

# REEF WATER QUALITY



## Farming in Reef Catchments

The method for soil sampling and analysis for sugarcane properties  
regulated under the *Environmental Protection Act 1994*

For a simple online nutrient calculator tool go to the Farming in Reef Catchments website at  
[www.qld.gov.au/FarmingInReefCatchments](http://www.qld.gov.au/FarmingInReefCatchments) or call 13 74 68 (13 QGOV) for more help.



**Prepared by: Reef Water Quality, Environmental Policy and Planning division, Department of Environment and Heritage Protection**

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## Introduction

In October 2009, new reef protection measures were added to the Environmental Protection Act 1994. In part, these measures require that a person must not apply more than the optimum amount of nitrogen and phosphorus when carrying out commercial sugarcane growing in the catchments of the Wet Tropics, Burdekin Dry Tropics and Mackay-Whitsunday.

Soil testing is required prior to the plant cane crop being planted to calculate the fertiliser rate for nitrogen and phosphorus as these are environmentally relevant. It is recommended you also test the soil for other important elements, e.g. potassium to develop a balanced nutritional program for your crop.

Soil testing provides a guide to nutrient concentrations in the soil. Using the soil testing results will enable you to fine-tune your property management, and apply nutrients at rates that meet the needs of the plants on a particular block of sugarcane. This approach reduces the risk and cost of over-fertilising. By optimising nutrient application, there is less chance of surplus nutrients being lost to waterways, where they harm the environment.

To guide nutrient management, representative surface soil samples (0–20 cm) need to be tested to determine the organic carbon (OC), phosphorus (P) and phosphorus buffer index (PBI) of the cane blocks being planted each season.

The organic carbon status of the soil is used to define the potential for nitrogen to mineralise in the soil which is then deducted from the total amount of nitrogen necessary to produce the potential cane yield for a block.

Soil phosphorus status is used to define phosphorus fertiliser requirements according to the *Six Easy Steps* program developed by BSES Limited\*, and takes into account past applications of mill by-products such as mill mud and/or mill mud/mill ash mixtures that can represent a significant contribution of nitrogen and phosphorus to the soil.

A companion document, *The method for calculating the optimum amount of nitrogen and phosphorus to be applied to sugarcane properties regulated under the Environmental Protection Act 1994* provides details about how you can make these calculations each season.

The purpose of this document is to help growers decide on the number of soil samples they require to adequately assess the fertility status of cane blocks being planted.

Rather than sampling every plant cane block (a cane farm may have many small blocks) this document describes how to choose particular blocks to represent the fertility status of a number of plant cane blocks of the same soil type. A single block can represent the fertility status of a number of plant cane blocks belonging to the same soil grouping, as identified in the Six Easy Steps 'Soil Reference Booklet' for the particular district.

Blocks that received applications of mill by-products in previous cane cycles potentially have a higher soil phosphorus status than blocks not receiving any by-products. To take account of this, separate soil samples should be taken from blocks considered to represent those that have (a) received and (b) not received previous applications of mill by-products.

By keeping good records of soil tests and management practices, you can monitor trends in soil fertility over time, especially the organic carbon and phosphorus status of the soil which can assist in accurate nutrient management, improved soil health and cost savings.

\*BSES Limited is the organisation now known as Sugar Research Australia (SRA)

# Purpose of this document

- To provide information on the requirements for soil testing and analysis under the reef protection measures in the *Environmental Protection Act 1994* (the Act).
- To provide guidance on factors that should be considered when designing a soil sampling plan and collecting soil samples.
- To specify the required soil tests laboratories should conduct.
- To identify the records and primary documents to be kept to meet the requirements of the Act.

# Requirements for soil testing

## Why is soil testing required?

Soil testing prior to the plant cane crop allows you to calculate the fertiliser rate for nitrogen and phosphorus. Applying nutrients at rates that meet the needs of your cane crop reduces the risk and cost of over-fertilising. By optimising nutrient application, there is less chance of surplus nutrients being lost to waterways, where they harm the environment.

## What needs to be tested?

Under the Act, the soil must be analysed prior to applying fertiliser on plant crops to determine the content of:

- organic carbon (i.e. Walkley Black)
- extractable phosphorus (i.e. Colwell P or BSES P [Colwell P should only be used for soil samples with a pH  $>7.5$ ]), which provides an indication of the phosphorus available to the sugarcane crop
- the Phosphorus Buffer Index (PBI).

Details of the tests and methods that must be applied are provided in Step 3.1 in this document.

## How often do soil tests need to be taken?

Soil needs to be sampled and tested, at a minimum, within the 12 months prior to the commencement of a new plant cane crop. The most effective time to sample is just after harvest of the last ratoon of the previous crop cycle.

You can also have soil samples analysed from late crop cycle ratoons to indicate the presence of any agronomic issues, such as sub optimal pH. This provides an opportunity to correct for agronomic issues prior to establishing a fallow crop.

**Increased sampling frequency provides a better insight into the nutrient status of your soils, and can assist in monitoring any changes in soil properties over time as a result of changed farm management practices and/or fine-tuning of farm inputs.**

## What do I need to prepare before soil testing?

Before you conduct a soil test, you will need to ensure you have the right tools (see Stage 2).



# Soil testing guidelines

There are four important stages in the process of soil testing with a number of distinct steps.

## Stage 1. Developing a soil sampling plan

**1.1** Obtain a soil map



**1.2** Identify blocks being planted with sugarcane



**1.3** Identify block management practices



**1.4** Select representative blocks for sampling



**1.5** Complete your soil sampling plan



## What if I need help?

If you need help with soil testing on your farm, please contact your local productivity services board or a reputable agronomist.



## Stage 2. Collecting soil samples

**2.1** Sample collection



**2.2** Labelling



## Stage 3. Soil analysis in the laboratory

**3.1** Laboratory selection



**3.2** Send samples for analysis



**3.3** Record keeping



## Stage 4. Interpretation of the results

# Stage 1. Developing a soil sampling plan

It is important to plan where and when samples will be taken on your property, taking into account the:

- stage in the cropping cycle
- different soil types on the property
- various nutrient management practices that may occur across the property
- size of the property.

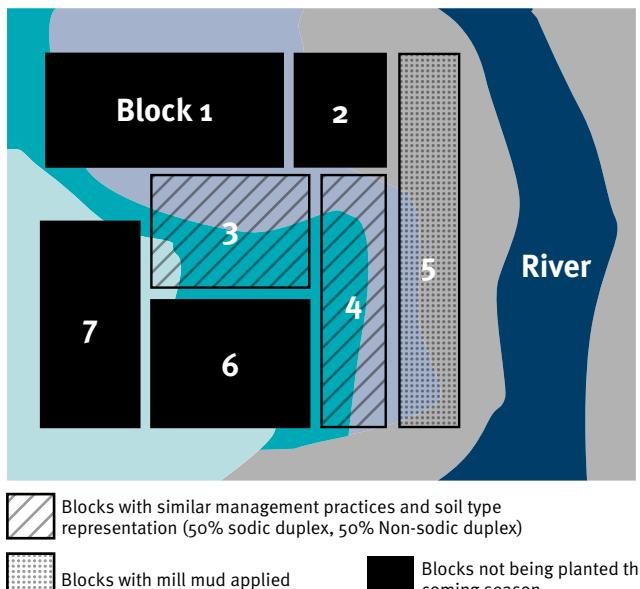
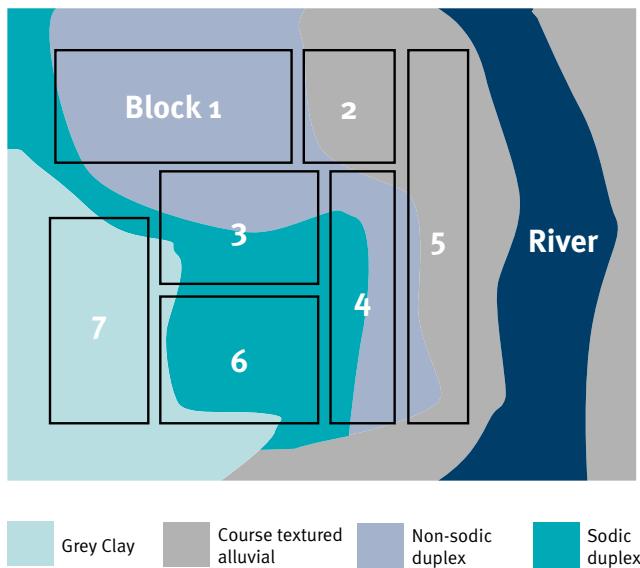
The proper design of a soil sampling plan involves selecting an area for soil sampling that represents the fertility status of the blocks being planted. By using a map that identifies the soil-sampling locations for record keeping, you can monitor trends in soil fertility over time, particularly the organic carbon status and the amount of soil phosphorus.

## Step 1.1: Obtain a soil map

To calculate the most accurate nutrient requirement for your crop it is important to collect soil samples that consider the management features and different soil characteristics of your farm.

The soil map/s describing the soil types and boundaries relevant to your farm and the specific locations and sites of where you decide to collect your soil samples is the basis for your soil sampling plan. When completed, your soil sampling plan will be an important reference document for any future soil sampling requirements.

**It is important to record the specific location of your sampling sites within each representative block on your soil sampling plan so that you can return to the same spot and identify trends in the fertility status of each block over time.**



## Step 1.2: Identify blocks being planted with sugarcane

Nutrient recommendations are only as good as the quality of the samples being collected. A good representative sample consists of a large number of soil cores taken from within a uniform area of a soil type or block.

Representative cane blocks are selected for sampling. Samples taken from within each representative block being planted to sugarcane are mixed to form a composite soil sample. Figure 1 shows an example of a soil map showing cane blocks.

**Figure 1: A soil map of a hypothetical farm showing block boundaries**

**Source:** Adapted from Schroeder, B.L., Wood, A.W., Panitz, J.H. (2007-2009), Nutrient management series, Canegrowers magazine.

## Step 1.3: Identify block management practices

Using a copy of your soil map, mark the blocks that have the same soil type or proportion of soil types and similar nutrient management regimes and group them using a unique identifier (i.e. cross-hatching, shading or a label).

Use a unique identifier or label for blocks that have had mill by-products applied prior to planting cane, as these should be sampled separately to blocks that have not had mill by-products applied.

Figure 2 provides an example of how to group blocks with similar soil types and management practices (based on fertiliser application, mill by-product application, irrigation, cropping and yield) to develop your soil sampling plan.

**Figure 2: A soil map of a hypothetical farm grouping blocks with similar soil types and nutrient management regimes**

**Source:** Adapted from Schroeder, B.L., Wood, A.W., Panitz, J.H. (2007-2009), Nutrient management series, Canegrowers magazine.

## Step 1.4: Select representative blocks for sampling

Select representative blocks from each group with an identifier or label from which soil samples will be collected, taking the following conditions into account.

### Step 1.4.1: Sample site selection

For blocks with the same soil types or soil groupings and that are farmed the same way (based on fertiliser application, mill by-product application, irrigation, cropping and yield), select a block of average productivity that you consider is representative of the rest of the blocks in the group.

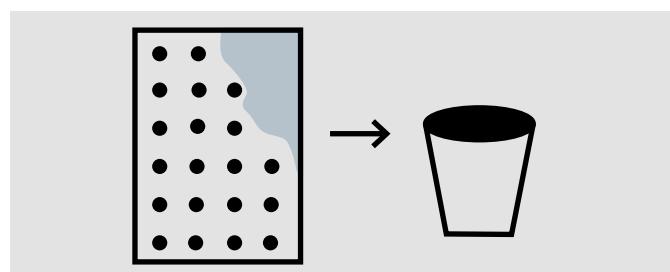
### Step 1.4.2: Soil type characteristics

A more accurate soil test result is obtained by sampling each individual soil type within a block to form separate composite samples for each soil type. This would mean that nutrient application rates are calculated for each soil type within blocks, and would require nutrient application to match each soil type within blocks. It is acknowledged that in some instances it may not be possible to apply nutrients at different rates within a block. For this reason, two methods are provided for selecting core sample sites within representative blocks on your farm; a *minimum standard* and a *better practice* sampling method.

#### **Minimum standard core sample site selection:**

##### *Sampling blocks with one dominant soil type*

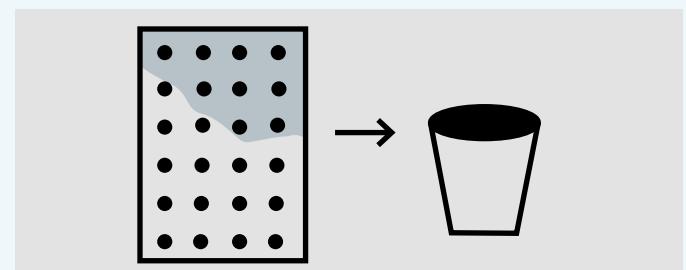
For blocks with more than one soil type, collect samples from a section of the block that best represents the dominant soil type from that block using one of the suggested sampling patterns shown in Figure 6.



**Figure 3:** Example for sampling a block where there is one dominant soil type using minimum standard core sample site selection. Shading indicates soil type differences. Black dots represent the core sampling sites. Samples from these sites are combined to form one composite sample

#### *Sampling blocks with an unclear dominant soil type*

Sample the block using your chosen sampling pattern irrespective of soil type distinctions. The final soil sample will form a composite sample made up of a mixture of soil types from within the sampled block.

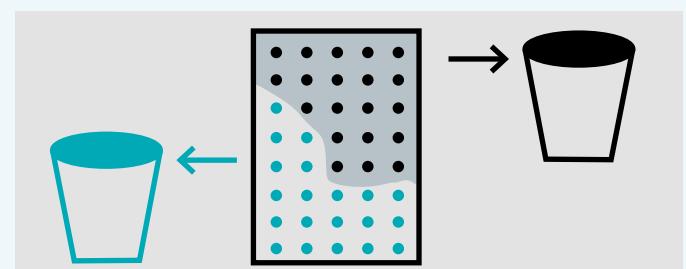


**Figure 4:** Example for sampling a block where there is an unclear dominant soil type using minimum standard core sample site selection. Shading indicates soil type differences. Black dots represent the core sampling sites. Samples from these sites are combined to form one composite sample

#### **Better practice core sample site selection:**

##### *Sampling blocks with a clear or an unclear dominant soil type*

Where it is possible to apply nutrients at different rates within a block specific to soil type differences (i.e. with the use of a variable rate applicator) soil cores are obtained from each soil type to form composite samples that represent each individual soil type.



**Figure 5:** Example for sampling a block where there is an unclear dominant soil type using better practice core sample site selection. Shading indicates soil type differences. Black dots represent the core sampling sites from which samples are collected and mixed to form composite sample 1. Blue dots represent the core sampling sites from which samples are collected and mixed to form composite sample 2

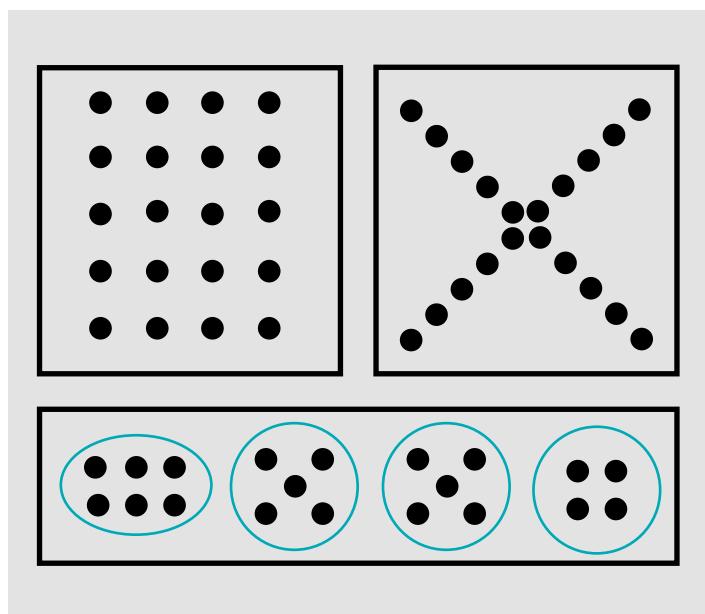
Note: Nutrient application rates are to be calculated for each individual area that a composite sample represents. If nutrient application cannot be varied on-farm to suit soil type distinctions within blocks, the minimum standard core sample site selection should be used.

### Step 1.4.3: Sample area and pattern

For a representative block or area smaller than 15 hectares, at least 20 core soil samples need to be taken and mixed together to form the composite sample sent for testing. Therefore, if the block or area is 1 hectare, at least 20 cores sites should be selected for the composite sample. If the block or area is 5 hectares, 4 sites per hectare should be selected for the composite sample.

To sample a representative area or block greater than 15 hectares, at least 40 or more core sites must be selected in total. These 40 cores are then mixed together to form the composite sample. If the block or area is 20 hectares, 2-3 sites per hectare should be selected to take core samples (see Figure 6 for suggested site selection patterns).

**Note that the greater the number of cores taken to form a composite sample, the more reliable the analytical results for that sample will be.**



**Figure 6: Suggested sampling patterns within cane blocks or soil type distinctions.**

**Source:** Schroeder, B.L., Wood, A.W., Panitz, J.H. (2007-2009), *Nutrient management series, Canegrowers magazine*.

### Step 1.5: Complete soil sampling plan

When you are ready to take the samples, document your soil sampling plan on your soil map, including the location of the representative blocks and the date and location of sampling sites.



## Stage 2. Soil sample collection

Remove all trash and organic matter from the surface before taking soil cores. If this is not done the analysis will return an inaccurate result. Take soil cores with an auger or soil tube from the surface of the soil to a depth of 20cm. Provide a composite sample of 500g and submit as soon as possible to a soil testing laboratory.

To take soil samples, you'll need the following materials:

- a sampling tool such as:
  - a shallow probe
  - a thin-walled deep soil probe
  - a hydraulic/motor driven probe/auger
  - an auger (either a turning auger or a soil tube)
- new plastic bags\*
- a clean plastic bucket\* and clean gloves\* for mixing cores
- labels
- a marker for labelling samples
- a record sheet (the form in Attachment 1 can be used).

\*It is important to use clean equipment to avoid contaminating your soil samples.

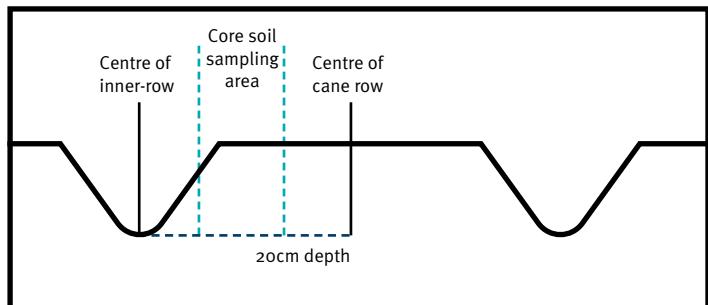
### Step 2.1: Sample collection

Soil sampling should occur prior to incorporating a green cane trash blanket into the soil, as this can affect the soil test analysis and results. Also avoid sampling headlands, poorly drained areas and fertiliser dump sites. Areas that have been fertilised or had ameliorants applied must not be sampled for a minimum of eight weeks following application.

Cores of soil should be collected from the shoulder of the cane row, about midway between the centre of the cane row and the centre of the inter-row (see Figure 7), down to a depth of 20cm from the surface, using either a turning auger or a soil tube, if possible. It is important to avoid collecting material such as trash or organic matter from the surface. If using a soil tube, the tube should not be lubricated or galvanised because this can cause inaccurate results.

After collecting cores in a clean bucket, thoroughly mix together those taken from the same block or soil type distinction (depending on the use of the *minimum standard or better practice* sampling method) to form a composite sample (breaking large clods apart by hand).

### Positioning of core sampling area



### Cross section view of core sampling area

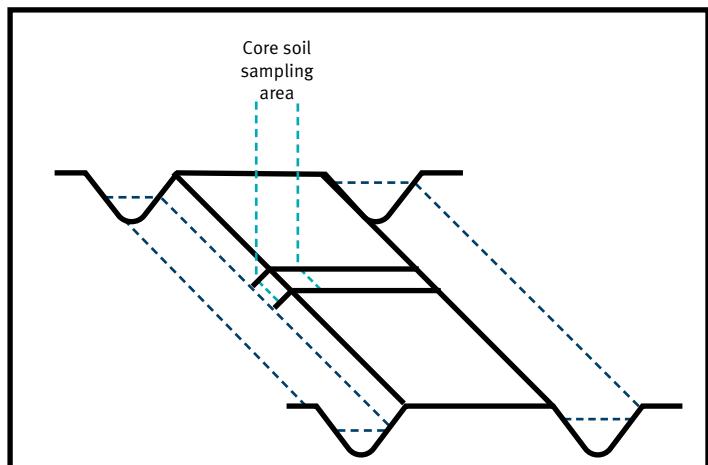


Figure 7: Area in profile for core soil sampling.

### Step 2.2: Labelling

Using a permanent ink marker, label the composite sample with the date, block or area sampled and farm name and submit to a certified laboratory for testing (Figure 8).

Attachment 1 provides a form suitable for recording information about the block or sampled area and submitting with the soil sample to the testing laboratory. Keep a copy of this form for your records.

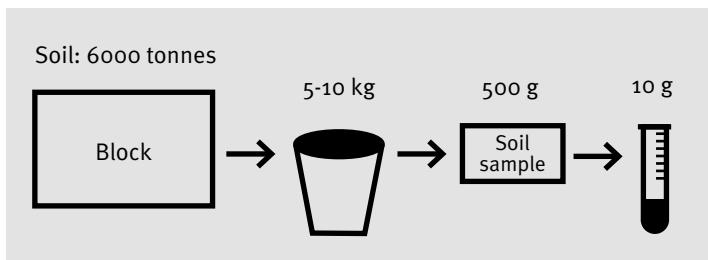


Figure 8: Soil analysed in the laboratory is a sub-sample of the composite sample collected from the block or area.

Source: Schroeder et al. 2004

The following information will be required to support the calculation of the optimum amount of nitrogen and phosphorus application. If you are utilising the services of a professional fertiliser industry advisor who is not familiar with your property, they'll also need to understand your farm management practices with respect to the application of mill by-products and fallowing.

**Mill by-products:** Did you apply mill by-products to the block? State what type, when they were applied and how much.

**Fallow management:** Did you have a fallow before planting cane? Was it bare ground, grass or a legume crop, how was it managed?

Attachment 2 provides a form to record this information.

## Stage 3. Soil analysis in the laboratory

### Step 3.1: Laboratory selection

Identify a suitable laboratory to undertake the following analysis using the methods specified below. It is important that these methods are used as they are calibrated to the Six Easy Steps program for nutrient management in the sugarcane industry.

1. OC uncorrected Walkley Black (Method 6A1)
2. BSES (acid) extractable P (Method 9G2 or 9G1)\*
3. P buffer index (PBI) adjusted to Colwell extractable P (Method 9I2)

These methods can be found in *Rayment, G.E. and Lyons D.J. (2011) Soil Chemical Methods – Australasia*, CSIRO Publishing, available at the Environment and Heritage Protection (EHP) website at [www.qld.gov.au/FarminginReefCatchments](http://www.qld.gov.au/FarminginReefCatchments).

Other tests, such as those to determine soil pH or available potassium, are encouraged for assessing the overall fertility status of the soil to develop a balanced nutritional program.

\*Note that while the BSES (acid) extractable phosphorus soil test has been found to be well-suited to estimating plant available phosphorus in the acidic soils that occur in much of the Queensland sugarcane industry, investigation has found that it may overestimate available phosphorus in neutral to alkaline soils. It is therefore recommended that growers with such soils seek professional advice in relation to the phosphorus application on their sugarcane block/property after receiving their soil test results.

**Suitable laboratories performing the chemical analysis of soil samples are required to participate in Australasian Soil and Plant Analysis Council (ASPAC) proficiency trials and maintain certification for the nominated methods where available. The ASPAC website is [www.aspac-australia.com](http://www.aspac-australia.com).**

**It is recommended that laboratories are able to demonstrate that their operations comply with the Australian Standard AS ISO/IEC 17025-2005 'General requirements for the competence of testing and calibration laboratories' and have the technical expertise for the specified methods. The National Association of Testing Authorities (NATA) accreditation would provide evidence of compliance to this standard. The NATA website is [www.nata.asn.au](http://www.nata.asn.au).**

### Step 3.2: Send samples for analysis

Send composite samples to a suitable laboratory for nutrient analysis.

If you are using a professional fertiliser industry advisor to make recommendations on how much nutrient to apply, ensure they produce recommendations consistent with *The method for calculating the optimum amount of nitrogen and phosphorus to be applied to sugarcane properties regulated under the Environmental Protection Act 1994*. This document is available from the Department of Environment and Heritage Protection website at [www.qld.gov.au/FarminginReefCatchments](http://www.qld.gov.au/FarminginReefCatchments).

A professional advisor is an individual who meets the following national competency standards:

- i) AHCWRK301A – Collect samples for a rural production and horticulture monitoring program (this supersedes RTE3504B)
- ii) AHCPMC402A – Develop a soil health and plant nutrition program (this supersedes RTF4004A)
- iii) AHCPMC505A – Conduct environment and food safety risk assessment of plant nutrition and soil fertility programs (this supersedes RTE5527A)

Fertcare Accredited Advisors meet these standards.



## Step 3.3: Record keeping

It is important to note that records must be kept of activities relating to the application of fertilisers and chemicals on your sugarcane property. The following documents must be kept as records for five years:

- a map identifying the blocks grown under cane to reference with written records of where soil sampling and analysis has been undertaken
- soil testing results as a report from a suitable certified laboratory or accredited advisor.

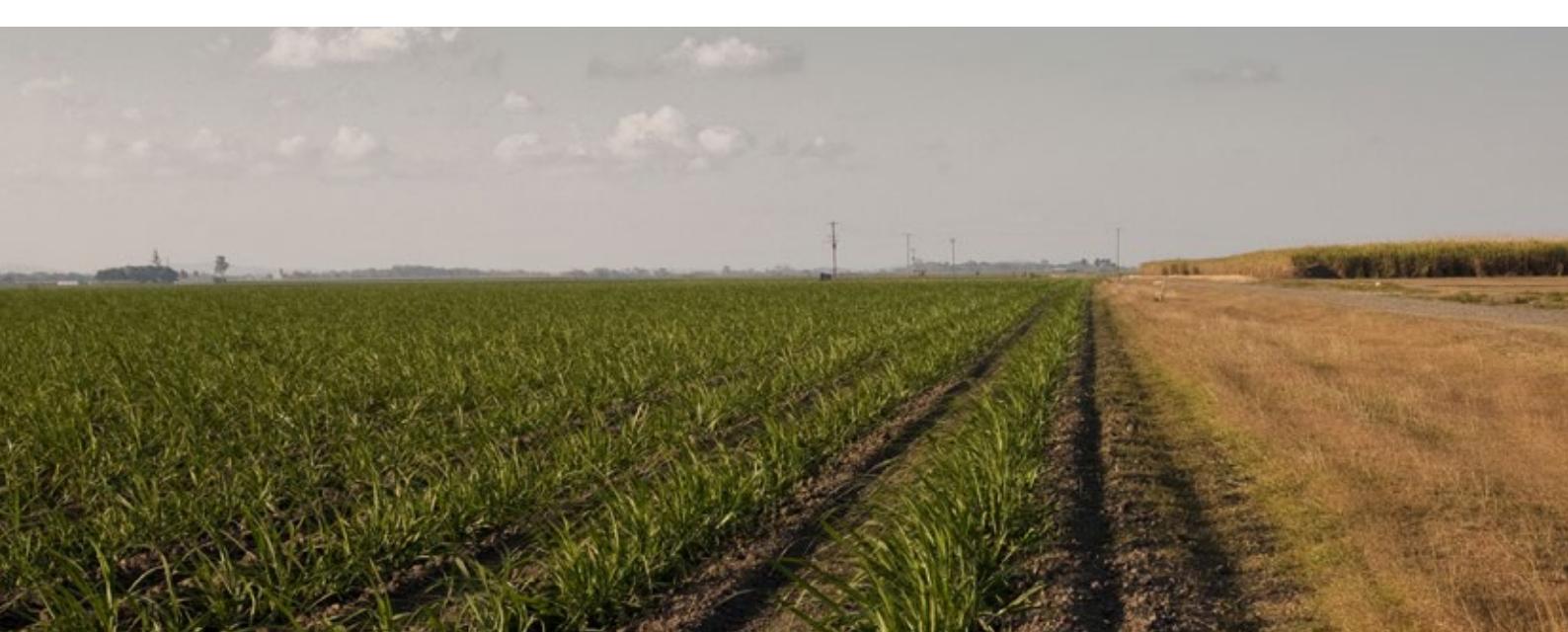
Compulsory record keeping forms and further information is available from the Department of Environment and Heritage Protection website at [www.qld.gov.au/FarminginReefCatchments](http://www.qld.gov.au/FarminginReefCatchments).

## Stage 4. Interpretation of results

Soil test reports contain the analytical data from tests conducted in a laboratory using specific methodologies. Most laboratories offer packages of soil tests however it is important to ensure that the package chosen includes the analysis methods outlined in Step 3.1.

Once you have obtained your soil test results, calculate the optimum nutrient requirements for your crop using the document called *The method for calculating the optimum amount of nitrogen and phosphorus to be applied to sugarcane properties regulated under the Environmental Protection Act 1994*. This document is available from the Department of Environment and Heritage Protection website at [www.qld.gov.au/FarminginReefCatchments](http://www.qld.gov.au/FarminginReefCatchments).

You could also engage a professional fertiliser advisor to calculate the optimum nutrient requirements for you. You can find an advisor by contacting your local productivity services board or fertiliser re-sellers.



## References

Incitec Pivot (2002). A qualitative guide to soil sampling, Version 3 October 2002.

Rayment, G.E. and Lyons, D.J. (2011) Soil Chemical Methods - Australasia, CSIRO Publishing, Collingwood, VIC. Australia.

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Schroeder, B.L., Wood, A.W., Hurney, A., Panitz, J.H. (2008), BSES Accelerating the adoption of best practice nutrient management: Wet Tropics.

## Attachments

Attachment 1 and 2 may need to be completed as records for the soil sampling that has taken place on your property. The attached documents do not need to be completed if your soil analysis laboratory provides forms requiring the same information. Ensure that you retain a copy of the information for your records.

Additional items to keep with the records are your:

- › soil sampling plan
- › soil nutrients analysis commercial laboratory report
- › commercial nutrient report including recommendations for nutrient application rates.



## Attachment 1. Guidance form: Soil sample records—information on the representative block sampled

In the event that the accredited laboratory doesn't provide form/s to document your soil sampling details, complete this form for each soil sample that you submit to an accredited laboratory for testing and keep a copy for your records.

**Grower name**.....

**Property address** .....

**Farm name / ID number** .....

**Contact number** .....

**Block/Area sampled** (specify below)

.....

**Block/Area identifier**

.....

**Sampled soil type/s**

.....

**List the blocks (using their identifiers) that this soil test represents**

.....

.....

.....

**Date of soil sampling**

\_\_ / \_\_ / \_\_

## Attachment 2. Guidance form: Information required for the calculation of nitrogen fertiliser on your property

In the event that a laboratory doesn't provide form/s to document your soil sampling details, complete this form for each soil sample that you submit to an accredited laboratory for testing and keep a copy for your records.

**Block management:** Block/Area name: ..... Date soil sampled \_\_\_\_ / \_\_\_\_ / \_\_\_\_

### **Mill by-products:**

Did you apply mill by-products to the block? If so, specify the type by ticking the box below:

- mill mud
- mud/ash mixture

Date of application .....

Rate of application (wet t/ha) .....

### **Fallow management**

- Did you have a fallow before planting cane?

#### **If so, what type of fallow did you have?**

- Bare/ grass
- Legume If so, what legume crop .....

  - Did you harvest the seed? Yes  or No
  - Was it a poor legume crop or a good legume crop? Poor / good
  - Did you leave the crop standing? Yes  or No
  - Were residues left on the surface of the soil or did you plough in? Surface  or Ploughed in

**Other crop** If so, what crop? .....

**Other** Specify.....

