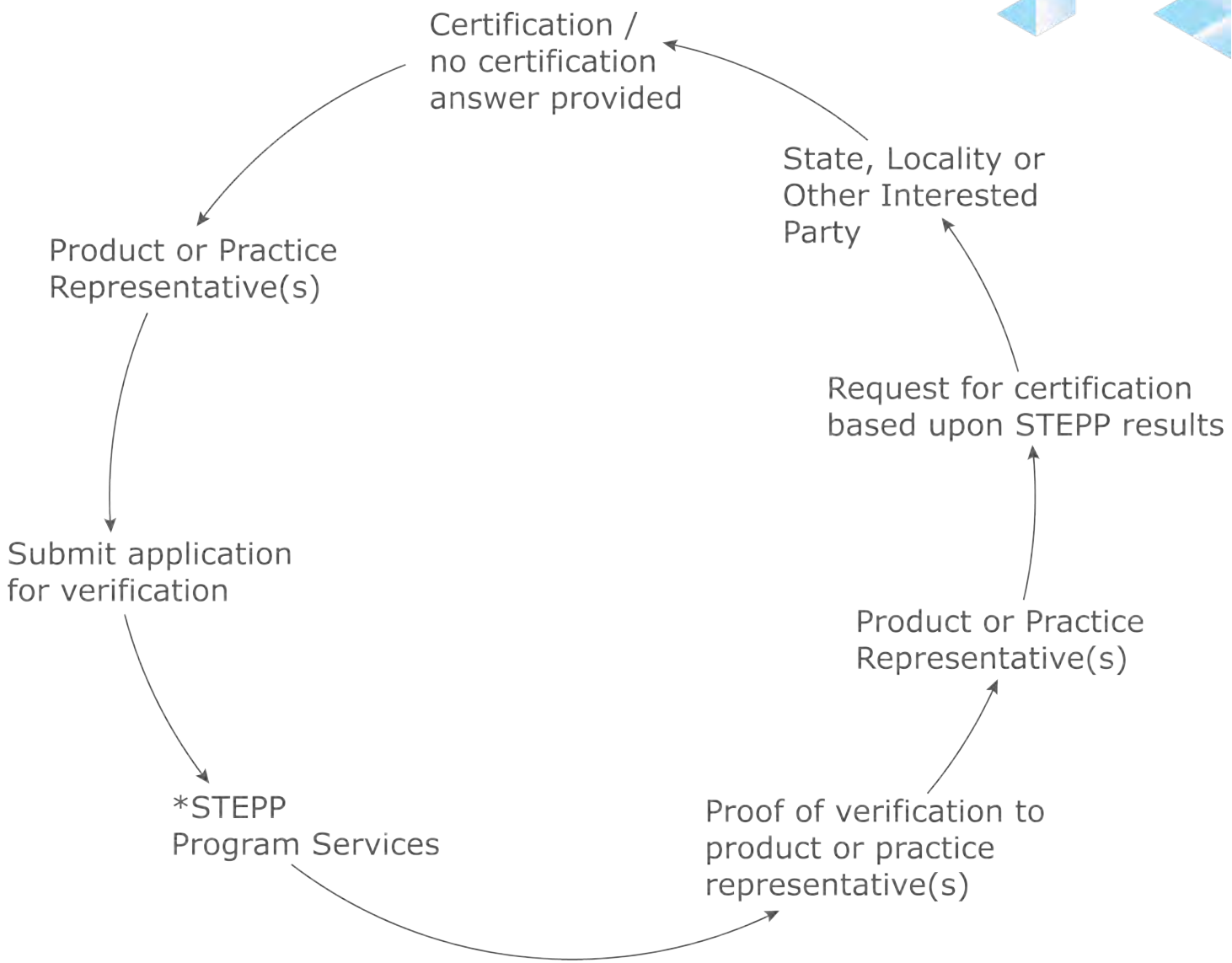
Certification

- Performance of verified products/practices meets regulatory performance standards

STEPP Process

***STEPP Program Services**

1. Reviews QAPPs
2. Identifies appropriate ASTM testing standard(s) to apply
3. Submits verification application to approved testing facility
4. Approves testing facilities
5. Reviews verification reports
6. Stores/handles testing and verification data
7. Additional services/activities



Engagement / Outreach

State / MS4 Survey on Stormwater Testing

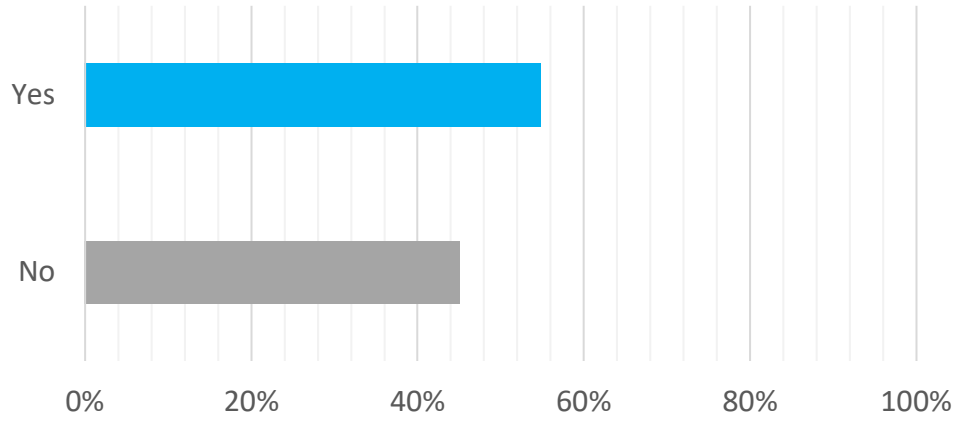
Outreach and Engagement

- **Engagement with EPA**
  - Headquarters, regional offices
- **Engagement with other key states**
  - GA, MA, CA, VA, CO, IN, and others…
- **Engagement with key municipalities**
  - Indianapolis; Capitol Watershed District; Sanitation District No. 1
- **Ongoing work with ACWA**
  - Stormwater Roundtable; Survey

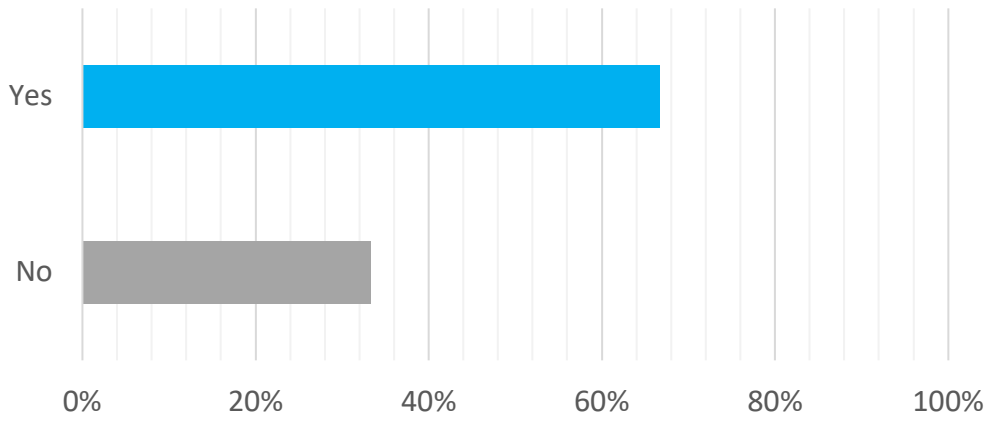
National STEPP Survey

Does your program **currently rely** on a performance-based testing and evaluation program when making decisions on approval for the use of stormwater products and practices and/or treatment crediting?*

MS4 Results



State Results

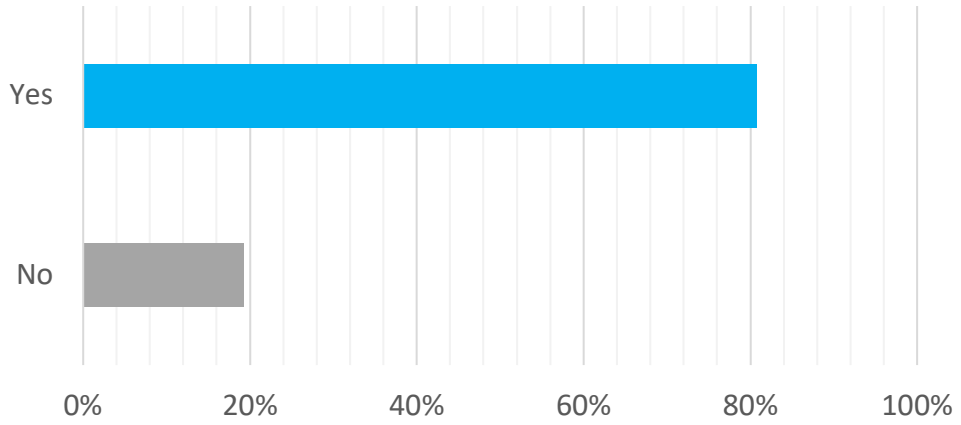


*Examples include TAPE, NJCAT/NJDEP, TARP, International Stormwater BMP Database etc.

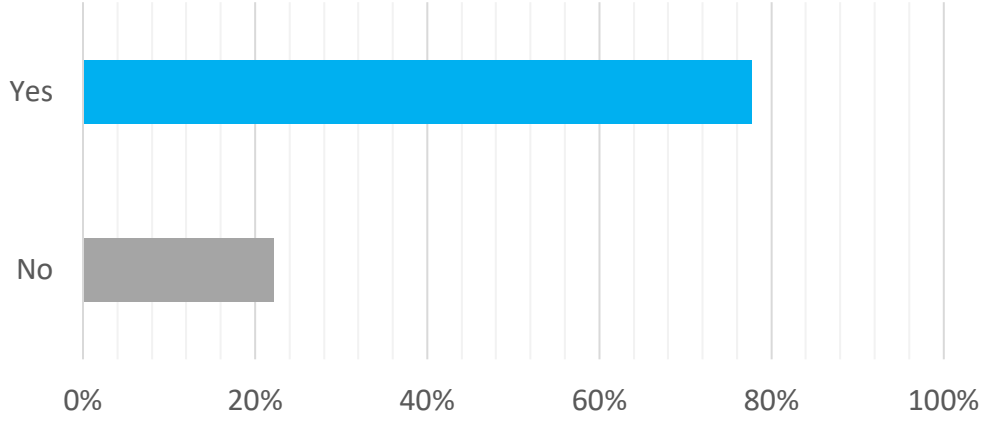
National STEPP Survey

If a **national performance testing and evaluation program** for stormwater products and practices were available, would your program defer to it?*

MS4 Results



State Results

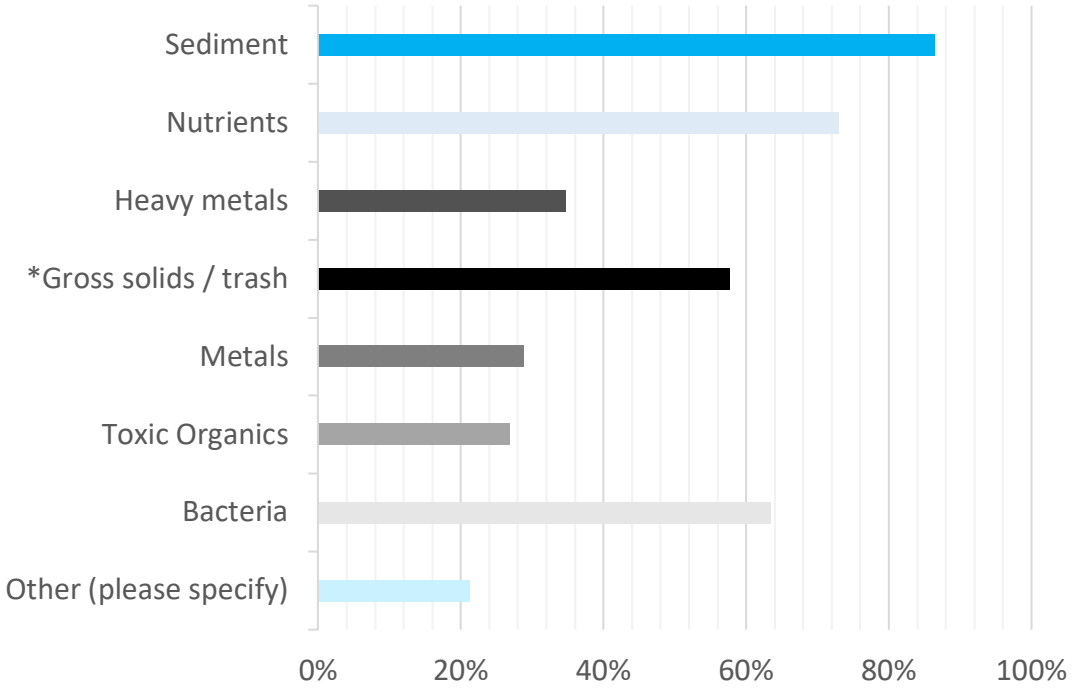


*Assuming this program utilizes similar or identical protocols used in existing state or regional programs (TAPE, NJDEP)

National STEPP Survey

What are the current stormwater related pollutants of most interest or priority in your MS4 program?

MS4 Results



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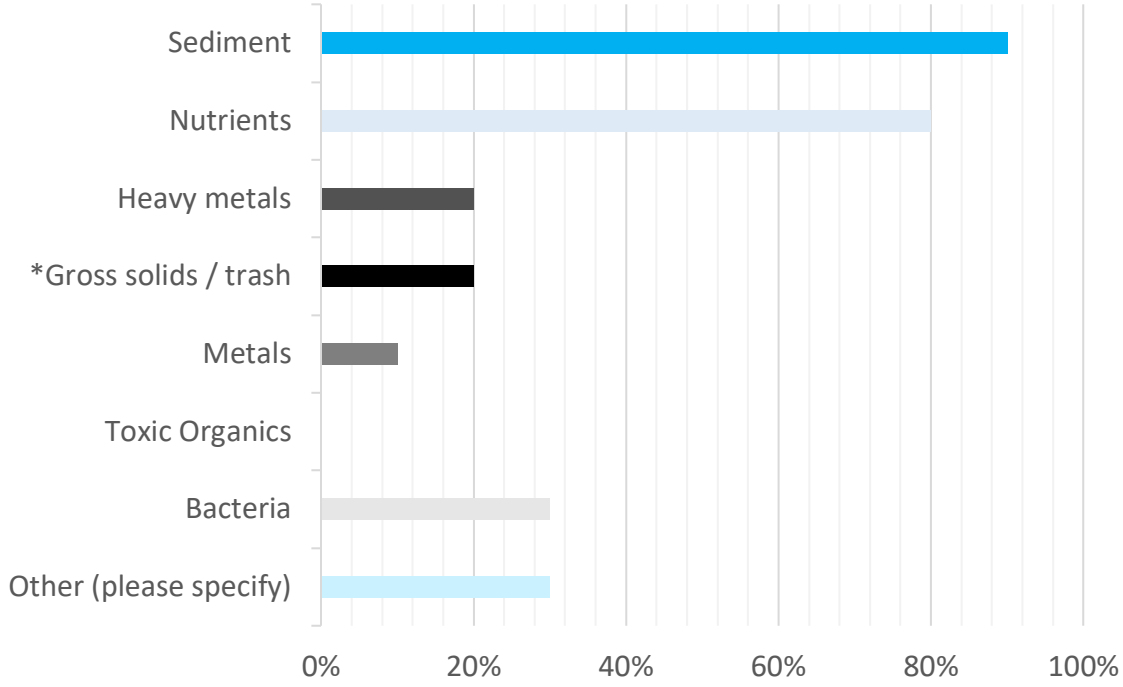


* Trash is primarily a local issue

Updates on STEPP

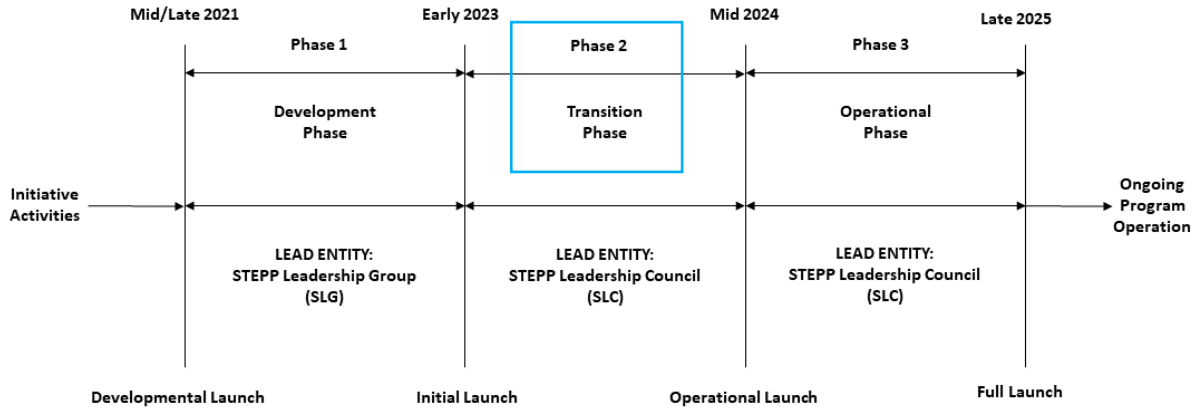
Schedule / Pathway

Multi-phase plan

Phase 1 (2021-2022) = Development Phase

Phase 2 (2023-2024) = Transition Phase

Phase 3 (2024-2025) = Operational Phase



STEPP Updates of Note

Updates

- **STEPP to focus on trash capture technologies for soft launch by Mid-2023**
  - Establishing governance bodies
  - Finalizing and establishing verification processes and documentation
- Survey illustrates high support and need for STEPP
- Continued engagement w/state, MS4s and EPA
- Congress to provide $3M/year for Centers of Excellence for Stormwater Infrastructure Technologies (CESITs)

STEPP Updates of Note

Updates

- Sediment via lab testing will be included soon after soft launch
- Continuing to develop field testing aspect of program
- Developed state and MS4 membership fee schedule
- Transitioning from Phase 1 to Phase 2
- Significant interest from several states and jurisdictions

Get Involved!

Visit our website at **nationalstormwateralliance.org**

- www.nationalstormwateralliance.org/stepp

View recording of STEPP overview at NMSA YouTube channel:

- https://www.youtube.com/watch?v=4nx80dwo2Ew&t=265s

Seth Brown, PE, PhD – NMSA, Executive Director; STEPP Center of Excellence, Director

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Questions and Answers with:

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