

# Sampling design and preparation

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## Preparation for sampling

### 1 Purpose and scope

This document outlines all aspects of preparation for water and sediment sampling. It also outlines secure handling of samples from the point of collection to the laboratory or court.

### 2 Associated documents

*Sampling design and preparation:*

- *Permits and approvals*
- *Choosing a laboratory and analytical method, holding times and preservation*
- *Operating a basic handheld Global Positioning System unit for an investigation or compliance inspection*

*Physical and chemical assessment: Water quality sampling using in situ water quality instruments.*

### 3 Health and safety

Before following the methods contained in this document, a detailed risk management process (identification, assessment, control and review of the hazards and risks) must be undertaken. All work carried out must comply with the Queensland Work Health and Safety legislative obligations.

### 4 Permits and approvals

Permits and approvals may be required to conduct activities involving animals, plants and/or in protected areas (for example National Park/Regional Park, State Forest or State Marine Park). See *Permits and approvals* document for more information on requirements.

### 5 Skills, training and experience

When preparing for field work, ensure staff are available who have the necessary skills to undertake the methods that will be used in the sampling program. Also consider whether site specific inductions are required.

### 6 Things to consider when preparing for field work

#### 6.1 Preparation of a sampling schedule

A sampling schedule should document:

- whether permits or approvals to enter and sample land are needed
- a landholder communication plan
- review of any previous work
- a site plan which identifies specific locations where the samples are to be collected
- when the samples are to be collected

- how the samples will be collected (sampling protocols)
- types of samples to be collected (including quality control samples)
- who will be doing the sampling and skills/training required
- analysis required for the samples and what laboratory will be undertaking the analysis
- sampling containers and associated equipment needed
- preservatives and sample storage conditions needed
- how the samples will be referenced and recorded during collection
- the maximum holding time for each sample
- health and safety considerations
- chain of custody (COC) and other evidentiary requirements
- equipment cleaning/decontamination method
- transport logistics (e.g. if remote consider distance/time from sampling location to courier and laboratory etc.)
- other records or information that may need to be obtained.

## 6.2 Naming of sites and samples

Where possible, it is best to decide on names or a naming convention for the sites and samples before heading out into the field. Calling a site 'Site A' is not sufficient – the name should be unique to the site and the project. At each site, a number of samples may be collected – for example, a water sample and a sediment sample, or replicates. To avoid confusion, each sample must be given a unique name/identifier, such as PROJECT-SITE-SED for sediment (e.g. TEXAS-DAM1-SED) and PROJECT-SITE-WAT for water. A number of containers may be used to collect each 'sample'. These containers must have the same sample name recorded on each container. The number of containers per sample must be recorded. The sample identifier (Sample ID) needs to be as short as possible and individual, but also contain sufficient information to describe the sample properly (for example project name, sample location, sample type, and sample depth). Keep in mind the ID needs to be able to fit on a sample jar label or a sample bottle label. Also, for sediment samples, the depth is an important inclusion because several samples are often collected from the same location. Sample date and time, sampler, etc. must also be recorded on the sample jar and the COC. If a site is a routine monitoring site, a consistent name should be used for easy data review. For example, site names documented in an Environmental Authority (EA) should be given to the same sites sampled under an associated Receiving Environment Monitoring Program (REMP).

## 6.3 The Sample Register

If multiple people are collecting samples for an investigation, a person should be nominated as the official property officer prior to attending site. All samples should be handed to this person who takes custody of all the exhibit/samples, and must be able to prove at all times the whereabouts of these items when in their control. Where samples are taken away or delivered to a third party (for example a laboratory) this person needs to record and log the removal from their custody and hand over to another party. This can be signed for and receipted in the sample register. The sample register must contain the following information for each sample:

- The unique name / identifying number: e.g. *TEXAS-DAM1-SED01*
- Description: e.g. *Security-sealed plastic bag containing a plastic bottle with soil samples.*
- Time the sample was taken: e.g. *2.45pm*
- Where taken: e.g. GPS location and/or river bank LHS (very important that the exact location is identified)
- By whom: e.g. *Jane Smith DES*

The sample register then needs to have a declaration as to the transfer / handover of possession. For example,

“At (time) and (date) the samples attached to this register were handed into the possession of (name – position)...” or “... At (time) and (date) the following samples were handed into the possession of (name – position)”. This would usually be at the bottom of the register. This is a different document to the chain of custody (COC) document required by laboratories.

This register forms the contemporaneous notes taken at the time and will form the basis of any evidence you may later be asked to produce in court.

## 6.4 Communicating with the laboratory

### 6.4.1 Before sampling

Before undertaking sampling, a laboratory needs to be chosen to undertake the analysis of the samples. See *Choosing a laboratory and analytical method, holding times and preservation* document for more information.

It is important to contact the analytical laboratory before going into the field (if possible). Laboratories differ in what they can analyse, and their requirements (such as sample volume and preservatives). Points to discuss with the laboratory include:

- the analysis required and whether the laboratory can reach the required limits of reporting (LOR)
- the procedure for ordering sample bottles (and whether they can be individually sealed in plastic ‘tamper proof’ bags if being used in an investigation) (Figure 1)
- the delivery time for any sample containers ordered
- the laboratory’s recommended preservation requirements for the analyte of interest
- the laboratory’s maximum holding times for the analyte of interest
- the quantity of samples to be submitted
- sample submission and chain of custody (COC) documentation
- the date and time of sample submission to the laboratory
- the turnaround time of the analysis
- conditions under which re-analysis can be conducted.

When in the field, communicate with the laboratory about any changes from the original plan that may occur (particularly in relation to when the samples will arrive).

It may also be useful to inform the laboratory of:

- the sample source
- the likely range of concentrations
- the purpose for which the results are to be used, or if high concentrations are expected (e.g. if the sample is from an area affected by a chemical spill).

The benefits of providing the laboratory with as much information as possible include:

- assisting the analyst in choosing a suitable analytical method with an appropriate LOR. In some cases the LOR can be improved if the analyst knows these details beforehand
- avoiding subsequent delays because samples need to be diluted and re-analysed.



**Figure 1: Sample containers security-sealed in plastic**

## 6.4.2 After sampling

The receiving laboratory should be notified in advance that samples are to be dispatched. An acknowledgment of notification should be received back from the laboratory prior to sending the samples to them. Only in exceptional circumstances should samples be sent without prior notification. Samples delivered to the laboratory must be handed to a supervisor or appropriate responsible staff member. This person should acknowledge receipt of the samples by signing the consignment documents accompanying each sample carrier box, chain of custody documentation or other appropriate form of receipt.

The analyst must contact the sampler promptly if there are any signs of tampering or other irregularity. In such cases, the sampler and analyst should discuss and decide whether analysis should proceed or whether re-sampling is required. Record the details of this discussion.

**Note:** The analyst's report should include details of the condition of the samples on receipt. If any irregularity was discovered on receiving the samples, the analyst must also give details of this.

## 6.5 Anticipating potential court action

Samples and their method of collection may be required to be proven in a court of law at a later date. Each part of the collection process, the transportation to the laboratory and the subsequent hand over needs to be clearly explained and documented (including COC documentation). If samples are required for a court action, failure to do this may render any results inadmissible in court.

## 6.6 Sample containers, preservation, storage and holding times

### 6.6.1 Sample containers

Sample containers and preservation techniques may vary from laboratory to laboratory (in accordance with which Australian and international standard methods they are using), and so it is necessary to discuss the requirements with the laboratory prior to ordering containers. Samples should be collected into the appropriate container and stored as per the requirements of the analysing laboratory. Sample containers should have a water proof label attached with space for the sampler to fill in appropriate details.

**Note:** If investigating a pollution incident, the situation may arise where sampling is required even though the correct sample container is not available. As there is often only one opportunity to sample in this situation, do not automatically assume that it is not possible to sample. A level of cautious improvisation should be considered such as using alternative clean containers. Contact the laboratory for options.

## 6.6.2 Preservation, storage, and holding times

Before going into the field, ensure the preservation requirements and the maximum holding times for different parameters are known and can be met. Discuss holding time requirements with your analysing laboratory. The samples need to be delivered before the maximum holding times, with enough time for the laboratory to analyse the samples.

If preservatives are to be taken into the field, they should preferably be supplied in small vials sealed in plastic bags. The vials should be labelled with the following information:

- preservative type and quantity
- preservative expiry date
- batch number
- hazard warnings if necessary.

Clear labelling of all chemicals is essential and material safety data sheets (MSDS) should accompany chemicals at all times.

Some sample containers are supplied with preservatives *in situ*. This may be in the form of a small volume of liquid or crystals inside the empty container.

Samples should generally be stored refrigerated or frozen. Refrigerated samples should be kept at between 1 and 4°C (AS/NZS 5667.1:1998) for chemical samples, and at  $5 \pm 3^\circ\text{C}$  for microbial samples (AS/NZS 2031:2012). The sample should be cooled to the correct temperature range as rapidly as is reasonably practicable and kept within that temperature range until analysis commences. When transporting samples, they should be transported in a chilled or frozen state in line with storage conditions (see sections 6.7.1.1 and 6.7.1.2).

## 6.7 Transportation of samples

The transportation of samples needs to be organised in advance, to ensure samples arrive at the laboratory on time, in the condition specified by the laboratory and with the chain of custody intact. If using a commercial courier, discuss the time frames involved in the delivery, to ensure samples will arrive before the recommended maximum holding times have expired. Regularly check the status of the samples to ensure they do not get 'held up' somewhere.

When preparing for sampling, make sure any cooler boxes or refrigeration equipment have been cleaned thoroughly with appropriate cleaning equipment. For example, if a cooler box has been used for storing fish, and is then used for storing samples collected for nitrogen or phosphorus, residual odorous substances from the fish (such as ammonia) can permeate the container walls, even if the container is of high density polyethylene (HDPE).

Transportation options can include:

- personal delivery
- being sent via a commercial carrier (such as road transport or air cargo).

**Note:** Not all commercial transportation companies will ship all chemicals. Contact the courier company for details prior to sampling. Commercial carriers have shipping regulations – ensure the sample packaging and labelling meet the requirements. Samples sent by air are subject to the International Air Transport Association (IATA) Dangerous Goods Regulations (updated annually). Failure to comply with regulations can lead to prosecution of the consignor. Consult the airline company or the Civil Aviation Safety Authority (CASA) before sending samples to ensure the sample packaging (including the carrier box) and the labelling of the carrier box meet the requirements.

### 6.7.1 Packing samples

Samples need to be packed in a way that minimises the risk of breakage, leakage or spillage during transport. Some points to remember:

- Sample containers should be packed in an upright position so they do not fall over and potentially leak.

Therefore, any extra space should be packed with plastic sheets or other inert material to keep samples upright.

- If undertaking ultra-trace sampling, it may be appropriate to double bag samples to protect them from cross contamination from leakages and melted ice.
- Glass bottles and jars should be packed in bubble wrap.
- Freight should be labelled as fragile if containing glass jars/bottles, and use 'keep chilled' stickers if required.

#### **6.7.1.1 Samples requiring refrigeration**

In order to quickly cool samples when they are first taken, either place samples in a pre-chilled portable fridge, or place in a cooler box with crushed ice packed closely around the samples (use double bags if necessary). Points to remember:

- Do not place ice over the top of the sample containers as melted ice can potentially cause contamination.
- Keep the sample container lids above the level of the ice.
- If using ice to chill the samples, repack into a cooler box with frozen ice bricks once samples are cooled (approximately two hours). This prevents any risk of the samples being contaminated by melted ice.

#### **6.7.1.2 Samples requiring freezing immediately after collection**

For samples that require freezing immediately after collection, a pre-chilled portable freezer is the best option for sample storage. If this is not possible, an alternative is dry ice. Points to remember when using dry ice:

- It is available in block and pellet form. Pelletised dry ice is preferable as it can be packed in much closer contact with the samples.
- A combination of block and pellets can also be used, the pellets being placed next to the sample containers.
- Suppliers of dry ice are listed in the telephone directory or can be found via web search.

**Note:** It is hazardous to transport dry ice inside a motor vehicle with all of the windows closed.

If a freezer or dry ice is not available, samples can be frozen by surrounding them with a slurry of crushed ice mixed with common domestic salt (sodium chloride). This rapidly achieves temperatures well below 0°C.

### **6.7.2 Chain of custody (COC) documents**

Chain of custody (COC) documents record information about a sample/s including date, time, sample identification (ID), sample matrix, preservation type, and analyses required. Most importantly they provide a record who has had custody of the samples from field sampling through to the submission at the laboratory. The COC document should be signed each time a person hands the sample to another person, and should include the full name and title of the person receiving the sample. Each laboratory has their own COC documentation which should be acquired prior to sampling.

## **6.8 Security of samples**

If samples are to be used for legal proceedings, it must be demonstrated that there was minimal risk of interference with the samples between the time of sampling and the time of analysis, hence the nomination of a property officer and the use of the sample register. This requires a well-designed system for security of the samples, including precautions to make any such interference evident upon receipt by the analyst. The date and times of transfer and to whom, need to be recorded. The security of samples is particularly important if samples are to be sent using a courier company (and not a direct handover from the sampler to the analyst/laboratory). Ensure the laboratory receiving the samples is aware that the samples may be required for legal proceedings and that they are handled appropriately. The more times samples are handled the greater the risks and issues surrounding the chain of custody. Hence, there is a need to minimise handling with third parties. Make sure that any third party details are recorded in case they need to provide evidence of their handling of the samples in court e.g. name, address and contact details.

### 6.8.1 Sample seals or evidence bags

Either sample seals (Figure 2) or evidence bags can be used to secure samples. Typically seals are specially printed self-adhesive 'security' labels, designed to be affixed across the body and cap of the sample container. Each seal is made of a 'self-destruct' material so that any attempt to remove it will result in its disintegration and cannot be re-affixed in its original condition.

Include the seal/evidence bag number and the sample identification number when recording details of samples.



Figure 2: Example of security labels and seals

### 6.8.2 Locked carrier boxes

One way to hinder unauthorised access to samples is to use a system of insulated carrier boxes fitted with locks that can be opened only by:

- an appropriate staff member of the organisation with the authority to do so
- the analyst or other laboratory staff member having similar authority.

The two parts of the assembly need to be fastened by (for example) suitable rivets, rather than screws, as screws can be removed and replaced without leaving evidence of the fact. Locks should:

- be fitted in a way that ensures the lock cannot be removed without leaving evidence of tampering
- be part of the body of the carrier box, or a padlock that fastens a hasp and staple assembly permanently fitted to the body; and that they are
- case hardened to resist cutting by a hacksaw.

**Note:** If this system is used, it should be possible to testify in court that the keys were kept in secure places.

## 7 Preparation of equipment

Equipment needs to be checked to make sure it is in good working order, to avoid breakages and delays whilst in the field. All equipment that will be used for sampling needs to be cleaned and prepared before going into the field. This is to ensure there is no chance of contamination from previous sampling. Any equipment that requires calibrating must be calibrated to the manufacturer's specifications before and checked after sampling. Records of all calibrations need to be kept. See *Water quality sampling using in situ water quality instruments*.

## 8 Essential items

The following section provides some items considered essential for sampling in the field. They are also summarised in a checklist in Appendix 1.

- Basic health and safety items:
  - call in/emergency procedure

- personal protective equipment (PPE) such as life jacket, zinc free sunscreen, hat, appropriate clothing, insect repellent
- drinking water
- communication devices (such as phones, satellite phones, SPOT devices).
- Sampling schedule
- Sample register
- Contact list:
  - all field staff on the sampling trip
  - office staff who may need to be contacted
  - landholders who have given approval to enter their properties
  - analytical laboratory contact details to inform them of any change in plans or to ask questions
  - transport companies.
- Global positioning system (GPS) (see *Operating a basic handheld Global Positioning System unit for an investigation or compliance inspection* document)
- Camera and/or video camera/body cam – photos can be considered evidence, and therefore, need to be stored in a secure location. Be prepared to immediately download digital images on return to the office
- Voice recorder – a voice recorder can be useful for immediate recording of your observations if circumstances make writing on paper difficult. If you use one, you should listen to the recording and transcribe it as soon as practicable
- Maps – maps or aerial photographs showing the location where sampling is to be undertaken should be taken to site. The maps should also indicate the best route to the sampling site, if it is private property and any other potential sampling sites
- Smartphone/tablet - with maps and other applicable information
- Marking pens – only waterproof pens should be used for labelling samples (enamel paint pens are useful). When sampling waters for the presence of solvent-type compounds, extra caution should be used because marking pens contain solvents and could contaminate the sample (e.g. look for a xylene free permanent marker)
- Notebooks, field sheets, pens and pencils
- Methods for sampling
- Chain of Custody (COC) paperwork and other documentation required by the laboratory/transport company
- All equipment associated with the specific method to be used in the field
- Spare equipment – pack spare batteries, pens, markers, sampling equipment and containers where possible. This is to allow for breakages, lost equipment and extra ad hoc sampling.

## 9 References and additional reading

AS/NZS 2031:2012, *Selection of containers and preservation of water samples for microbiological analysis*.

AS/NZS 5667.1:1998, *Water Quality—Sampling—Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples*.



## Appendix 1

**Table 1: Equipment checklist**

Equipment	✓
Personal protective equipment (PPE) such as life jacket, zinc free sunscreen, hat, appropriate clothing, insect repellent	
Drinking water	
Communication devices	
Sampling schedule	
Contact list	
GPS	
Sample register	
Evidence bags, seals	
Camera/video/voice recorder	
Maps	
Marking pens	
Notebooks, field sheets, pens and pencils	
COC and other laboratory and transport paperwork	
All equipment associated with field methods (e.g. water sampling, sediment sampling) and spare equipment	