Instructions for Nalgene Bottles

1 Essential things to know about Nalgene Storm Water Sampler bottles

1.1 What are Nalgene bottles?

Nalgene Storm Water Sampler bottles (Nalgene bottles, Figure 1) are commercially produced bottles that collect a grab sample of water without the need for personnel on site. The bottles are deployed above the water level prior to a storm event, fill once water either flows over them (e.g., in the stormwater grate) or reaches the intake level when deployed into a stream or drain. They close off by means of a float valve or ball cock, preventing any further water from mixing with the sample.

The debris cassettes supplied with the bottles can be removed if there is a high chance of leaves and other suspended (organic) material clogging the inlet and preventing the collection of a water sample.

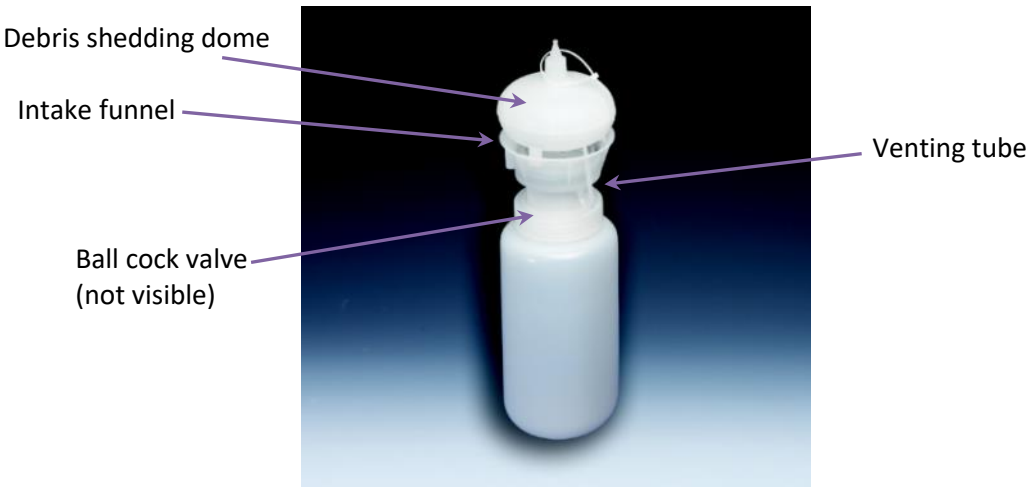

Figure 1: **Nalgene® Storm Water Sampler bottles.** Image from Thermoscientific [1].

1.2 How will a Nalgene bottle help me?

The sampler bottles collect a single 'grab' sample once the water level reaches the bottle intake level (Figure 2a). They are designed for, and best suited to, collecting a sample from the first-flush in a stormwater location because they can be deployed well before a rain event, and at multiple locations. This avoids the requirement to rush out to a site as soon as rain begins or for multiple personnel when sampling multiple sites. The bottles can also be used for collecting samples at high flows in streams, and you could deploy a series of bottles at increasing heights to collect across the rising limb of a storm event (Figure 2b).

[1] Nalgene storm water sampler with HDPE bottle. http://www.thermoscientific.com/content/tfs/en/product/nalgene-storm-water-sampler-hdpe-bottle.html?ca=stormwater

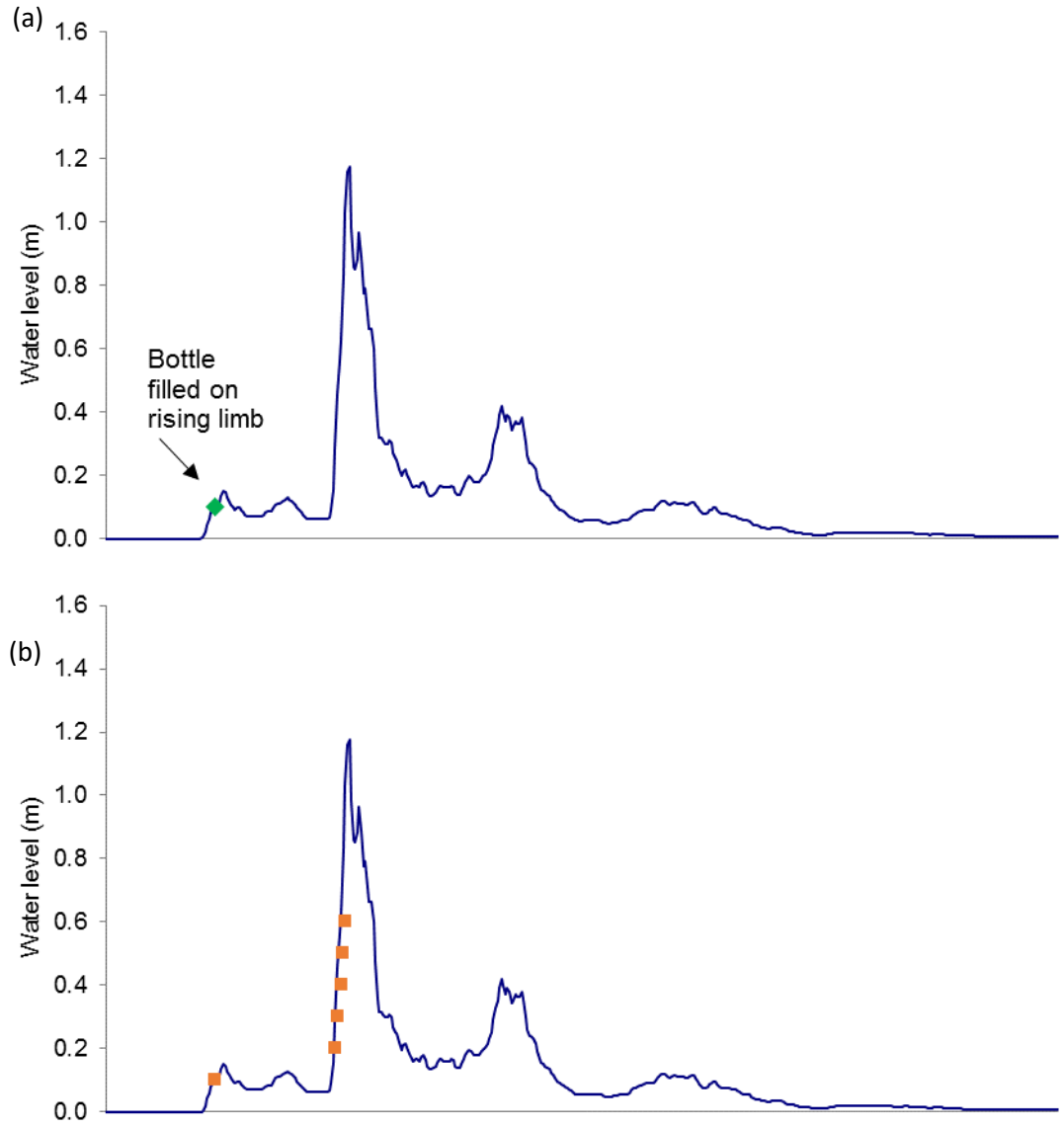

Figure 2: Stormwater hydrographs indicating timing of a) single bottle deployed at a height of 0.1 m or b) multiple bottles deployed from 0.1 m to 0.6 m.

1.3 How do you use a Nalgene bottle?

The bottles need to be deployed in the field prior to a rain storm (Figure 3). When the flow rises, they collect a grab sample and the ballcock valve closes. They then need to be retrieved and capped. The water sample retained can be shipped to a laboratory for analysis of any kind of contaminant. For organic contaminants, the plastic bottles can be replaced with glass bottles.

Figure 3: Deployment in a stream showing the deployment height.

1.4 Where can I use a Nalgene bottle?

- Streams, excluding those that have tidally-influenced flows.
- Stormwater drains.
- Stormwater pipes.
- Pumped stormwater discharges.

The bottles are not suitable for tidal locations as they could fill on an incoming tide, rather than with a storm flow.

1.5 What else do I need to know?

Some key features of these bottles:

- The bottles are 1 L so they provide sufficient water volume for several analyses, but in very clean water they may not provide enough volume for TSS or SSC as well as many other analyses.
- Glass bottles can also be purchased which would be suitable for measuring organic contaminants such as hydrocarbons (TPH or PAHs) or pesticides.
- The bottles only fill on a rising limb, so they can not sample the water quality at the end of a storm.
- Multiple bottles can be deployed at different heights to collect samples from first-flush and peak flow (highest water level).
- The bottles fill in about 3 minutes with the debris cassette in place.
- The bottles fill in less than 90 seconds with the debris cassette removed, so they represent a snapshot in time, just like manually collected grab samples.
- The intake funnel is ~250 mm above the base of the bottle, so the water depth in the stream, pipe or stormwater drain must rise to at least 250 mm to collect a sample, unless the bottle is partially buried (which can be done in a stream bed or drainage ditch).

- The grab samples collected are unpreserved water samples, so the samplers should be retrieved as quickly as possible, particularly for analysis of microbiological variables.

2 Preparatory work

The level of detail in the descriptions below vary depending on the application. For applications that are expected to be the most commonly used, these instructions provide relatively complete information regarding how and when to implement this approach. For applications that are expected to be more rarely used, the details will depend on the specific situation and only general guidance is provided.

2.1 Determine target water level

This section contains information on how to determine the water level for deployment at a stormwater site or in a stream.

2.1.1 In a stormwater deployment

In a stormwater application, the primary use of these bottles is often to sample the first-flush. The water level that is associated with the first-flush will be different in every location. However, as a rule of thumb, in a stormwater network location where there is no flow during dry weather, the target water level could be 20-100 mm. Some contaminants are associated with **peak** flow, so you could also sample at a higher water level as well.

Because the intake funnel is ~250 mm above the base of the bottle, if the bottle is on the base of a stormwater pipe, the water would need to rise to at least 250 mm to collect a sample. In smaller pipes and drains, a rise of 250 mm is unlikely to reflect the first-flush. Therefore, the bottle may need to be deployed at a stormwater pipe outlet, where it can be positioned below the invert of the pipe. In a soft-bottom stormwater drain, the bottle could be partially buried, ideally within a mounting tube to prevent soil or sediment entering the bottle during deployment. When sampling peak flows, it may be appropriate to deploy the bottle at the base of the pipe or drain.

2.1.2 In a stream deployment

There is not always a clear first-flush effect in streams, due to the (generally) larger catchment sizes. However, peak contaminant concentrations, often do occur in the early part of a storm event and on the rising limb. Peak flows can be associated with peak concentrations for other contaminants, such as suspended solids. Sampling in a stream may therefore target either (or both) of these hydrological conditions by deploying bottles at the appropriate height.

In a stream, the water level that relates to a first-flush or peak flow will depend on the size of the stream and its catchment. This section provides guidance on how to determine this water level, in cases with and without hydrological data. In the absence of hydrological data, it is difficult to assess the target water level as every stream and site will respond differently to rainfall. Furthermore, it will be impossible to confirm the point in the storm event at which a bottle filled. We *highly recommend* deploying a water level logger alongside the bottles. Note that because every site will respond differently, a water level recorder in a nearby site or stream may not provide any indication of the water levels at the monitoring site.

If there is a requirement to only sample larger storm events, e.g., > 5 mm depth over 24 hours, then the target water level will either need to be above the level reached during a small event, or the

bottles will need to be deployed immediately before the storm, to avoid filling during a small event. In this case, it would be difficult to determine the height in the absence of hydrological data.

With hydrological data

The most reliable way to determine the target water level is to examine a historical hydrograph of water level from the site of interest. This is easiest if there is a permanent water recorder station at the site of interest. If not, a low-cost water level logger (such as a Hobo U20L) could be deployed for a few events prior to the anticipated sampling events. In this case, the logger should also be retained in the stream during sampling events.

Once this data is in hand, you can examine the hydrograph of previous events and determine the water level that relates to the first 30 minutes of a storm event. This is a rough rule of thumb consistent with the rule of 30 minutes being first-flush in a stormwater location, assuming that the streams being monitored are from relatively small catchments, with considerable impervious surfaces and reticulated systems that rapidly delivers stormwater to the streams. The water level after 30 mins is likely to be slightly different for all events, so choose one that is either similar to the event you are expecting or is from a relatively small event (i.e., not a major flood).

To target the peak flow, check the water level at peak flow for storms of similar characteristics (rainfall depth and duration) to that predicted for your target storm event.

The deployment height of the bottle is therefore the target water level minus the baseflow water level at the time of deployment.

With no hydrological data

The best approach would be to visit the site during a rain event and note how quickly the water level rises from baseflow and to what level. Select a water level that is above the baseflow and is rapidly reached in even a small storm (rather than only reached at peak flows).

The second, and a much poorer option, would be to guess, and simply deploy the bottle approximately 20-100 mm above the baseflow water level. This approach does risk the bottle filling unexpectedly, for example, in the case of a small discharge to the stream from someone hosing pavements if that results in a sufficient water level rise.

2.2 Mounting Considerations

2.2.1 Mounting tube

A mounting tube for the bottles (Figure 4) can assist with deployment. This is particularly recommended if the bottle needs to be buried, for example in a dry stormwater drain.

Figure 4: Mounting tube for the sampler bottles.

2.2.2 Mounting in streams and rivers

The following factors should be considered:

Flow: Just as a grab sample should be collected from a flowing section of water, ideally a run section and never in a pool or backwater, these bottles should be deployed in a run section.

Point sources and dead zones: The deployment location should be away from the immediate influence of point sources, tributary stream and drain confluences and dead zones (e.g. backflow eddies) that will not have completely mixed in the river channel.

Water depth: The bottles should be deployed at a height that relates to your target water level (see Section 2.1.2). Except for in large streams, you probably need to place samplers in a section of the stream that is deep enough for the bottles to be partially submerged during baseflow. If the bottles are completely above the water, it will require a water level rise of 250 mm before a sample is collected. If the stream bed is soft, the bottle base could be pushed into the stream bed slightly to obtain the correct height. If the stream bed is concrete, then you could have a problem and you might want to choose a different site.

Attachment: The easiest deployment is to bang a waratah into the stream bed and either hose-clip or cable tie the bottles to the waratah. Ensure that the cable ties are threaded through a hole in the waratah so that they do not move up and down. If the waratah doesn't have many holes in it, the mounting stake that comes in the mounting kit can be attached to the waratah to provide finer scale height variation. On the bottles, it is best to use multiple cable ties, located around the neck and around the body of the bottle (Figure 5). A thin rope or cable tie should be put through the hole on top of the debris deflector dome and loosely attached to the waratah to ensure that this is not lost at high flows.

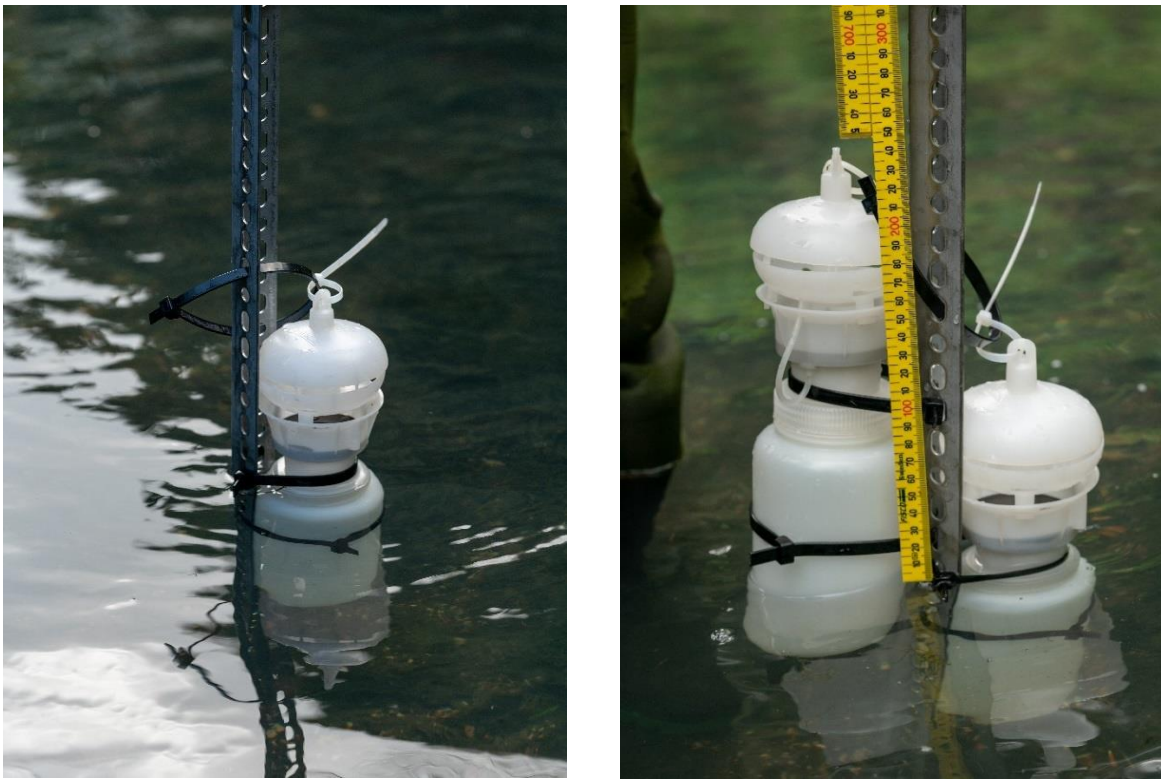

Figure 5: Stormwater sampler bottle attached to a waratah stake in a stream, deployed as individual or multiple bottles at different heights.

2.2.3 Mounting in stormwater networks

Dead zones: The deployment location should have a steady flow but not be too turbulent.

Water depth: The bottles should be deployed at a height that relates to your target water level (see Section 2.1.1). You may need to find a spot that is just downstream of the pipe outlet, rather than inside the pipe, to ensure that the bottle intake is at the desired height.

Attachment: Every stormwater deployment is likely to be slightly different and methods will need to be adapted for each. Some suggestions for attachment methods are provided here (Figure 6).

In a drain: use the mounting tube, attach to a waratah and partially bury in the bed of the drain (see video at 6:29, https://f1.media.brightcove.com/12/665001591001/665001591001_4758702678001_1159728607001.mp4?pubId=665001591001&videoId=1159728607001)

In a stormwater pipe: use a steel pipe with threaded rod inside which can be extended to brace against the top and bottom of the stormwater pipe, with the sampler bottle attached at the desired height (see Figure 6a & b).

In a stormwater grate: hang the bottle from the stormwater grate, on the upstream side of the grate to ensure that water enters the bottle (see video around 4:30, https://f1.media.brightcove.com/12/665001591001/665001591001_4758702678001_1159728607001.mp4?pubId=665001591001&videoId=1159728607001)

For a more permanent (frequently used) installation, a piece of timber with an angle bracket could be dynabolted into the concrete stormwater structure, such as the side of a culvert, and the bottles can then be attached to this at the desired height (see Figure 6d).

Figure 6: Bottles mounted (a) with an extendable threaded rod; (b) close up of the threaded rod; (c) using existing steel mesh on a stormwater outlet; and (d) to a piece of steel angle, dynabolted to the side of a stormwater outlet wingwall.

2.3 Equipment and Field Record Forms

Equipment lists are provided in Sections 3.1 and 4.1 below, specific for deployment and retrieval. The equipment required differs depending on the location of deployment, either in a stormwater pipe / drain or in a constantly-flowing stream. Check that you have all the equipment needed prior to your field trip.

A standard field form should be used to record field visit metadata, including essential information on the timing of deployment. An example form is provided in Attachment 1. This form provides a record that verifies the location and timing under which deployment was carried out, along with other factors that may influence the data being collected. This record is also essential for later reconciliation with water quality results received from the laboratory.
A photograph of the deployment site also provides a useful record.

2.4 Health and Safety

Collection of field measurements and water samples from rivers has some elements of danger that should be considered in a Health and Safety Plan, prepared in accordance with your own organisational processes. Safe access to routine monitoring sites in all weather conditions is particularly important. Special attention to safety is needed when sampling of rivers is conducted from the shore, a bridge, a boat or by wading during high, swift and/or turbid conditions. Only trained personnel shall be involved in fieldwork and suitable lone worker procedures are required if lone work is unavoidable. Appropriate personal protection equipment, such as hi-visibility clothing and floatation aids, should be provided to ensure safety. Gloves should be worn when sampling all river waters, from pristine to heavily contaminated. This is to protect samples from potential contamination and the sampler from potential harm. For further guidance on safety precautions when collecting discrete water samples refer to the NEMS Code of Practice Safe Acquisition of Field Data In and Around Fresh Water. http://www.nems.org.nz/assets/Documents/NEMS-12/Safe-Aquisition-of-Field-Data-in-and-Around-Fresh-Water-v11.pdf

When sampling for metals in summer, ensure that sunscreen being used is not a zinc-containing formula. The very high zinc content of these sunscreens has potential to easily contaminate samples.

3 Field Deployment

3.1 Equipment List

Gear list for deployment
Clean stormwater sampler bottles
Ruler to measure deployment depth
Disposable, powder-free nitrile, latex or vinyl gloves
Medium cable ties and long cable ties
Side-cutters or scissors for snipping cable ties
Field sheets and pencils

Additional equipment depending on deployment options
Waratah & waratah hammer
Mounting tube and spade
Pete's pipe, spanner and wrench (pipe wrench, vise grips or strong pliers); hose clamps
2x G-clamps
Waders (chest or thigh, depending on stream depth) and rope

3.2 Preparation and Transport

If Nalgene bottles have been washed for re-use, check that the black rubber gasket is correctly seated to ensure the bottle seals once a sample has been collected.

Nalgene bottles should be transported in a clean environment, e.g., inside large zip-lock plastic bags, or lidded bins.

3.3 Deployment

3.3.1 Stream deployment

Install the bottle(s) on a waratah placed at a suitable location in the stream, as follows.

1. Install waratah or other mounting structure in the stream, usually by hammering into stream bed. If the stream bed is concreted, look for a location to attach on the stream bank such as on a gabion basket.
2. Put on disposable gloves (powder-free), to be worn at all times when handling the bottles.
3. Using a long and thick cable tie, thread cable tie through a hole in the waratah, then around the body of the bottle until it holds loosely.
4. Adjust the height of the bottle to the desired height, using the ruler to measure from the water surface to the intake; or from the stream bed to the intake, depending on how you have calculated your desired intake water level.
5. Thread another cable tie through an appropriate waratah hole at the height around the neck of the bottle.
6. Tighten all cable ties to ensure the bottles can not move vertically or spin. Snip tails from cable ties to reduce collection of debris.
7. Add a final cable tie to the top of the debris shedding dome and loosely attach to the waratah. This is to ensure this part of the bottle is not lost during a storm event even if it pops off.
8. Thread a rope through a top hole of the waratah and fix firmly to something on the stream bank. This provides additional security of the equipment in case of a large storm.

3.3.2 Stormwater pipe deployment

Install the bottle(s) inside the stormwater pipe, as follows.

1. Using a threaded rod and pipe, with the sharp end of the pipe at the invert of the stormwater pipe, wind the threaded rod until it reaches the obvert of the stormwater pipe and tighten.
2. Attach the bottle to this pipe with hose clamps or cable ties, adjust to the correct height and tighten.

3.3.3 Stormwater pipe outlet deployment

Install the bottle(s) below the pipe outlet, using clamps if it is a perched outlet, or with waratahs.

1. Attach clamps to the bottom of the stormwater pipe or stake waratah into ground downstream of outlet.
2. Cable tie (or hose clamp) your bottle to the clamps.

3.3.4 Stormwater drain deployment

If the stormwater drain contains constant flow during dry weather, follow instructions above for stream deployment.

If the stormwater drain is dry during dry weather but flowing to only a low water depth during wet weather, you can bury the mounting tube in the drain and insert the bottles into this.

1. Calculate depth of hole: this is 290 mm minus your target water level
2. Dig a hole to depth as calculated in step 1.
3. Using a hose clip or cable tie, attach the mounting tube near the bottom of the mounting stake with the tube on the open “V” side of the stake.
4. Insert the mounting tube & stake in the hole with the tube on the upstream site and backfill, ensuring mounting kit remains vertical
5. Check height from ground level to bottom of the holes in the side – this should equal the target water level.
6. Put on disposable gloves (powder-free), label the stormwater sampler bottle with the site name and date, and insert sampler bottle into the buried mounting kit.
7. Replace upper grated end cap, making sure to snap the end cap into the engagement holes.
8. Make sure the red plug is inserted into the upper grated end cap to prevent clean rainwater entering the tube.

3.4 Records

The field sheet attached in Appendix A, or similar, should be filled in, with particular attention to the heights deployed.

4 Field Retrieval

4.1 Equipment List

Gear list for retrieval	
Zip-lock bag containing the lids for each bottle	
Chilly bin packed with frozen slicker pads	
Disposable, powder-free nitrile, latex or vinyl gloves	
Side-cutters or scissors for snipping cable ties	
Ruler to measure bottle height	
Camera	
Field sheets and pencils	
Stormwater drain application (above water during dry weather)	Stream water application (underwater during dry weather)
Small spade	Elbow length gloves
	Waders

4.2 Retrieval Steps

4.2.1 Stream retrieval

1. Put on disposable gloves with elbow length gloves on top for retrieval.
2. Wading into the stream, measure the depth from the water level to the intake funnel.
3. Use side cutters to snip cable ties attaching debris domes.
4. Hold the body of the bottle securely with one hand and use side-cutters to snip cable ties attaching bottle to the waratah.
5. Unscrew the bottle intake funnel / dome and cap with a clean lid.
6. Check label on bottle is still present and legible.
7. Remove waratah if not using again.

4.2.2 Stormwater pipe or outlet retrieval

1. Put on disposable gloves for retrieval.
2. Measure the distance from the intake funnel to the base of the stormwater pipe to check if it moved during the event.
3. Use side cutters to snip cable ties attaching debris domes.

4. Hold the body of the bottle securely with one hand and use side-cutters to snip cable ties attaching bottle.
5. Unscrew the bottle intake funnel / dome and cap with a clean lid.
6. Check label on bottle is still present and legible.
7. Remove all equipment used to attach bottle in location.

4.2.3 Stormwater drain retrieval

1. Check height of tube – measuring from bottom of intake holes to ground level.
2. Remove the grated end cap from the tube (insert a pen or screwdriver into one of the end cap engagement holes).
3. Put on disposable gloves.
4. Remove the stormwater sampler bottle from the tube.
5. Unscrew the bottle intake funnel / dome and cap with a clean lid.
6. If using site again, leave mounting tube in place, otherwise remove it.

4.3 Sample Transport and Handling

During transport to the laboratory, the bottles should be stored in an insulated container with cooling blocks.

Samples should be transferred to laboratory-supplied bottles appropriate for the contaminants of interest. The samples should be shipped to the analytical laboratory as soon as possible, with appropriate chain of custody documentation and laboratory request forms.

The Nalgene bottles can then be retained and washed for future uses.

Attachment 1: Field Sheet

Water Quality Data Sheet – Stormwater Sampler Deployment & Retrieval

Site details

Site Location Code	Description

	Deployment	Retrieval
Date		
Person recording data		
Person deploying samplers		

Sampler details

Sample codes	Location	Deployment height & reference	Time deployed	Time retrieved	Observations