Sampling piezometers for water quality analysis

Wet Tropics Major Integrated Project
Standard Operating Procedure
WTMIP SOP 006

Version 1.0

Wet Tropics Major Integrated Project

05/07/2020

Table of Contents

WTMIP SOP 006 - Sampling piezometers for water quality analysis

1. Purpose and scope

This document provides guidance on the process of collecting water samples from a piezometer and submitting them for analysis as part of the Wet Tropics Major Integrated Project (WTMIP).

The method outlined in this document applies whenever water quality samples are collected from a piezometer using a pump and submitted to a laboratory for analysis of dissolved nutrients, pesticides and dissolved organic carbon.

2. Training, competency and responsibilities

Program staff, contract staff, landholders and external stakeholders participating in the collection of samples are provided with training in water sampling methods. Records of participant competency are maintained within the Terrain Natural Resource Management (NRM) file management system (SharePoint).

Table 1 Roles and responsibilities of WTMIP program participants

Position	Responsibilities
WTMIP Project Leader	Provide resources for the implementation and continued development of this method.
WTMIP Water Quality Project Officers (Leader/Technicians)	Ensure methods described in this method document are followed. Train new staff members in the methods. Continually review and develop the methods where appropriate.
WTMIP program staff, contract staff, landholders and external stakeholders	Follow the methods described in this document. Provide feedback to WTMIP Water Quality Project Officers for continued development of this method document.

3. Workplace health and safety

Field based work activities must adhere to Terrain NRM work health and safety (WHS) requirements. The following procedures and available equipment must be considered prior to undertaking fieldwork:

- Joint Corporate Nature, Terrain NRM, Cape York NRM and Northern Gulf Resource Management Group Health and Safety Policy and Procedures Manual.
- Terrain NRM Water Quality Monitoring Risk Assessment.
- Trip plan, including call-in schedule and emergency response procedures.
- Communication devices required for the trip (e.g. mobile phone, SPOT GPS device, EPIRB).
- First Aid Kit.
- Personal Protective Equipment, such as safety boots, pants, long sleeved shirt, hat.

4. Equipment

A list of equipment required for the manual collection of water samples is provided in **Appendix A**. The quantity of items required will be determined by the number of samples to be collected during the field trip.

Submersible bore pumps, tubing and battery power supply systems used in the WTMIP to collect water samples from piezometers are shown in **Figures 1** and **2**. If samples are being collected for pesticide analysis, then the vinyl tubing should be replaced with Teflon tubing, as per Sundaram (2009). Sample bottles for unfiltered and filtered nutrient samples and pesticide samples are shown in **Figure 3**. A syringe and filters (for when samples are 'field filtered') are shown in **Figure 4**.

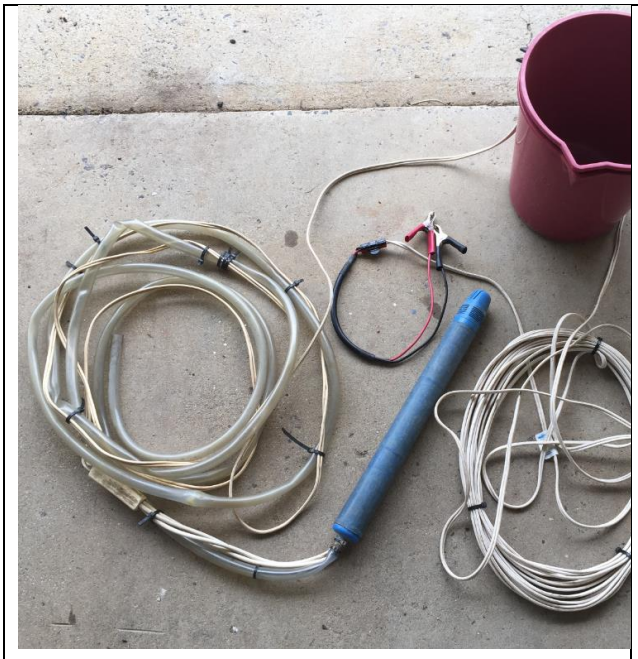

Figure 1 Proactive Environmental Twister bore pump, tubing with connection for 12V battery

Figure 2 Rule IL280P slimline submersible pump with connection to 12V battery and purging bucket

Figure 3 Bottles for collection of unfiltered and filtered nutrients and pesticide samples (left to right)

Figure 4 Syringe, filter (yellow) and pre-filter (blue)

Table 2 Bottle type, volume, processing and storage summary

	Nutrients - unfiltered	Nutrients - filtered	Pesticides	Dissolved organic carbon
Analysis type	Not analysed – sent to lab to be filtered for analysis of dissolved nutrients.	Dissolved nutrients (ammonia, nitrate, nitrite, oxidised nitrogen, dissolved organic nitrogen, total dissolved nitrogen, orthophosphate).	84 x Great Barrier Reef Catchment Loads monitoring pesticides, including the 22 x ms-PAF pesticides.	Dissolved organic carbon
Bottle material	Polyethylene	Polyethylene	Amber glass	Amber glass
Bottle volume	100 mL	50 mL	200 mL	200 mL
Minimum sample volume	40 mL	40 mL	200 mL	200 mL
Headspace required?	No	Yes	No	No
Sample storage	Chilled (1-4°C)	Chill immediately and freeze (- 20°C) within 24 h	Chilled (1-4°C)	Chilled (1-4°C)
Store sample in dark?	No	No	Yes	Yes
Maximum holding	<6 hours	24 hours chilled or 28 days frozen	7 days	7 days

5. Method

The methods outlined below are based on guidance provided in the following documents:

- The Queensland Monitoring and Sampling Manual: *Environment Protection (Water) Policy (2009)* (DES 2018).
- Geoscience Australia - Groundwater Sampling and Analysis – A Field Guide (Sundaram 2009).
- Sub-artesian water quality sampling (WMO026) (DNRM 2014).
- Standard Operating Procedure FM001 Manual Water Quality Sampling for Total Suspended Solids and Nutrients (DSITI 2017).
- Standard Operating Procedure FM006 Manual Water Quality Sampling for Pesticides (DSITI 2017).

5.1 Pre-field trip preparation

1. Check that pump is in good working order and batteries are charged.
2. Place ice-bricks into esky (a sufficient number to rapidly chill samples).
3. Ensure you have the correct pre-ordered CRC Laboratory bottle sets for piezometer sampling, including a set for preparing quality control samples, if scheduled for this sampling occasion (see Section 7)
4. If collecting into unlabelled intermediate bottles (i.e. if 'field' filtering), label the bottles with site name, piezometer identification code and date.
5. Check that you have a sufficient quantity of gloves, in the appropriate size, and they are clean and sealed in a Ziplock bag.
6. Load car with the equipment listed in Appendix A.

5.2 Site order for piezometer purging and sampling

The order in which the piezometers are sampled is important to avoid contamination (i.e. start with the piezometers that are expected to have lower analyte concentrations than following piezometers), and to

minimise sampling time. The recommended sequence for sampling the WTMIP piezometers is presented in Table 3.

Table 3 Sequence for sampling WTMIP piezometers

Piezometer group	Tully Paddocks	Johnstone Paddocks	Moresby Bioreactor
Sampling sequence	Site number, Piezometer number		
1	T1, P1	J5, P1	P5
2	T1, P2	J5, P2	P8
3	T1, P4	J2, P1	P11
4	T1, P3	J2, P2	P4
5	T2, P2	J4, P1	P7
6	T2, P1	J4, P2	P10
7	T2, P3	J3, P1	P3
8	T2, P4	J3, P2	P6
9	n/a	n/a	P9

5.3 Purging piezometers

1. Drive car as close as possible to the piezometers, mindful of maintaining access for, and visibility to, other farm vehicles.
2. Remove plough offset disc cover from the top of the piezometer (if there is one present).
3. Remove piezometer cap.
4. Determine the water height in the piezometer by using a plopper/whistler to measure the distance from the top of the piezometer to the water surface. Record this distance and subtract it from the known piezometer depth[1] to calculate the height of the water column.
5. Rinse the plopper and tape measure with clean tap water and place into a storage container.
6. Calculate the volume of the piezometer using the following formula:

$$V = \pi \times r^2 \times H \times 1000$$

Where:
V = volume (litres)
$\pi = 3.14$ (constant)
r = radius of the piezometer (in metres; i.e. half the internal diameter of the bore)
H = water level in the piezometer (in metres; i.e. overall piezometer depth, minus the distance between the top of the piezometer and the water surface).

7. Record the volume.
8. Insert the pump into the piezometer until it reaches the bottom.
9. Attach cable clamps on the electrical cord to the battery (positive first, then negative) to start the pump.
10. Purge the piezometer by pumping water into the graduated bucket, either until three times the piezometer volume has been extracted or the piezometer is pumped dry.
11. Record the volume extracted during purging[2].
12. Once purged, remove the clamps from the battery (negative first, then positive).

[1] The overall depth of each piezometer can be obtained from the installation report provided by DNRME. Note that the base of monitoring bores can silt up over time. Dr. Alex Cheesman (Research Fellow, James Cook University) advised that the depth of the bores should be checked annually to account for changes in depth. Glynis Orr (Principal Scientist, DNRME) advised to also check after flood events or if the casing appears damaged.

[2] If you record the water height on the lab Chain of Custody form you will have a permanent record of this information stored in the database alongside the water quality results.

13. Remove the pump from the piezometer and submerge in a tub of clean tap water. Pump continuously for several minutes to ensure the pump and plastic hose are rinsed thoroughly.
14. Once the pump and hosing has been rinsed, roll up the hose and electrical cords and place in the storage container.
15. Empty the bucket and return it to the vehicle, along with the pump and battery.
16. Place the cap back on the piezometer and cover with the plough offset disc (if present).
17. Drive to next piezometer and repeat.

5.4 Preparation for sample collection (at site)

It is preferred that piezometer sampling is undertaken by two field staff so that one person can be the designated bottle handler (or 'clean hands') and the other manages the pump and battery and records sampling information (i.e. 'dirty hands'). Should only one staff member be available for piezometer sampling, extreme care must be taken to maintain clean gloves during the sampling process. This may involve changing gloves multiple times during the process after touching the pump or the purging bucket.

1. Drive car as close as possible to the piezometers, mindful of maintaining access for, and visibility to, other farm vehicles.
2. Remove plough offset disc cover from the top of the piezometer (if present).
3. Remove piezometer cap.
4. Check that the piezometer has refilled sufficiently post-purge for a sample to be taken.
5. Prepare the work area to ensure it is free of contaminants and the contents of the sampling kit are easily accessible (this may involve working out of a large Ziplock bag, to avoid contact between the sampling equipment and the ground).
6. The designated bottle handler puts on non-powdered gloves by carefully removing one at a time from the box contained in a Ziplock bag. Take care to hold the glove at the wrist-end to avoid touching the fingers or palm of the glove with bare hands. The gloves are to be worn during all stages of sample collection. Should a glove become contaminated by accidently touching an unclean surface, then change gloves or put a clean glove over the top of the contaminated glove.
7. Remove the pre-labelled sample bottle from the sampling kit that corresponds with the name of the site. The second field staff member is to check that the correct bottle has been selected. If undertaking 'field' filtering, the sample will be collected into an intermediate container that was hand-labelled in the office prior to undertaking fieldwork.
8. Visually inspect the bottle for damage and to ensure the lid was on tight during storage. Replace any damaged/unsealed bottles with a spare unlabelled bottle, ensuring that sample details are recorded on the new bottle in felt-tip permanent marker pen.
9. Estimate the water height in the piezometer by looking into the piezometer and estimate the volume available for sampling. This could be done more accurately using the plopper and the formula presented in Section 5.3 but is not considered critical as a volume estimate is adequate to undertake Step 4 in Section 5.5 below.

5.5 Collecting water samples

1. The un-gloved staff member lowers the pump into the piezometer so that it is not in contact with the bottom of the well.
2. Attach cable clamps to the battery terminals and begin purging the piezometer into the graduated bucket.
3. Gloved sampler rinses the sample bottle twice with approximately 50 mL of purge water, replacing the cap each time and shaking the bottle so all surfaces are rinsed.
4. The sample bottle can be filled once half the piezometer volume has been purged. Replace the cap and screw on tightly.
5. Should an opened sample bottle or cap be dropped during sampling, discard the bottle and repeat the process using a spare, hand-labelled bottle.
6. Disconnect the cable clamps from the battery.
7. Place the sample bottle into the esky containing ice bricks.
8. Remove gloves and place in the rubbish bag.

9. Enter the sampler's names and the date and time of sample collection onto the Chain of Custody (CoC) form.
10. Remove the pump from the piezometer and submerge in a tub of clean tap water. Pump continuously for several minutes to ensure the pump and plastic hose are rinsed thoroughly.
11. Once the pump and hosing has been rinsed, roll up the hose and electrical cords and place in the storage container.
12. Empty the bucket and return it to the vehicle, along with the pump and battery.
13. Place the cap back on the piezometer and cover with the plough offset disc.
14. Drive to the next piezometer and repeat.

5.6 Filtering into the dissolved nutrients bottle (if 'field' filtering)

Samples must be filtered on a clean work surface in the field or on return to the office. If it has been pre-arranged for Cairns Regional Council (CRC) Water Laboratory to undertake the sample filtration, then samples must be immediately transported to the laboratory for same day filtration (See Section 5.8 below).

The process to fill the dissolved nutrients bottle requires that water be decanted from the total nutrients bottle into a syringe, which is subsequently filtered into the dissolved nutrients bottle. In undertaking this process, both the total nutrients bottle and the syringe are considered intermediate containers and controls must be in place to mitigate the additional risks of sample contamination. The following process should be followed to prepare all water samples for analysis of filtered nutrients.

1. Prepare the work area to ensure it is free from contaminants. Remove sample bottles, syringe and filters from the ziplock bag and place on the work area, leaving all items sealed until required.
2. Cross check bottle labels on the unfiltered nutrients bottles (containing sample) with the filtered nutrients bottles (empty) and place each pair of bottles (for each site) together to avoid filtering into the incorrect container.
3. Put on non-powdered gloves by carefully removing one at a time from the box contained in a ziplock bag. Take care to hold the glove at the wrist-end to avoid touching the fingers or palm of the glove with bare hands. Replace gloves at any stage should a glove become contaminated by accidently touching an unclean surface.
4. Unwrap the syringe and attach the 0.8 μm pre-filter, followed by the 0.45 μm filter, taking care to not touch the filter/syringe tips or connection points.
5. Remove the plunger from the syringe, avoiding touching the internal surfaces of the barrel or the plunger.
6. Shake the total nutrients bottle thoroughly to resuspend solids and fill the syringe with at least 40 mL of sample water. Replace the plunger.
7. Push approximately 2 mL of sample water through the filters as a filter rinse and discard.
8. Remove the lid from the dissolved nutrients bottle and filter approximately 5 mL of sample into the bottle.
9. Replace the lid and shake vigorously ensuring all surfaces of the dissolved nutrients bottle and lids come into contact with the water and discard the waste water.
10. Repeat steps 7 and 8 to rinse the dissolved nutrients bottle twice.
11. Filter the remaining sample into the dissolved nutrients bottle. If filtering becomes difficult, change the filter and pre-filter, making sure each set of filters are rinsed with 2 mL of sample water before continuing to filter the sample.
12. Replace the lid, ensuring a good seal and freeze the sample immediately.

During filtering it is important that staff be patient as the process may be difficult if the samples contain a high concentration of suspended solids. Change the filters as frequently as necessary to ensure the minimum required filtered sample volume is obtained.

5.7 Sample preservation

When in the field all samples should be immediately placed in an esky containing sufficient ice bricks to rapidly cool all samples to below 4°C and the esky put in a cool place. Portable refrigeration/freezer units may be used where available, however, samples for pesticide analysis must not be frozen at any stage.

On returning to the office dissolved nutrients bottles must be frozen (-20°C) and remain frozen during transport to the laboratory. Unfiltered nutrients bottles should be immediately transported to the laboratory on ice bricks for filtration (see Section 5.8 below) Pesticides bottles must remain chilled below 4°C in a designated sample refrigerator. For further information refer to Table 2.

5.8 Sample transport

When sending samples to the laboratory, it is important to ensure an adequate number of ice bricks are placed in eskies with the samples. It is advised that chilled pesticide and/or unfiltered nutrient samples be transported in a separate esky to frozen dissolved nutrients bottles as this allows greater control over the preservation conditions. A higher ratio of ice bricks may be placed in eskies containing the frozen samples to prevent them from thawing.

To minimise contamination through leakage and sample bottles breaking, eskies should be clean, bottle lids must be on tight, glass bottles (if collecting pesticide samples) should be wrapped in padded sleeves and bottles should be packed upright. Bagged ice should only be used over ice bricks as an absolute last resort due to contamination risk from melt waters. Stocks of ice bricks are maintained in the designated sample refrigerators in the Tully, Innisfail and Cairns Terrain offices.

Unfiltered nutrients bottles should be immediately transported to the laboratory for filtration. Laboratory filtration must have been pre-arranged with CRC Laboratory due to the time critical nature of the task. Samples must be delivered to the laboratory by 3 pm the day of collection to allow filtration to be undertaken the same day.

Given the proximity of CRC Laboratory to the Cairns Terrain office, and the number of WTMIP staff travelling between Innisfail/Tully and Cairns each week, it is often practical for a WTMIP staff member to deliver the samples to the laboratory in person. A courier can be used in cases when no WTMIP staff are available. Delivery by WTMIP staff is preferred over a courier to avoid the reliance on a third party and the risk that eskies may be left in a hot environment for an unacceptable period of time.

Each batch of samples shipped to the laboratory should contain the relinquishment form issued with each set of bottles prepared by CRC Laboratory. When packing samples, the CRC Laboratory project number (i.e. the 09XXXX number) on the sample bottles should be cross checked with that on the relinquishment forms accompanying the samples and on the CoC form emailed to the laboratory ahead of the sample delivery (see Section 7).

6. Quality control samples

Quality control sampling for the WTMIP follows guidance contained in the Queensland Monitoring and Sampling Manual: *Environment Protection (Water) Policy (2009)* (DES 2018). The quality control samples required for this program, and the frequency of their collection, are outlined in Table 4.

The transport blank must be prepared by a NATA accredited laboratory. The reverse osmosis water used to rinse the pump and the laboratory–grade ultrapure water ('Milli-Q' water) used to prepare the field blank should also be obtained from a NATA accredited laboratory. It is the responsibility of the samplers to ensure they have an adequate supply of quality control samples.

Authorisation must be received from WTMIP Water Quality Project Officers for any change to the frequency outlined below. Work groups are encouraged to discuss implementation of quality control sampling prior to commencement of each wet season in order to evaluate the risks of sample contamination.

Table 4 Frequency of quality control sample collection

Quality control sample	Frequency of collection
Field blank	One every fourth sampling occasion, collecting at least four over the course of a year per basin, with each sampler collecting at least two.

Transport blank	One every fourth sampling occasion, collecting at least four over the course of a year.
Field spike	None. Four per year will be submitted as part of Local Scale Monitoring sampling, which uses the same sample transport regime.
Duplicate and replicate	One every fourth sampling occasion, collecting at least four over the course of a year.

7. Sample documentation

All water quality samples must be accompanied by supporting documentation. Laboratory services for WTMIP water quality monitoring activities are provided by CRC Laboratory. The CRC Laboratory has an established Laboratory Information Management System (LIMS) that generates electronic Chain of Custody (CoC) forms already populated with the sample details. It is the responsibility of the sampler to ensure they understand how to record the relevant information using the CRC Laboratory sample submission process, and to contact the WTMIP water quality team for advice if required. It is also the responsibility of the sampler to submit the CRC Laboratory form to the laboratory via email ahead of sample submission.

7.1 Chain of Custody form

A Chain of Custody (CoC) form is issued by CRC Laboratory for every batch of bottles prepared by the laboratory. and is used to document sample metadata. An example of a CRC Laboratory CoC form is provided below in **Figure 5**.

Fields of the CoC form to be completed by the sampler are shaded blue. It is mandatory that the following fields are completed:

- Samplers' name/s and email address.
- Date and time sampled.

Comments relating to individual samples, for example, the volume pumped from piezometers during purging or whether the sample was particularly turbid or tannin stained, can be recorded in the 'General site observations' field. All information recorded on the form will be reported and stored alongside the analytical results for use in later interpretation of the data.

The electronic CoC should be renamed following instructions from CRC Laboratory and emailed to the general laboratory email (laboratory@cairns.qld.gov.au) prior to the submission of samples. Carbon copy (cc) the email to the WTMIP Water Quality Leader and Data Manager to enable the progress of the job to be tracked and the receipt of data to be checked (see WTMIP Data Management Plan for further information).

7.2 Sample submission sheet

Each batch of bottles prepared by CRC Laboratory contains a hard copy sample relinquishment form (**Figure 6**). The relinquishment form should accompany the samples when they are submitted to the laboratory and is signed by the person delivering the samples as a formal record of the date and time the samples were handed over to the laboratory. CRC Laboratory reception staff can print a replacement copy of the form should it go missing during sampling.

Cairns Regional Council Laboratory Services

Please fill in the blue boxes below and email to **laboratory@cairns.qld.gov.au**

Please deliver samples to:

Cairns Regional Council Laboratory Services
38 MacNamara St
MANUNDA QLD 4870

Phone: **07 4044 8344**
Fax: **07 4044 8333**
Web: www.cairns.qld.gov.au

Customer Details

Company Name	TERRAIN_NRM
Project Number	095011
Contact Name	
Email Address	
Project Description	Johnstone Piezometers

Sampler 1
Sampler 2

#	Sample Number	Sampling Point	Description	Sampled Date/Time	General Site Observations	Container Numbers
1	670094	TERRN-255	MIP FS J2 P1			670102
2	670095	TERRN-256	MIP FS J2 P2			670103
3	670096	TERRN-257	MIP FS J3 P1			670104
4	670097	TERRN-258	MIP FS J3 P2			670105
5	670098	TERRN-259	MIP FS J4 P1			670106
6	670099	TERRN-260	MIP FS J4 P2			670107
7	670100	TERRN-261	MIP FS J5 P1			670108
8	670101	TERRN-262	MIP FS J5 P2			670109
9						

Figure 5 Example Chain of Custody (CoC) form

Proposed Collection Date: 06-March-2019

Tully Piezometer **095733**

Terrain NRM

PO BOX 1756
INNISFAIL QLD 4860

Cairns Regional Council
Water and Waste

Laboratory Services
38 MacNamara St
MANUNDA QLD 4870
phone: (07) 4044 8344
fax: (07) 4044 8333
email: laboratory@cairns.qld.gov.au

Order Number: _____

Reports to:	email	phone	fax
■ Alicia Buckle	alicia.buckle@terrain.org.au		
■ Emma-Lee Harper	Emma-Lee.Harper@terrain.org.au		
■ Fiona George	fiona.george@terrain.org.au		

Chain of Custody

Relinquished by: _____ Date / Time _____
Received by: _____ Date / Time _____
Received by: _____ Date / Time _____

Sample details are listed in the Electronic Chain of Custody spreadsheet supplied by the customer.
This is filed in **\\WQLAB\Water Quality Lab\LIMS\LW-LIMS-PROD-DATA\COC\Imported Files** and is called:

_____

Additional Samples	Date	Time	Analyses Required

Laboratory Use Only

Delivered by: ☐ client ☐ VSC

☐ Received within 24 hours?
☐ Appropriate Containers?
☐ Appropriate Preservation?

Data Entry Batch: _____

Temperature on Receipt (°C): _____

Page 1 of 1

Figure 6 Example sample relinquishment form

8. References

DES (2018). Monitoring and Sampling Manual: Environmental Protection (Water) Policy. Brisbane: Department of Environment and Science Government.

DES & WTMIP (2018). DES FM001 (WTMIP SOP 002): Manual water quality sampling for total suspended solids and nutrients.

DES & WTMIP (2018). DES FM006 (WTMIP SOP 003): Manual water quality sampling for pesticides.

DNRM (2014) Sub-artesian water quality sampling (WMO026), State of Queensland, Department of Natural Resources and Mines, Service Delivery. Version 5.0.

DSITI (2017). Standard Operating Procedure FM010 Quality assurance and quality control procedures associated with the collection of water samples.

Sundaram B, Feitz A, de Caritat P, Plazinska A, Brodie R, Coram J and Ransley T (2009). Groundwater Sampling and Analysis – A Field Guide. Geoscience Australia, Record 2009/27, 95 pp.

Appendix 1

Equipment	✓
Site maps with piezometer locations and codes.	
Plopper/whistler and tape measure.	
12 V submersible piezometer pump[3], attached to 10 m vinyl or Teflon[4] hose and electrical cords. Contained within a tub with lid to avoid contamination through soiling.	
Pump battery. Either a car battery or portable Absorbent Glass Matt (AGM) batteries.	
1 x 15 L bucket, with volume graduations, for purging piezometers.	
Sampling pack as supplied by CRC Laboratory in esky, containing a set of bottles for each site as described below: ▪ Sample bottles (**Figure 3**) o For field filtered nutrients (preferred) – 2 x sample bottles (100 mL bottle for unfiltered nutrients (no label with bar code) and 50 mL bottle for filtered nutrients). o For laboratory filtered nutrients – 1 x 100 mL bottle for unfiltered nutrients (labelled). o For pesticides (non-routine) – 1 x 200 mL amber glass bottle (labelled). ▪ 1 x individually packed and sealed TERUMO 60 mL syringe. ▪ 1 x Millipore Millex-HV 0.45 μm hermetically sealed filter, individually packed and sealed (**Figure 4**). ▪ 1 x Millipore Millex-AA 0.8 μm hermetically sealed filter, individually packed and sealed (**Figure 4**).	
1-2 spares of each bottle type.	
1 x box of spare Millipore Millex-HV 0.45 μm hermetically sealed filters, individually packed and sealed.	
1 x box of spare Millipore Millex-AA 0.8 μm hermetically sealed filters, individually packed and sealed.	
Non-powdered vinyl disposable gloves. 1 x box each of large and extra-large size, stored within sealed zip-lock bags to prevent contamination.	
Sample documentation (i.e. electronic CRC Laboratory Chain of Custody form, loaded on field tablet with hard copy backup) (see **Section 7**).	
Felt-tip pen (Sharpies are reliable).	
Accurate time equipment (e.g. mobile phone).	
Clean esky with ice-bricks (sufficient to rapidly chill samples) or car refrigerator.	
Quality control solutions (see **Section 6**): o Laboratory supplied trip blank sample. o 20 L of laboratory supplied reverse osmosis (RO) water in large blue water container for rinsing piezometer pump. o 5 L of laboratory supplied ultra-high purity water ('Milli-Q' water) for preparing field blank.	
Additional sampling pack for the collection of quality control samples containing: o 1 x field blank sample bottle o 1 x trip blank sample (i.e. pre-filled with Milli-Q by the laboratory not more than one week prior to sampling) o 1 x replicate sample bottle.	

[3] Two models of submersible pump are being used in the WTMIP. The Proactive Environmental Twister Groundwater Pump (14 L/min at 3 m depth, 16 m head) and Rule IL280P 'Amazon' Deluxe Electric Bilge Pump (18 L/min, 16 m head). Should the amount of silt in the piezometers ever prevent the use of submersible pumps, airlift methods will need to be investigated.
[4] If water samples are being collected for pesticide analysis then the submersible pump hose should be replaced with Teflon tubing.

Version Control

Document History	Date	Amendment:	Amended by:	Reviewed by:	Approved by:
Version 1.0	05/07/2020	Draft SOP prepared from field procedures written by Maria Ribbeck (Tully Canegrowers), Fiona George (Terrain NRM), Dalton Howden and Will Darveniza (Innisfail Canegrowers).	Alicia Buckle (Terrain NRM)	Fiona George Emma-Lee Harper Suzette Argent (Terrain NRM) Dalton Howden Will Darveniza Maria Ribbeck (Tully Canegrowers) Glynis Orr (QLD Government, DNRME)	Charles Hammond (Terrain NRM)

Terrain NRM and WTMIP partner organisations are grateful to the Water Quality and Investigations team at Queensland Government Department of Environment and Science for providing SOPs from the Great Barrier Reef Catchment Loads Monitoring Program as model documents for the development of WTMIP SOPs.