DEPARTMENT OF ECOLOGY
State of Washington

# Collection of Stormwater Solids Using In-Line Traps

## Standard Operating Procedure
## Version 2.1

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Washington State Department of Ecology

Standard Operating Procedure for Collection of Stormwater Solids Using In-Line Traps

Version 2.1

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*Any reference to specific equipment, manufacturer, or supplies is for descriptive purposes only and does not constitute an endorsement of a particular product or service by the author or by the Department of Ecology.*

*Although Ecology follows the SOP in most instances, there may be instances in which Ecology uses an alternative methodology, procedure, or process.*

SOP Revision History

| Revision Date | Rev number | Summary of changes | Sections | Reviser(s) |
|---|---|---|---|---|
| 7/03/2018 | 2.0 | General updates to dates, references and website throughout. Safety section update. Added 3 new stormwater suspended solids trap designs for use in this SOP. | All | Brandi Lubliner |
| 1/11/2024 | 2.1 | Recertification. Only version number and date changes | All | Brandi Lubliner |
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## 1.0 Purpose and Scope

**1.1** This document delineates the Department of Ecology's Standard Operating Procedure (SOP) for field procedures to passively collect stormwater solids, sometimes called suspended particulate matter, from stormwater runoff in storm drains using in-line solids traps. External users that reference this SOP are expected to describe or reference their own agency or jurisdiction safety protocols in their Quality Assurance Project Plan (QAPP), as this document describes Ecology protocols.

**1.2** These traps are deployed over periods of time (sometimes up to 6 months) often with regular site visits to confirm deployment and provide basic maintenance. The quantity of stormwater solids obtained depends on site conditions and the contributing drainage area. It is known to range from 50 to several hundred grams (dry weight) for laboratory analysis (Ecology, 1996).

**1.3** This SOP provides a conceptual and generic approach using medium to small devices to capture transported stormwater solids. It attempts to standardize installation and stormwater solids sample collection from in-conveyance locations, given there are a variety of trap designs available for use.

## 2.0 Applicability

**2.1** Suspended particulate matter, also called suspended solids, in stormwater runoff is transported through natural channels, ditches, culverts and engineered pipe and treatment systems. Each monitored pipe discharge system will have its own individual characteristics that require a specific configuration of equipment and installation that best enables the collection of representative samples.

**2.2** A successful location for traps features stable construction and the ability to install or anchor the trap (Ecology, 1996).

**2.3** Considerable evolution in the designs of in-line stormwater solids traps has occurred since 2009, when this SOP was first written for the bottle-type design, and continues to date. All of the stormwater solids traps described here were designed to passively capture suspended solids from flowing water (usually stormwater) for characterization and source control purposes. Ecology does use the low-profile trap in receiving water locations.

**2.4** Use of this SOP is intended to standardize collection of suspended solids for characterization and chemical analysis. How representative the collected sample is depends on the system, location and amount of time the trap is deployed. In the QAPP describe the reasons for choosing the trap design(s) for the sampling site locations. However, because all designs have inherent bias, laboratory data generated from the analysis of these stormwater solids should not be used alone to determine solids loadings.

**2.5** Likely not all devices will be used by a single study. The applicability of which trap is better suited based on the conveyance configuration and study concerns, should be detailed in the QAPP. Size of the pipe or catch basin and volume of sample needed are the primary considerations. Ecology has experience with two of the traps described; the "Norton" and the low-profile designs. Based on the literature and local permittee experience, the

installation and sample collection procedures for the two new designs should be similar. At this time, Ecology staff do not know how these will perform relative to the Norton or low-profile traps. Additional sample collection information will be needed in the QAPP.

2.5.1 Bottle-type trap: holds a sample bottle upright in a catch basin or pipe (Ecology 1996, 1996, 2012). Also called the "Norton" trap (Ecology, 2012).

2.5.2 Low-profile type trap: mounted in pipes or open conveyance (Ecology 2012) and size exclude gravels or larger. Requires flowing water to drop thru slots in the screens, reverse directions, and exit the trap. In systems with base flow, they need to be elevated to not oversample bed load or base flow material. Also called the "Hamlin" trap (Ecology, 2012). Ecology's low profile type traps (Photo 2, 3, and 4) were tested for utility in several stormwater conveyances (Lubliner, 2012) and compared to the bottle-type trap. Since, several size exclusion designs for the upper piece were developed and are shown in Photo 3 and 4. Comparison testing of the performance of the low profile design continues at the City of Seattle (2017).

2.5.3 Flow-through filtration traps: mounted in pipes and uses screens or mesh to size exclude and capture sand or finer solids (Cardno, 2016). The City of Portland developed the Screened Inline Flow-Through® ("SIFT" Photo 5 and an SOP describing its use, Portland 2013.

2.5.4 Bowl-type trap: a small rounded dome (Photo 6) with an orifice held upright in a catch basin or pipe. This is a prototype design still under development at the City of Seattle (Cardno 2016 and Seattle 2017). This device mechanically operates much like the bottle-type trap, but is smaller and may be more easily deployed in smaller pipes.

**2.6** In-situ stormwater solids traps are not intended to capture bed load material.

**2.7** These traps are designed to be mounted inside a stormwater conveyance system, such as a catch basin or stormwater pipe, where the trap can be anchored to the pipe walls or other permanent fixture.

**2.8** These traps are often located in pipe diameters of 24" in diameter or greater to prevent blockage. Small diameter pipes (<24 inches) pose additional trap design constrictions. The bowl-type trap was designed for these smaller pipes (Seattle, 2017).Large storm events are generally needed to inundate the 8" tall sample bottle-type trap (Seattle, 2008).

**2.9** Most of these traps work best where velocity flows are greater than 5 feet per second through a pipe.

**2.10** Flexibility of trap design is allowable, but may require adjusting sampling procedures described in this SOP.

## 3.0 Definitions

**3.1** **Base Flow**: Flows occurring in the drainage after 48 hours with no measurable rainfall are defined as base flows. This flow may be consistent or intermittent within a stormwater conveyance system.

**3.2** **Bed Load**: Small particles that are re-suspended during periods of elevated storm flows that produce suspended sediment load (USGS, 2003).

**3.3** **Conveyance System**: A single pipe or series of pipes that convey stormwater as part of a municipal separate storm sewer drainage system (EPA, 2008).

**3.4** **Mounting Ring**: A mechanical device used to hold sampling equipment inside a pipe which is pressed against the inside of the pipe for mounting of the sampling device.

**3.5** **Wet Season**: The wet season in Western Washington is from October 1st through April 30th (Ecology 2005 and 2007). Winter wet season in Eastern Washington is from October 1st through June 30th (Ecology 2004).

## 4.0 Personnel Qualifications/Responsibilities

**4.1** If confined space entry is required for trap installation/checking traps/sample retrieval, personnel must have OSHA 8-Hour Confined Space Entry Certification.

**4.2** Sample collection from the traps must be done by experienced field sampling personnel.

## 5.0 Equipment, Reagents, and Supplies

**5.1** Stormwater Solids Trap Hardware

5.1.1 The necessary hardware generally consist of two main components: the trap itself (often consisting of multiple parts) and the means to fasten the trap in the stormwater conveyance. The bottle-type trap also requires a narrow or wide mouth sample bottle to be deployed with the trap (Seattle, 2008).

5.1.2 Traps can be mounted directly in stormwater pipes or other areas of the conveyance system positioned on the side of the drainage pathway to avoid interference with base flow.

5.1.3 If base flow is present in the pipe, the traps should be situated just above the base flow water level to ensure storm flows will inundate the traps. The idea is to position the trap for submergence of the trap during storm flows to settle solids into the trap.

5.1.4 Brackets are mounted onto the wall of the pipe (Photo 2), maintenance hole, or other structure using metal hit anchors.

5.1.5 Extension plates can be used when the bottle type trap bracket is mounted to a vertical wall and the bracket is submerged below the water level.

5.1.6 For the bottle- or bowl-type traps, suspended stormwater solids are captured when the water levels surpass the orifice and the trap fills with stormwater. By fluid exchange particle-laden flow will replace water already in the bottle or bowl from the prior storm, and the quieter environment allows the suspended load to fill the bottle or bowl.

5.1.6.1 Ecology's bottle-type trap (Figure 1 and Photo 2) was originally designed and used by the Washington State Department of Ecology (Wilson and Norton 1996, Barnard and Wilson 1995, Norton 1997) and have since been modified by both the City of Tacoma and City of Seattle to include an adjustable brackets to maintain a vertical position and retaining to keep the bottles from floating away.

5.1.7 For the low profile trap, filtration and settling is the mechanism of trapping stormwater solids. The size of the slit (Photo 3) or mesh (Photo 4) exclude debris and water falls thru openings at the top of the device, then into the lower body of the trap away from the flow forces in the pipe, slowing the rate of flow and allowing the suspended solids to fall into the lowest portion of the trap (Ecology 2012)

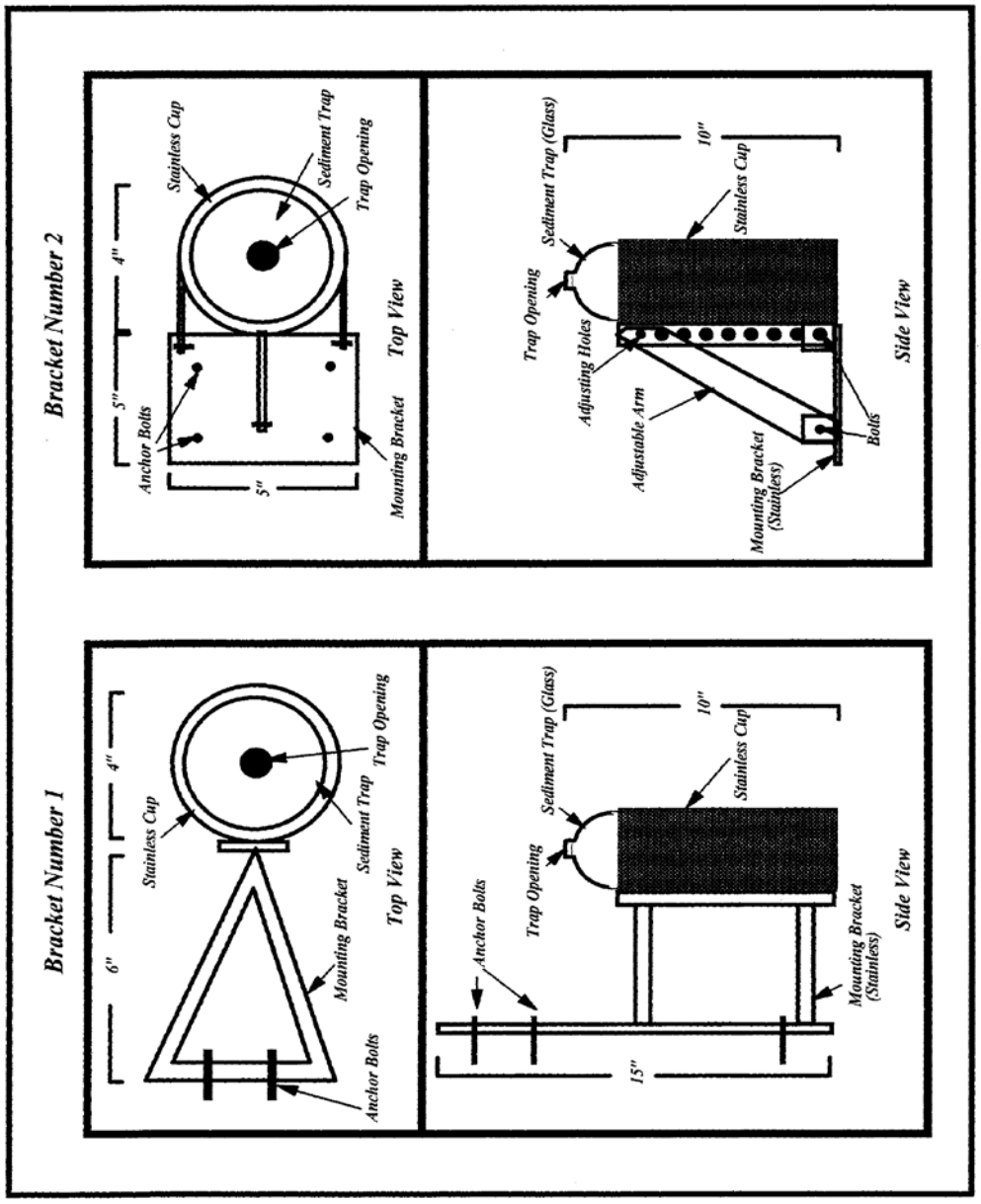


*Figure A7: Construction Details of Stormwater Sediment Trap.*

**Figure 1 - Construction Detail of Stormwater Sediment Trap (Ecology 1998)**


**Photo 1 - City of Tacoma**

**Photo 2 - Ecology**

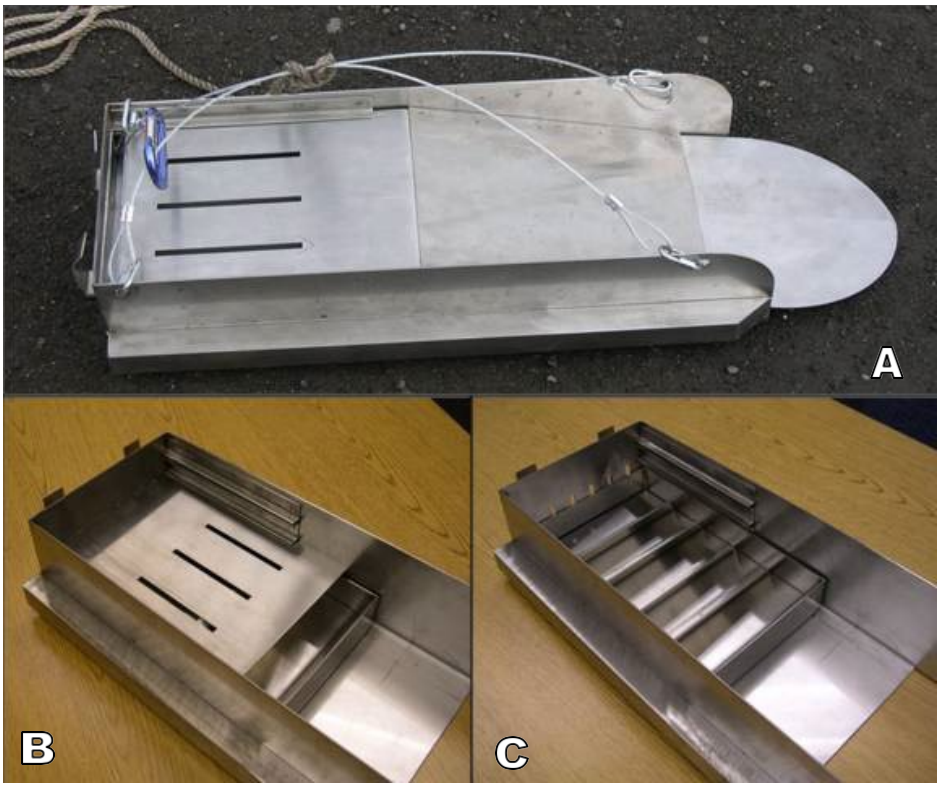


**Photo 3 - Low profile "Hamlin" trap: A) assembled trap, B) mid-level of trap, C) lower body of trap (Ecology 2012)**

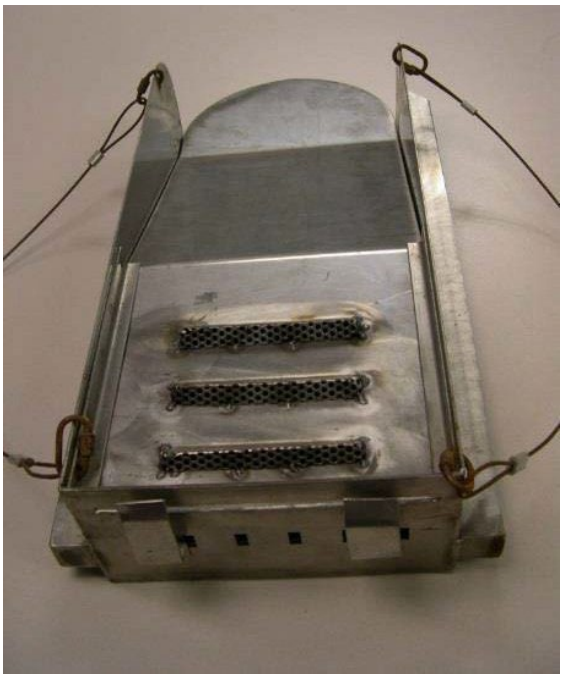

**Photo 4 - Low profile "Hamlin" trap, as modified by Seattle (Seattle 2017)**

**Photo 5 - City of Portland's SIFT® (Portland 2013)**


**Photo 6 - Bowl-type trap prototype designed by City of Seattle (Seattle 2017)**

**5.2** Supplies for installation and stormwater solids sample retrieval include but are not limited to:

5.2.1 Pre-cleaned bottles for deployment in the bottle-type traps and sample collection containers. Teflon containers are recommended, but bottle-type is dependent upon parameters to be analyzed. Glass bottles are not recommended for deployment in the bottle-type traps as they are often broken by rocks and other hard debris transported by larger flows. Sample bottles are needed only at the time of sample retrieval for the low profile solids traps.

5.2.2 Hammer drill with ¼” concrete drill bit

5.2.3 Stainless Steel metal hit anchors

5.2.4 Hammer

5.2.5 Latex gloves

5.2.6 Cooler with ice

5.2.7 Field notebook

5.2.8 Sample labels

5.2.9 Chain-of-custody forms

5.2.10 Personal Protective Equipment (PPE)

5.2.11 Camera

5.2.12 Sample jars/containers with preservatives

5.2.13 Pre-cleaned sample collection stainless steel or Teflon spoons and spatulas for scraping solids from the low profile solids traps.

5.2.14 Confined space entry equipment (if applicable)

## 6.0 Summary of Procedure

### *6.1 Trap Site Selection*

6.1.1 Install stormwater solids trap(s) in appropriate drainage pipes once the drainage area(s) has been evaluated.

6.1.2 Note observations including nearby discharges to receiving water or other pipe connections in field books.

6.1.3 Locate traps at key points throughout the entire stormwater collection system to identify sources of contaminants found in stormwater and/or stormwater outfalls representing the entire drainage area.

6.1.4 Specific monitoring locations will be based on project goals and objectives outlined in the QAPP.

6.1.5 In general avoid locations with small diameter pipes (less than 24-inches) to avoid plugging the pipe and backing up water, unless using a small version in-line trap designs.

6.1.6 Where possible, mount more than one trap at the sampling location. This typically provides more stormwater solids volume for analysis. An example mounting configuration is shown in Figure 2 below.

### *6.2 Trap Installation*

6.2.1 Personal protective equipment should be worn at all times during solids trap installation.

6.2.2 Before installing the bracket, test fit the bracket at the intended location and adjust the angle of the bracket into the most vertical position. The angle of the bracket is adjustable in order to install the solids trap in a vertical position (Figure 2, Seattle, 2008).

6.2.3 Mount the traps in the drainage system using a hammer drill equipped with a ¼" concrete drill bit to drill the pilot holes for mounting the bracket. Some municipalities allow traps to be mounted within the stormwater pipe itself (always confirm permission).

6.2.4 Drill the pilot holes through the four mounting holes located on each corner of the bracket and insert stainless steel metal hit anchors through the bracket and into the pilot holes (Seattle, 2008).

6.2.5 Drive the pin of the metal hit anchors with a hammer to secure the bracket into place (Seattle, 2008).

6.2.7 In vaults or maintenance holes with base flow or standing water, an extension plate can be used to mount the bracket below the water level. If an extension plate is used, the bracket must be mounted to the extension plate using short 1/4" diameter bolts before mounting into place (Seattle, 2008).

6.2.8 For sampling locations that are equipped with sumps, mount the trap so the mouth of the sample bottle or top of the low profile trap are just above the base flow level or static water level in order to capture solids in storm flows. For other locations, traps should be installed at the lowest point in the pipe, but not directly on the bottom of the pipe where interference could occur (Seattle, 2008).

6.2.9 In high energy conveyances consider installing a secondary "safety line" for all equipment to prevent equipment from being lost if the mounting bracket fails.

6.2.10 Tighten the trap assembly hardware. For the low profile traps in high flow systems, be sure to secure (bolt) the uppermost slide assembly part to the bottom of the pipe.

6.2.11 Using clean gloves, remove the lids from the bottles.

6.2.12 Keep bottle lids and any clean spare trap parts in aluminum foil and store in clean plastic, sealable bags for subsequent field checks and bottle or trap removal.

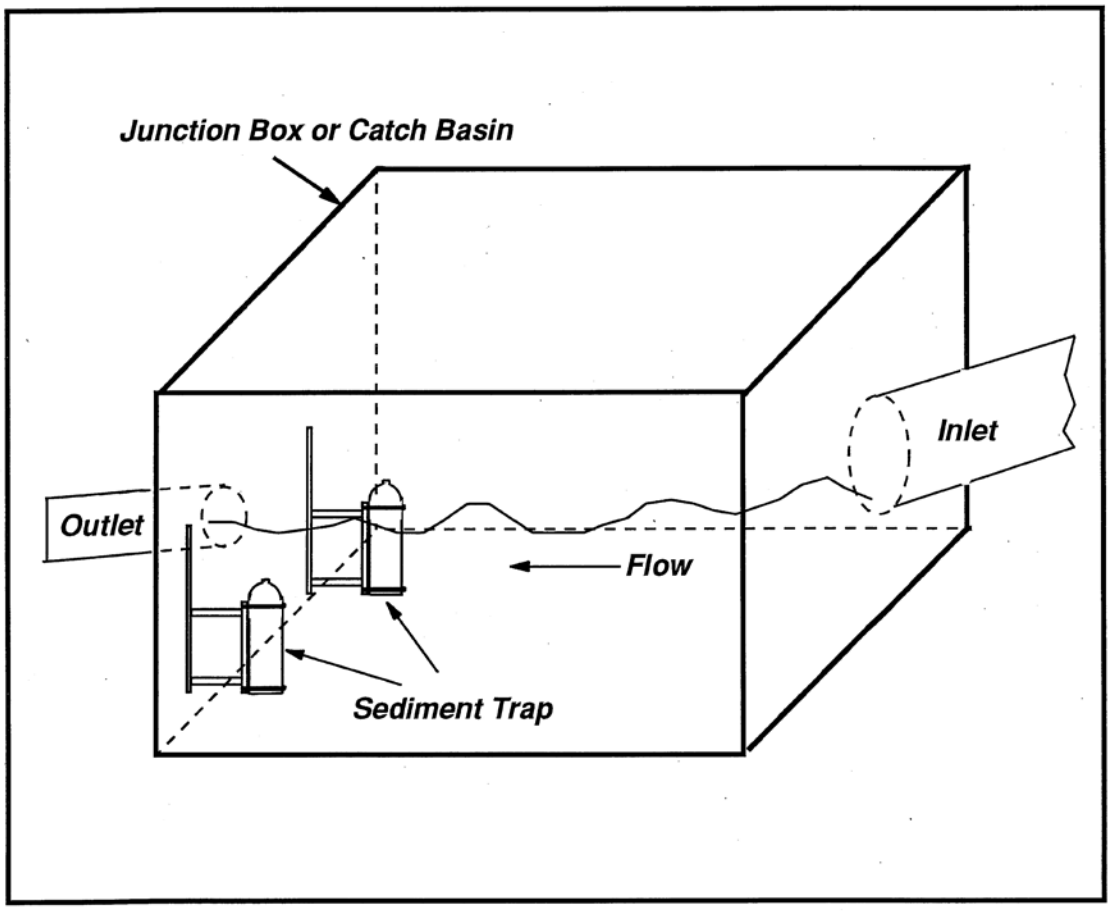


**Figure 2 - Example Mounting Configuration (Ecology 1996)**

### *6.3 Trap Checks/ Evaluation*

6.3.1 After initial installation, check traps within two weeks and then on a monthly basis to:

6.3.1.1 Determine that the trap assembly is still intact and structurally sound

6.3.1.2 That the trap is not causing a flow impediment to the collection system

6.3.1.3 Ensure that bottles are not missing, broken, or under filled/overfilled with stormwater solids.

6.3.1.4 Ensure all the uppermost part of the low profile trap is still in place and not bent or otherwise preventing sample water movement into the device.

### *6.4 Trap Retrieval/ Trap Checks*

6.4.1 Trap retrieval typically occurs before and after winter wet season

6.4.2 Check traps for solids volume accumulation and/or repair any damage that may have occurred.

6.4.3 Wear gloves prior to contact with solids trap parts, bottles and other equipment at the sampling station.

6.4.4 After accessing the traps, remove each bottle from the trap to inspect solids accumulation volume.

6.4.5 Depending on QAPP-listed parameters for analysis, a priority list of parameters should be included in your QAPP when insufficient volumes are collected.

6.4.6 If solids trap samples are retrieved, place Teflon-lined caps on the bottles or scrape the solids sample into pre-cleaned appropriate jars. Visually inspect the threads, wipe with clean, gloved hand and ensure lids are on tight. Place the samples in clean, plastic sealable bags.

6.4.7 Place samples directly on ice in a cooler for transport.

6.4.8 Samples from the bottle-type traps will likely have overlaying water and require centrifugation prior to submittal and/or laboratory analysis. Centrifuging may be performed by the laboratory or by field staff if appropriate equipment is available. Centrifuge procedures for field staff are listed in Section 6.6 below.

6.4.9 If more sample is needed replace the trap, or place a new (clean) Teflon bottle.

### *6.5 Modifications to Collect More Volume*

6.5.1 If more volume is needed and traps are re-deployed, modify the trap installation set-up by:

6.5.2 Installing more traps on the mounting ring or by inserting another mounting ring with traps secured.

6.5.3 Install debris deflectors, check the trap monthly and/or after significant rainfall to prevent debris (e.g., plastic bags) from blocking the trap.

6.5.4 Install a weir or other structure to enhance solids deposition by ensuring that the sample bottle is inundated under most storm flows.

6.5.5 Relocated traps to a new location

6.5.6 Document all sample retrieval and modification information in a field notebook.

6.5.7 If delivering samples to the laboratory, fill out the Chain-of-Custody form and deliver samples immediately.

6.5.8 Record all observations and activities on field forms and/or in field notebooks.

### *6.6 Centrifuge Sample Processing*

6.6.1 Analyses of the solids trap contents are performed on the solids fraction of the collected sample. In order to separate the liquid fraction a centrifuge is used to spin the samples and decant the overlying water. The remaining solid portion is then submitted for analysis.

6.6.2 Apparatus for centrifuge includes:

6.6.2.1 Centrifuge equipment

6.6.2.2 600 mL beakers, KIMAX 14005 or equivalent

6.6.2.3 Selected apparatus should meet a recommended Relative Centrifugal Force (RCF) rating of >5,000 g-force

6.6.2.4 Rinse water: Retain the overlying/decanted water

### *6.7 Centrifuge Processing Procedure*

6.7.1 Place the samples (Teflon bottles with solids and water mix) in a clean area for settling. Allow sample to settle for at least 12 hours or overnight prior to conducting the next step.

6.7.2 Decant off a portion of the overlying water from the sample and retain in clean 600 mL beaker from the original 1 L sample container, slurry the remaining solids using retained decant water from the sample being processed.

6.7.3 Distribute equal portions of the slurried sample into each of the two 600 mL beakers.

6.7.4 Transfer the remaining solids from the 1 liter collection bottle into the 600 mL beakers.

6.7.5 Use all of the retained decant water to rinse remaining solids from the 1 liter sample. If additional rinses are necessary, reagent grade water may be used.

6.7.6 Place the two beakers into the centrifuge making sure both beakers are of equal weight.

6.7.7 Centrifuge the beakers for 15 minutes at 2000 rpm (see recommendation in 6.16.2.3) until the overlying water contains no visible suspended solids. Decant water and discard overlying liquid fraction.

6.7.8 Transfer the solids from the bottom of the beakers and composite into a glass jar cleaned appropriately for the analysis to be performed using clean stainless steel spatulas or scoops.

6.7.9 Submit centrifuged stormwater solids to the laboratory for analysis.

## 7.0 Records Management

**7.1** Field data forms and/or field notebooks should be used during trap installation and retrieval. The following information should be recorded for each site, but is not limited to:

7.1.1 Name of samplers, weather conditions, times, and date of installation and sample retrieval

7.1.2 Number of traps installed

7.1.3 Problems with installation

7.1.4 Drainage area (acres/land use)

7.1.5 Confined space entry logs

7.1.6 Name of equipment installed

7.1.7 Sample retrieval procedures with any problems encountered

7.1.8 Flow conditions in the pipe at the time of retrieval

7.1.9 Volume retrieved from each trap

7.1.10 Needed maintenance/conducted maintenance of mounting bracket or traps

7.1.11 Field sample process procedures

7.1.12 Any field observations including but not limited to:

7.1.12.1 Potential construction activities occurring within the sampled drainage area that could result in an increase of sediment load to the stormwater conveyance system

7.1.12.2 Presence of sheen, odor, or discoloration

**7.2** Record rainfall measurements. Rainfall records should be evaluated and recorded for the days during solids trap deployment.

**7.3** Total precipitation and any flow records (if recorded) should be used to determine the quantity of particulates collected by the traps that represent the storm events that occurred during the sampling period. This information will help determine deployment time of each trap versus precipitation to estimate whether or not traps need to be deployed for a longer time period.

## 8.0 Quality Control and Quality Assurance Section

**8.1** Solids trap retrieval should be audited by experienced staff at least once a year to ensure proper collection of samples.

**8.2** Quality control samples are dependent upon QAPP project goals and objectives. Typically, one duplicate sample is collected for 10% of the sampling events; however, if only one or two samples are collected per year, more quality control samples may be needed to test quality.

**8.3** At a minimum, equipment blanks of the trap bottles should be taken at least once per year to ensure the decontamination procedures are sufficient.

## 9.0 Safety

**9.1** There are many hazards associated with stormwater solids sampling. Some of these hazards include fast moving water, deep water, and steep slopes to sampling sites and hostile dogs or people. Use extreme caution when exiting vehicles, walking along busy roads and approaching your sampling site.

**9.2** Safety is top priority for field staff and supervisors. Sample sites may be located on or near roads and bridges. Roadside hazards, weather conditions, accidents, and construction should be evaluated before departure (especially in winter). If the hazard is a permanent condition, relocation of the station may be necessary. Review periodically to assist with these safety determinations.

**9.3** Develop a site-specific safety plan based on the Environmental Assessment Program Safety Manual (Ecology, 2016) and the Chemical Hygiene Plan (Ecology, 2018b).

## 10.0 References


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