

Queensland  
**REEF WATER  
QUALITY**  
Program



Reef protection regulations  
Farming in Reef catchments

## **Erosion and sediment control guide**

**Version 2**

(Agricultural environmentally relevant activity standard  
for banana cultivation)

Prepared by:

Office of the Great Barrier Reef, Environmental Policy and Programs, Department of Environment and Science

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## **STANDARD CONDITIONS 11, 12, 13 and 14: EROSION AND SEDIMENT CONTROL**

Under the Reef protection regulations, the following standard conditions for minimum erosion and sediment control measures must be implemented and maintained as part of the Agricultural Environmentally Relevant Activity (ERA) standard for banana cultivation – version 2.

### **Standard condition 11**

Ratoon paddock inter-rows must have at least 60 percent covered ground at all times, except when undertaking renovation works (for example, to remove wheel ruts).

### **Standard condition 12**

By the start of the wet season all plant blocks must have at least 60 percent covered ground in the inter-row, except when undertaking renovation works (for example, to remove wheel ruts).

### **Standard condition 13**

At fallow all blocks must have a grassy fallow or cover crop established that maintains adequate covered ground.

### **Standard condition 14**

Measures that minimise the release of soil and surface water run-off to receiving waters must be implemented and maintained in areas that are subject to a high risk of erosion.

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## Glossary

**Activity:** The environmentally relevant activity (ERA) to which this Agricultural ERA standard applies.

**Appropriate person:** Means a person who has professional qualifications, training or skills or experience relevant to completing a nutrient management plan. This must include the ability to give an authoritative assessment, advice and analysis relevant to the farm, block and management zone, using protocols, standards, methods or literature, where relevant.

**Commercial:** For the purposes of this guide, commercial is defined as undertaking the activity (banana growing) for a fee or reward.

**Covered ground:** Covered ground may be living or dead and may include plant material and trash.

**Great Barrier Reef catchment:** Has the same meaning in the *Environmental Protection Act 1994*. The Great Barrier Reef catchment is the area shown on a map prescribed by regulation as the Great Barrier Reef catchment.

**Gully erosion:** Removal of soil along drainage lines by surface water run-off. Once started, gullies will continue to move by headward erosion or by slumping of the side walls unless steps are taken to stabilise the disturbance.

**Measure:** Refers to an action, or procedure, which is planned and implemented to minimise the risk to the environment of releases of sediment or nutrients into the environment as a result of the agricultural ERA.

**Receiving waters:** Means the *waters* into which the relevant agricultural ERA drains. *Waters* has the meaning in the *Environmental Protection Act 1994* and includes all or any part of a creek, river, stream, lake, lagoon, swamp, wetland, spring, unconfined surface water, unconfined water in natural or artificial watercourses, bed and bank of any waters, non-tidal or tidal waters (including the sea), and underground water. For the purposes of this standard, receiving waters also includes structures or features which may reasonably be expected to drain to *waters* including a stormwater channel, stormwater drain, or roadside gutter.

**Rill erosion:** Removal of soil by run-off from the land surface whereby numerous small channels are formed.

**Sheet erosion:** Removal of a fairly uniform layer of soil from the land surface by raindrop splash and/or run-off without forming noticeable channels.

**Wet season:** For the purposes of this guide, the wet season means between 1 November and 30 April of the following year.

## Introduction

The *Environmental Protection Act 1994* requires **commercial** beef graziers, sugarcane growers, banana growers and horticulture and grain growers in the Wet Tropics, Burdekin, Mackay Whitsunday, Fitzroy and Burnett Mary regions of the **Great Barrier Reef catchment** to comply with commodity-specific minimum practice agricultural standards under the Reef protection regulations.

The purpose of the Reef protection regulations is to protect the health of the Great Barrier Reef by reducing pollutant run-off (nutrients, sediment and pesticides) in waterways that flow to the Reef.

The regulated minimum practice agricultural standards are based on the best available science and agricultural industry expertise to deliver significant water quality benefits for the Reef while driving better land management practices for profitable and productive farming.

The explanatory information in this document is to be used by growers, and others involved in providing advice on reducing sediment loss on agricultural properties.

Topsoil is the most valuable layer in a soil profile. The removal of topsoil by erosion reduces the productivity of the land and limits the ability of soil to store both carbon and water. Susceptibility to erosion depends on a number of factors, including rainfall intensity, how prone soil is to erosion and the landscape, for example, steepness and length of slopes and the amount of **covered ground**. All soil types are susceptible to erosion during intense rainfall if there is no run-off control or covered ground.

Erosion and sediment control **measures** manage run-off by maximising covered ground and managing overland water flow, and are part of sustainable farming practices.

Managing the movement of soil, water and plant material coming on and off your farm is also vitally important for on-farm biosecurity. More information on biosecurity practices can be found in the [Banana best management practices on-farm biosecurity manual](http://www.horticulture.com.au), found at [www.horticulture.com.au](http://www.horticulture.com.au) and on the [Biosecurity Queensland](http://www.daf.qld.gov.au/business-priorities/biosecurity) website at [www.daf.qld.gov.au/business-priorities/biosecurity](http://www.daf.qld.gov.au/business-priorities/biosecurity).

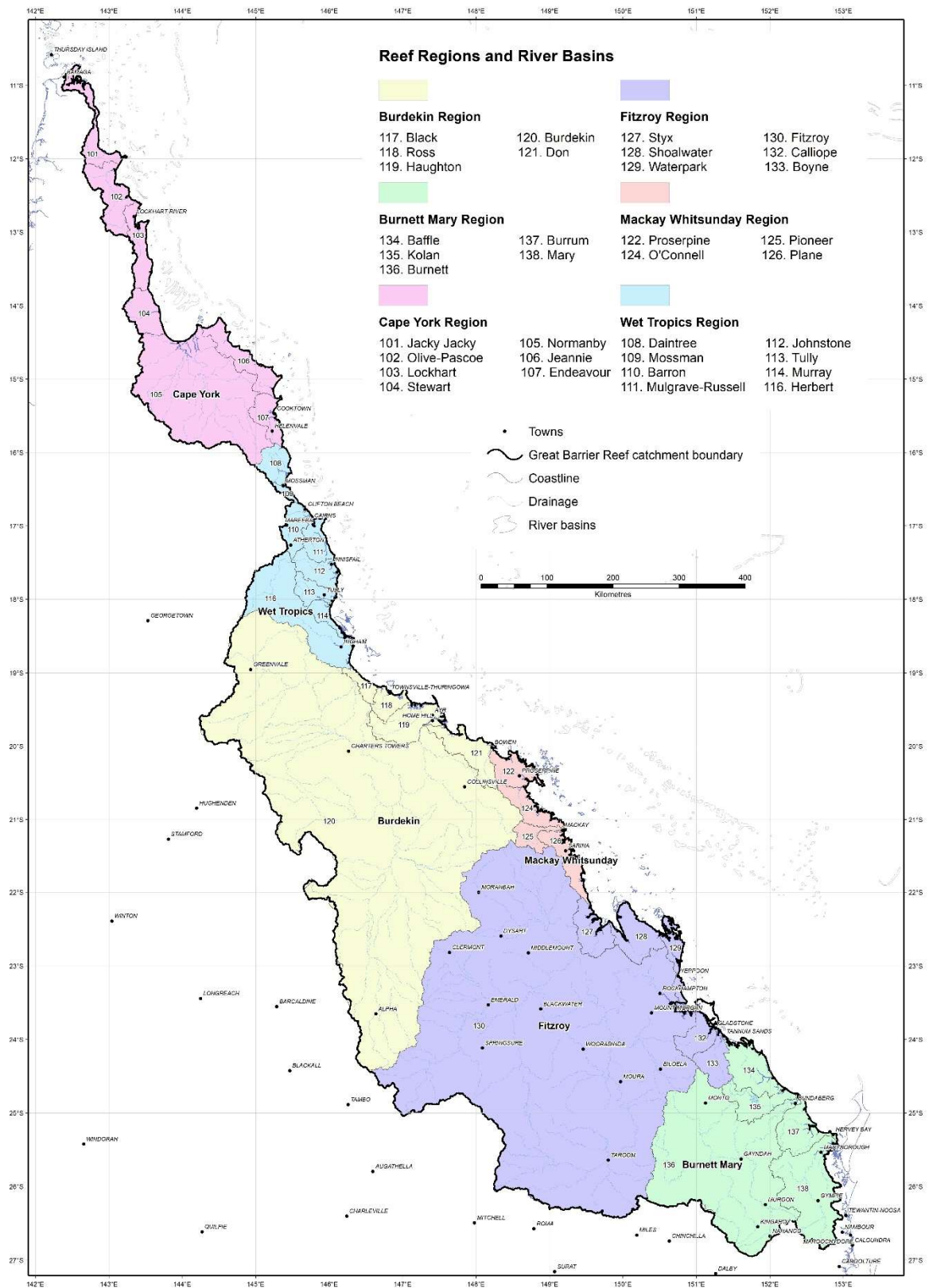
**It is important to make sure that any erosion and sediment control measures you take do not cause problems elsewhere on your property or on neighbouring properties.** You may be required to obtain other approvals under other legislation or regulations in regards to erosion and sediment control measures, in particular to meet requirements under the *Soil Conservation Act 1986* and *Vegetation Management Act 1999*.

The Great Barrier Reef catchment consists of Cape York, Wet Tropics, Burdekin, Mackay Whitsunday, Fitzroy and Burnett Mary natural resource management regions (Figure 1).

Producers in Cape York are not currently required to meet minimum practice agricultural standards as the region has met its Reef water quality targets (under the Reef 2050 Water Quality Improvement Plan 2017-2022).

You can find out if your property is in one of these regions by completing this [online form](http://www.qld.gov.au/ReefRegulations) available at [www.qld.gov.au/ReefRegulations](http://www.qld.gov.au/ReefRegulations).

The online form gives you the number of hectares of your Lot/s in each Reef catchment. If a Lot on plan (i.e. the boundaries of your property) crosses the outer boundary of the Great Barrier Reef catchment, the Lot is considered within the Reef catchment if more than 75 percent of the Lot, or more than 20,000 hectares of the Lot, is within the Reef catchment boundary. If a Lot is located across the boundary of two Reef regions, the Lot is taken to be in the region where more than 50 percent of the Lot is located.



**Figure 1:** The Great Barrier Reef stretches more than 2,300 kilometres along Queensland's coastline. It receives run-off from 35 catchments which are spread over six natural resource management regions.

## Purpose of this guide

The purpose of this guide is to provide practical information to enable you to comply with the standard conditions for erosion and sediment control on existing banana growing properties in accordance with the Agricultural Environmentally Relevant Activities (ERA) standard for banana cultivation – version 2, under the *Environmental Protection Act 1994* by:

- outlining acceptable practices that can be used on existing farms; and
- providing information on where to find help and further information.

This guide outlines the minimum practice standards that you are required to use to meet the Reef protection regulations. You are not limited to these minimum practice standards, and higher standard practices are encouraged.

## Regulations timeframe for commercial banana growing

The Reef protection regulations apply to different regions at different times. Please refer to the table below for the timeframes for commercial banana growing.

Commodity	Region	General record keeping requirements	Minimum practice agricultural standards
Banana cultivation	Wet Tropics	1 December 2019	1 December 2020
	Burdekin, Mackay Whitsunday, Fitzroy and Burnett Mary	1 December 2019	1 December 2022
	All Great Barrier Reef catchment regions	From commencement of an environmental authority for ERA13A – Commercial cropping and horticulture in the Great Barrier Reef catchment – banana cultivation	

## What do I need to do?

Before undertaking erosion and sediment control measures you should seek professional advice from an **appropriate person** – see the [Contacts](#) section for more information.

There are no specific sediment and erosion control measures mandated under the minimum practice standards. A number of examples of erosion and sediment control measures are described in this guide, however they may not all be suitable or relevant for your property. When planning and designing erosion and sediment control measures it is important to understand how the natural landscape (for example, steepness of slopes, soil types) interacts with water, nutrient and erosion processes and their drivers (for example, management practices, weather events) (WetlandInfo 2018a). Taking these factors into account, in conjunction with professional advice, will help you to determine which measures are most suitable for your property.

### Further resources

- Detailed soil and land resource information is available from the [Queensland Globe](http://qldglobe.information.qld.gov.au) at [qldglobe.information.qld.gov.au](http://qldglobe.information.qld.gov.au).
- Design specifications and considerations for the measures discussed can be accessed from the [Soil Conservation Guidelines for Queensland](#) or at [www.publications.qld.gov.au](http://www.publications.qld.gov.au).

## Ratoon blocks - standard condition 11

To comply with the Reef protection regulations, you must ensure that the inter-rows of all ratoon blocks have at least 60 percent covered ground at all times, except when undertaking renovation works, for example to remove wheel ruts. The inter-row space can be covered by living or dead matter, for example by encouraging grasses to establish or placing mulch or plant trash on the inter-row space (Figure 2).



**Figure 2:** Example of approximately 60 percent inter-row covered ground on a banana plantation in the Wet Tropics.

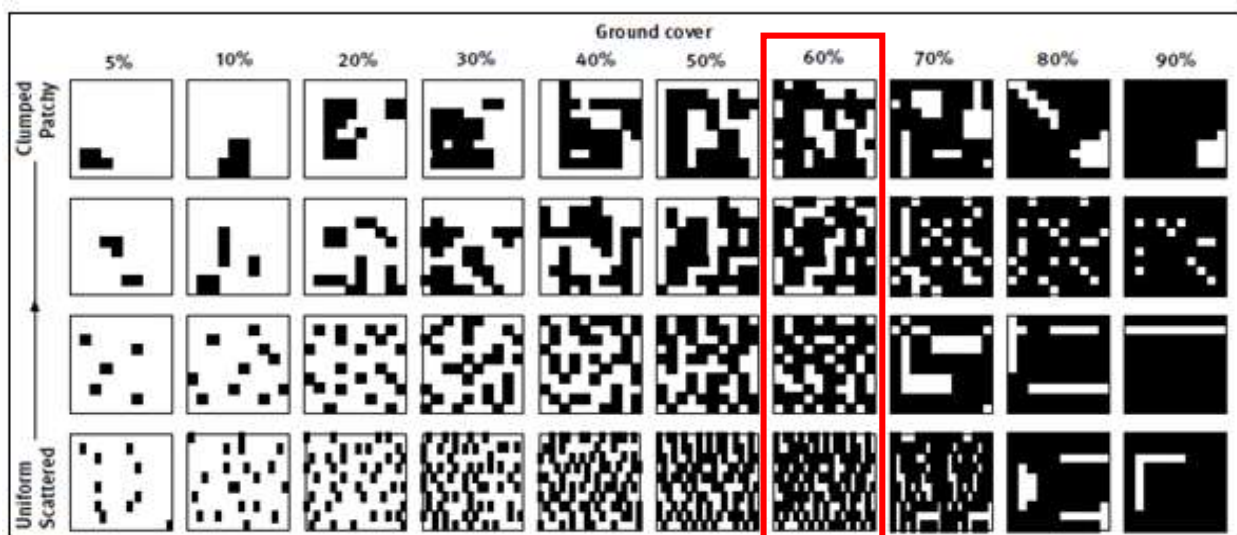
### Plant blocks - standard condition 12

To comply with the Reef protection regulations for plant blocks, you must ensure that all plant blocks have at least 60 percent covered ground in the inter-row by the start of the **wet season**, except when undertaking renovation works, for example to remove wheel ruts.

This will ensure that the inter-row is protected during the wet season when there is a high risk of nutrient and sediment run-off. Where there is limited trash from the young banana plants to provide inter-row cover, it's recommended that a rapidly establishing companion crop be planted, or the previous fallow crop is sprayed out to provide a layer of mulch on the soil surface (Department of Agriculture and Fisheries, 2016).

### Information on assessing 60 percent covered ground

You can use Figure 3 to help assess the percentage of covered ground.



**Figure 3:** Guide to assessing ground cover percentage, by identifying the proportion of ground cover (black areas) compared to bare ground (white areas). You should ensure that your inter-row areas have at least 60 percent covered ground (indicated by the red box).

### Information on timing inter-row renovation works

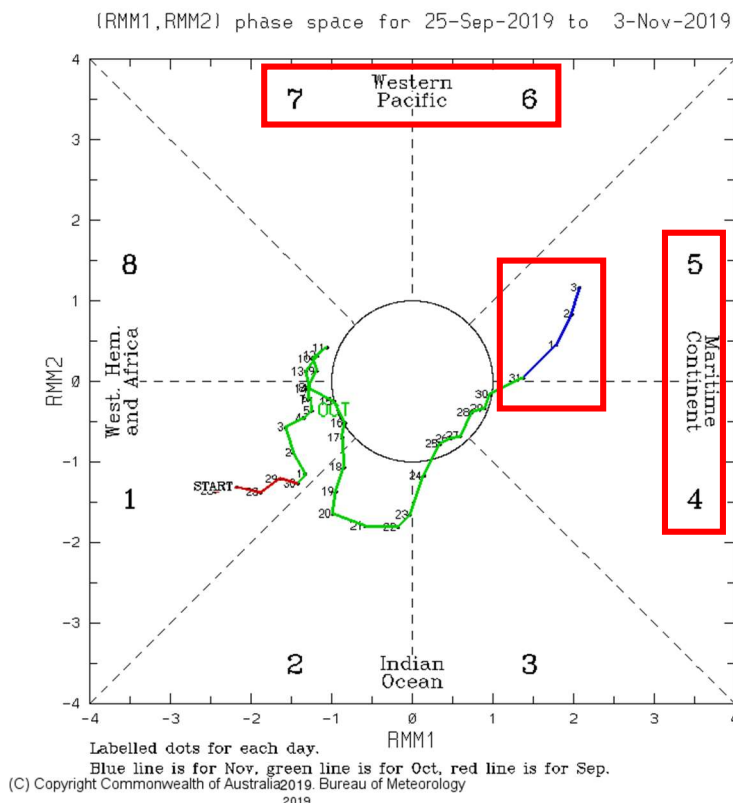
Deep wheel ruts in the inter-row area can be a source of sediment loss. They form due to excessive traffic during extended wet periods (Armour et al., n.d.). It may be necessary to periodically carry out inter-row renovation works to remove the wheel ruts from the inter-row area. Although inter-row renovation may be carried out at any time of year, it inevitably removes inter-row vegetation and puts your land at higher risk of erosion.

### Further resources

To minimise the risk of leaving bare soil exposed to rainfall, you can use the following information to check rainfall forecasts for the coming few weeks and months:

- [Bureau of Meteorology climate outlooks](#) show the chance of above or below average (median) rainfall over the coming months and are available at [www.bom.gov.au](http://www.bom.gov.au). Zoom in on the map and click on the town nearest to you to see more detail on possible rainfall totals. You can also look at the chance of at least a particular amount of rain falling.
- The [Madden Julian Oscillation](#) (MJO) plays a major role in tropical weather during the wet season leading to more cloud cover and a higher chance of monsoon rains. The MJO forecast is available from the Bureau of Meteorology website at [www.bom.gov.au](http://www.bom.gov.au). Although this forecast is more technical than the Bureau's seasonal outlooks, it provides a useful indication of rainfall over the coming few weeks.

You can interpret the MJO diagram as follows. If the blue line is outside the circle and in the areas of the chart marked Western Pacific (6 or 7) or Maritime Continent (4 or 5) (Figure 4), increased rainfall is more likely over tropical areas of northeast Queensland, and there is a greater chance of tropical cyclones forming.



**Figure 4:** The MJO diagram from the [Bureau of Meteorology](#) website. The blue line and areas of the chart to focus on are highlighted by the red boxes.

If the outlooks over the following weeks and month(s) suggest drier than average conditions that would indicate a preferable time to carry out inter-row renovation works. However, in addition to using these forecasts to help plan the timing of inter-row renovation works, you may also need to implement temporary measures to minimise soil loss and surface water run-off until the inter-rows are revegetated. Covered ground in the inter-row area should be re-established as soon as possible after these works have been completed.

### Fallow blocks - standard condition 13

To comply with Reef protection regulations for fallow blocks, you must establish a grassy fallow or cover crop after plants are removed in order to provide effective covered ground.

#### Further resources

More information on covered ground and suitable fallow crops, such as rapidly establishing companion crops or grasses, is available at the following:

- The Land and Soil chapter of [Banana Best Management Practices Environmental guideline](http://www.abgc.org.au), available on the Australian Banana Growers' Council website at [www.abgc.org.au](http://www.abgc.org.au)
- Chapter 12 of the [Soil Conservation Guidelines for Queensland](http://www.publications.qld.gov.au), available at [www.publications.qld.gov.au](http://www.publications.qld.gov.au).

### Measures to minimise soil loss and surface water run-off - standard condition 14

Erosion and sediment control measures to minimise soil loss and surface water run-off must be implemented and maintained at all times in areas on your agricultural property that have a **high risk of erosion**.

#### How do I know if I have land with a high risk of erosion?

Some areas of land have a higher risk of erosion than others. This includes areas with, but not limited to:

- a land slope of 3 percent (3 metres in 100 metres) or greater
  - the simplest way to measure the slope of specific blocks is by using Google Earth or you can use instruments such as a clinometer (DILGP 2015); or
- poor covered ground - that is less than 60 percent in terms of the inter-row space, or cover or fallow crops; or
- evidence of erosion, for example, abrasion, detachment or removal of soil from one point of the landscape to another. Examples can include evidence of active **sheet**, **rill**, and **gully erosion**; or
- newly renovated inter-rows.

#### Further resources

Detailed soil and land information relating to soil properties is available from:

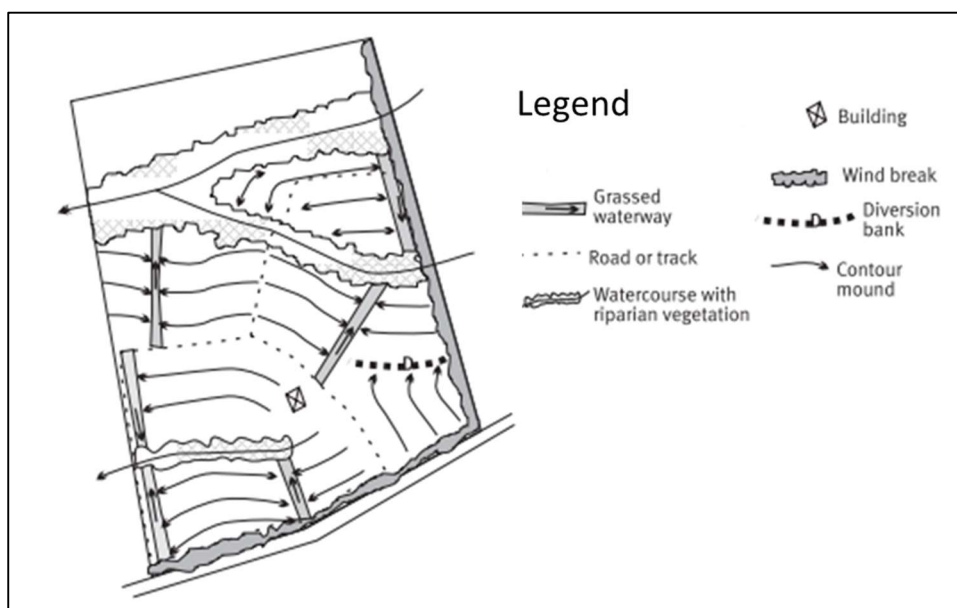
- the [Queensland Globe](http://qldglobe.information.qld.gov.au) at [qldglobe.information.qld.gov.au](http://qldglobe.information.qld.gov.au)
- the [Soil Conservation Guidelines for Queensland](http://www.publications.qld.gov.au), available at [www.publications.qld.gov.au](http://www.publications.qld.gov.au), which also includes information on a range of soil and cropping situations.

### Measures

The minimum practice standards do not mandate the implementation of specific measures. The measure/s you choose are up to you and should be the most suitable for your specific site. The design and size of any of implemented measures will depend on factors such as the topography and configuration of your property, the local climate, the catchment area and the area available for construction. You are strongly encouraged to consult an appropriate person before you begin work on any of sediment and erosion control measures. Implementing the wrong measure for your property could create other unintended problems.

The following are examples of measures that can be used to meet the erosion and sediment control requirements, and do not promote the use of one measure above others.

An example of where these structures might be placed is shown in Figure 5.



**Figure 5:** Example of run-off control measures on a banana farm, taking advantage of natural slope and drainage, and incorporating several of the measures described in this guide (Source: NRM Facts - Erosion control for bananas).

Measures that involve major earthworks can be introduced as blocks are replanted. Measures such as vegetated spoon drains, maintaining adequate covered ground, or drainage features that are external to the paddock can be implemented at any time during the crop cycle.

#### Further resources

- Chapters 2 and 6-9 of the [Soil Conservation Guidelines for Queensland](http://www.publications.qld.gov.au), available at [www.publications.qld.gov.au](http://www.publications.qld.gov.au), provide detailed information on soil conservation planning and design specifications for run-off control structures.

You may choose to consult a soil conservation expert to discuss the most suitable measures for your property, and for advice on the correct placement, construction and maintenance of all measures.

#### a) Surface water drainage structures

Drainage structures must be designed so that they minimise soil loss and surface water run-off to reduce run-off velocity. You should establish vegetated cover following construction of the structure and maintain this cover. An example of a suitable surface water drainage structure is a vegetated spoon drain:

##### Vegetated spoon drains

These structures (also known as constructed waterways or vegetated swales) are shallow, open, vegetated channels designed to collect run-off (Figure 6). They should be located where they can transport run-off to a drainage pathway or water storage (WetlandInfo 2018b). Their shallow form prevents slumping and slows run-off, allowing coarse and medium sized sediments to settle. Because sediment can be deposited within the spoon drain over time, especially where run-off is collected from areas with poor ground cover, the spoon drain may require reconstruction and/or sediment removal to ensure discharge capacity is maintained. You should re-establish vegetated cover immediately following any maintenance works.



**Figure 6:** Left: Diagram to show cross sections of vegetated drains (top) and vegetated swales (bottom). Right: Example of a wide, vegetated spoon swale on a banana property (Source: Queensland Department of Environment and Science, WetlandInfo 2018b).

### Regional considerations

Surface water drainage structures may need to be designed differently in regions with large volumes of intense rainfall, such as the Wet Tropics. In these regions, a higher gradient may be needed at the top of slopes to ensure sufficient drainage in addition to good vegetation in the drainage structures to maintain stability.

### Further resources

You can access detailed information on the design and construction of surface water drainage structures, including spoon drains at:

- [Vegetated swales and drains](http://www.wetlandinfo.des.qld.gov.au), available from the Department of Environment and Science WetlandInfo website at [www.wetlandinfo.des.qld.gov.au](http://www.wetlandinfo.des.qld.gov.au).
- [Chapter 9 – Waterways of the Soil Conservation Guidelines for Queensland](http://www.publications.qld.gov.au), available at [www.publications.qld.gov.au](http://www.publications.qld.gov.au).
- [Banana Best Management Practices Environmental Guideline](http://www.abgc.org.au) (pages 46–7), available from the Australian Banana Growers' Council website at [www.abgc.org.au](http://www.abgc.org.au).

You can find a list of plant species suitable for constructed waterways and/or drains in:

- [Appendix 4 of the Soil Conservation Guidelines for Queensland](http://www.publications.qld.gov.au), which can be accessed from [www.publications.qld.gov.au](http://www.publications.qld.gov.au).

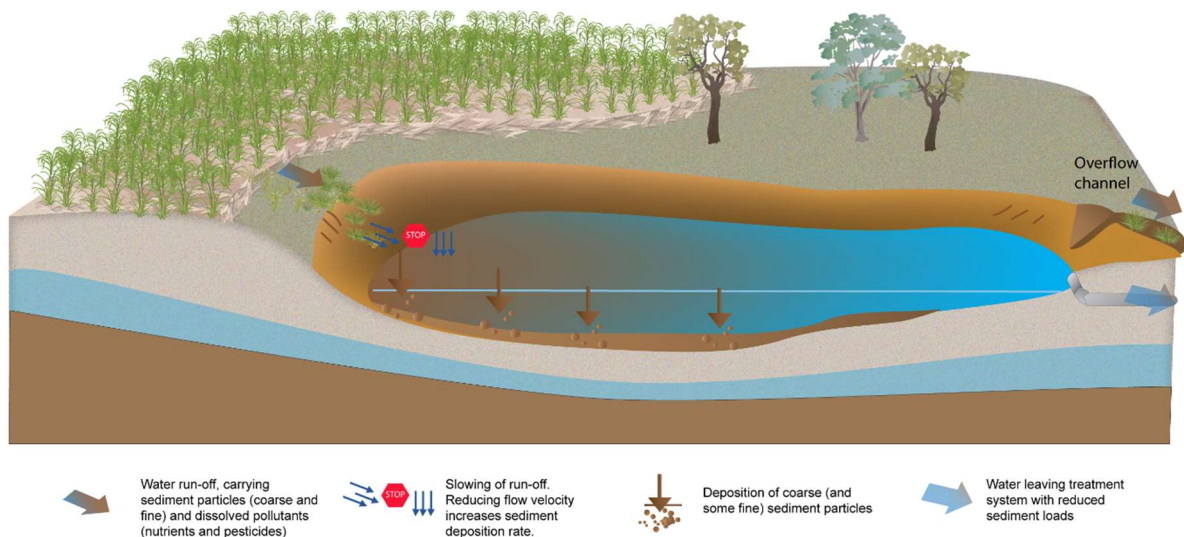
### b) Surface water detention structures

All surface water must drain to a suitable structure before reaching **receiving waters**. Examples of suitable structures include:

#### Sediment traps

Sediment traps (also known as silt traps or sediment basins) are structures that treat water by removing sediment, debris and litter suspended in run-off water by allowing it to settle out and be left behind when the water moves on. The size of the trap needed will depend on the area or size of the contributing catchment and the expected size of rainfall events to be treated.

Sediment traps should be designed so that all run-off water from the catchment area is collected and detained long enough to allow coarse and medium sized sediment to settle. Regular maintenance will be required to remove sediment that has built up and to retain the capacity of the sediment trap (WetlandInfo 2018c; Figure 7).



**Figure 7:** Top: Diagram to show how a sediment basin captures run-off water. Bottom: A newly constructed sediment basin (Source WetlandInfo 2018c).

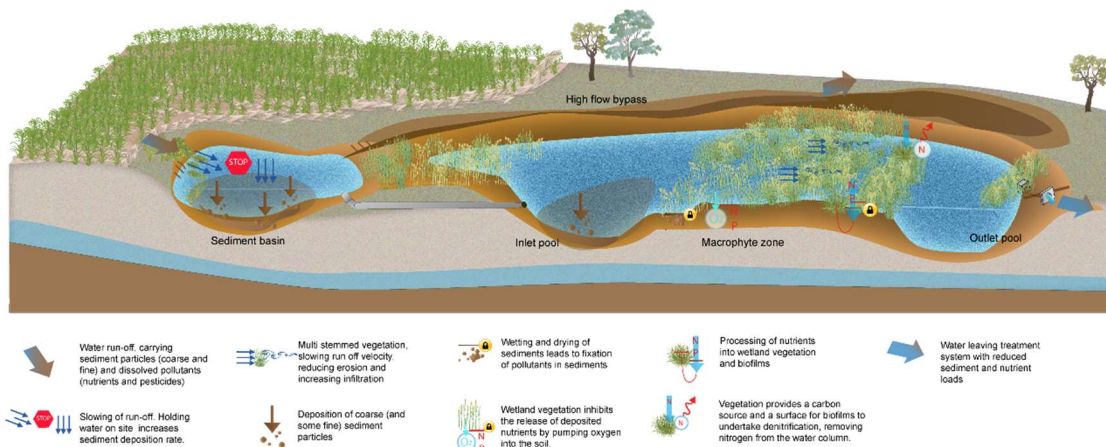
### Further resources

You can access further information on the placement, construction and maintenance of sediment traps:

- [Sediment basins](http://www.wetlandinfo.des.qld.gov.au), available from the Department of Environment and Science WetlandInfo website at [www.wetlandinfo.des.qld.gov.au](http://www.wetlandinfo.des.qld.gov.au).
- [Banana Best Management Practices Environmental Guideline](http://www.abgc.org.au) (page 46), available from the Australian Banana Growers' Council website at [www.abgc.org.au](http://www.abgc.org.au).
- [Soil Conservation Guidelines for Queensland: Chapter 12 Soil conservation in horticulture](http://www.publications.qld.gov.au), available from [www.publications.qld.gov.au](http://www.publications.qld.gov.au).

### Constructed wetlands

Constructed wetlands copy the conditions found in natural wetlands but can be built in a range of locations (Department of Employment, Economic Development and Innovation 2011; Figure 8). They improve water quality by removing fine sediments, nutrients and other pollutants.



**Figure 8:** Features of a constructed wetland.

### Further resources

You can find further information about the design, construction and management of wetlands at:

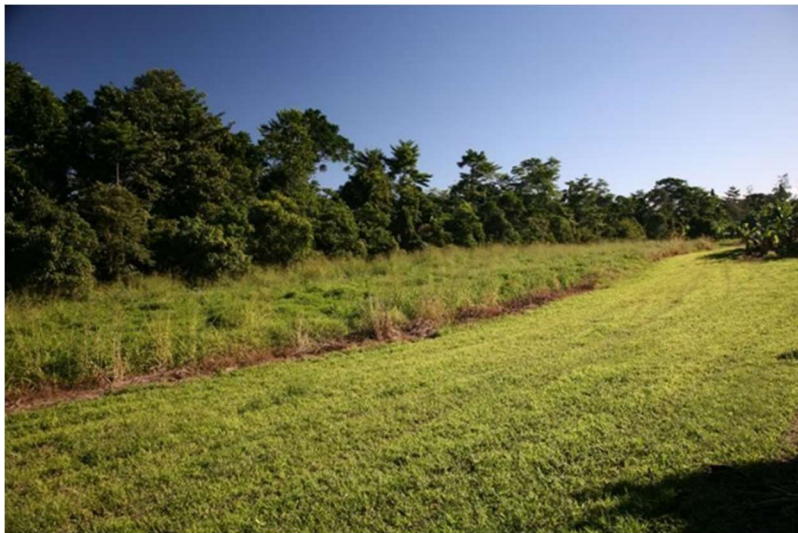
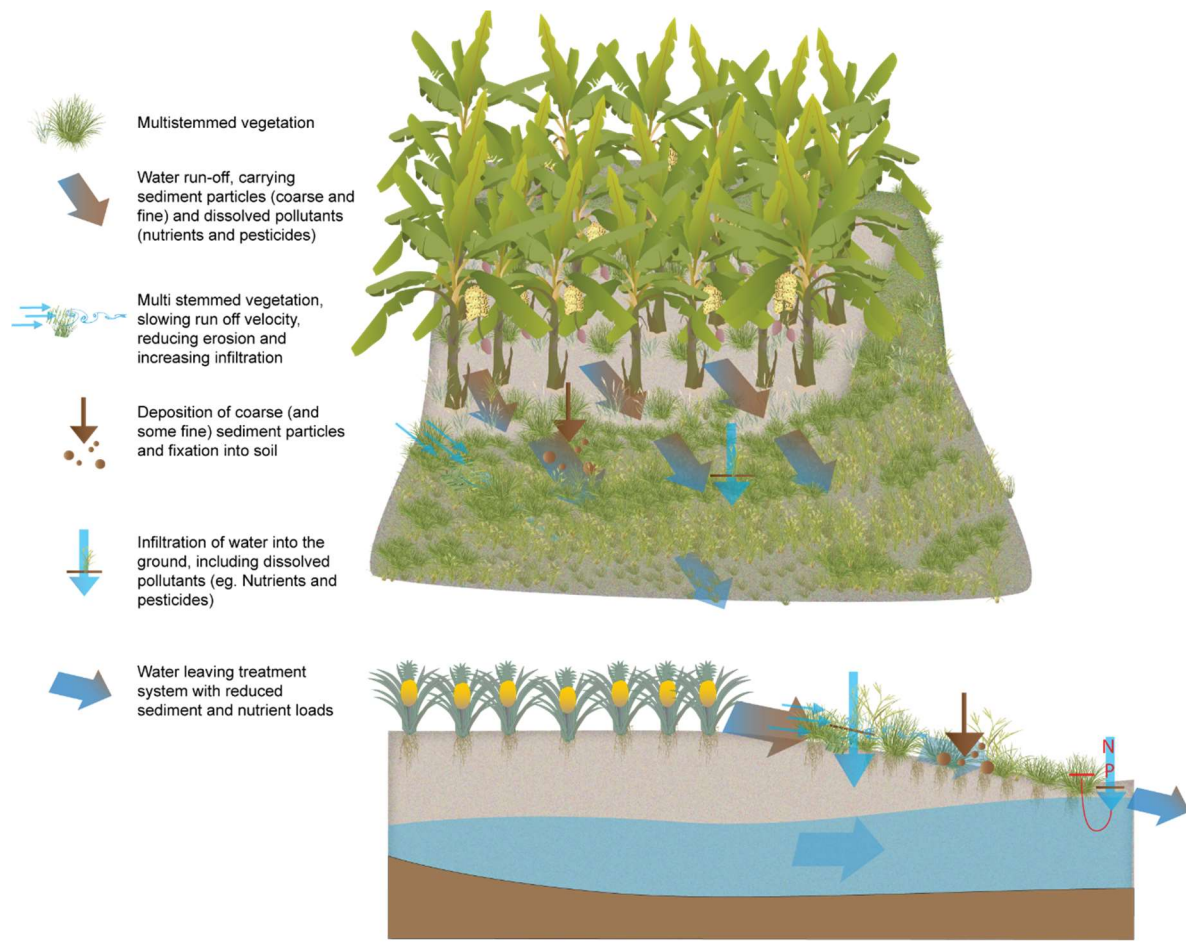
- [Constructed \(treatment\) wetland factsheet](#), available from the Department of Environment and Science WetlandInfo website at [www.wetlandinfo.des.qld.gov.au](http://www.wetlandinfo.des.qld.gov.au).
- [Treatment wetlands](#), available from the Department of Environment and Science WetlandInfo website at [www.wetlandinfo.des.qld.gov.au](http://www.wetlandinfo.des.qld.gov.au).

### c) Vegetated buffers

Vegetated buffers are an effective way to intercept the flow of water leaving a paddock and filter run-off containing sediment and nutrients before it enters a waterway (Carey et al 2015a; Figure 9). They should ideally be located adjacent to any receiving waters or riparian vegetation. The vegetated buffer should be at least five metres wide and should remain vegetated at all times. The overall width of the buffer should take into account soil loss rates, paddock size, land slope and the length available for the buffer strip.

A well-designed buffer strip will trap sediment generated during intense storms. Buffers in riparian areas can help reduce streambank erosion (Karssies and Prosser 1999). Buffers are most effective when the vegetation they contain is:

- dense and uniformly distributed
- perennial
- resistant to periods of flooding and drought (Prosser and Karssies 2001).



**Figure 9:** Top: Schematic to show how vegetated buffers slow and filter run-off on a banana plantation. Bottom: Example of a vegetated buffer adjacent to a banana production area (Source: WetlandInfo 2018b).

## Further resources

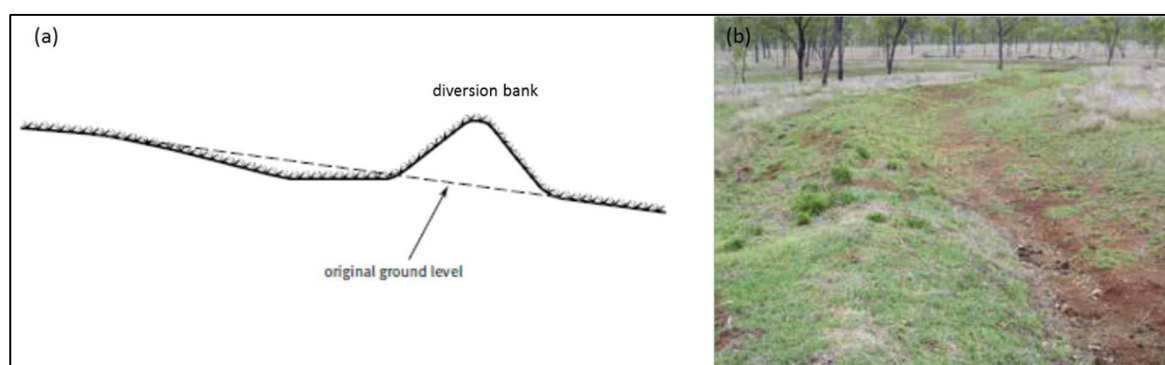
You can access detailed information, including specifications, on the design and construction of vegetated buffers at:

- [Soil Conservation Guidelines for Queensland: Chapter 12 Soil conservation in horticulture](http://www.publications.qld.gov.au), available from [www.publications.qld.gov.au](http://www.publications.qld.gov.au).
- [Buffer strips factsheet](http://www.wetlandinfo.des.qld.gov.au), available from the Department of Environment and Science WetlandInfo website at [www.wetlandinfo.des.qld.gov.au](http://www.wetlandinfo.des.qld.gov.au).
- [Guidelines for riparian filter strips for Queensland irrigators](http://www.clw.csiro.au), available from the Commonwealth Scientific and Industrial Research Organisation (CSIRO) website, [www.clw.csiro.au](http://www.clw.csiro.au).

High-value regrowth vegetation is protected in the Great Barrier Reef catchment. Vegetated buffers must comply with the Vegetation Management Act requirements. Refer to the [Department of Natural Resources, Mines and Energy](http://www.qld.gov.au/environment/land/vegetation/management) website for further information, at [www.qld.gov.au/environment/land/vegetation/management](http://www.qld.gov.au/environment/land/vegetation/management).

### d) Diversion banks

Diversion banks are usually constructed above a paddock and are used to divert run-off from areas where it could cause problems (for example cultivated paddocks or buildings) into a stable waterway such as a grassed channel, drainage line or water storage, where it can be safely disposed of (Figure 10; Carey et al 2015b; Queensland Government 2016).



**Figure 10:** Left: Cross profile of a diversion bank and Right: diversion bank in place on a property (Source: Soil Conservation Guidelines for Queensland Chapter 8).

## Further resources

You can access detailed information and specifications on the design and construction of diversion banks, including information on establishing a safe disposal area for run-off water at:

- [Queensland Soil Conservation Guidelines: Chapter 8 Diversion banks](http://www.publications.qld.gov.au), available at [www.publications.qld.gov.au](http://www.publications.qld.gov.au)
- [Run-off control measures for erosion control in cropping land](http://www.publications.qld.gov.au), available at [www.publications.qld.gov.au](http://www.publications.qld.gov.au)
- [Queensland Soil Conservation Guidelines: Chapter 2 Soil conservation planning](http://www.publications.qld.gov.au), available at [www.publications.qld.gov.au](http://www.publications.qld.gov.au)
- [Banana Best Management Practices Environmental Guideline](http://www.abgc.org.au) (pages 45–46), available from the Australian Banana Growers' Council website at [www.abgc.org.au](http://www.abgc.org.au).

Because diversion banks are usually located above the paddock, it may be possible to construct a diversion bank at any time during the crop cycle. You should seek specialist advice from an appropriate person on the correct placement, construction and maintenance of diversion banks.

#### e) Contour banks

Contour banks (also known as graded banks) are earthen banks constructed at intervals across a slope (Figure 11), with a slight gradient that is close to the natural contours of the land (Queensland Government 2016). They ensure that the flow velocity of run-off is slow enough to avoid erosion (Carey et al 2015a). In general, as the gradient of the land increases, contour banks should be constructed more closely together (Carey et al 2015c). Contour banks should be designed so that run-off is channelled into surface water drainage structures such as grassed waterways.



**Figure 11:** Left: Example of a contour bank layout on a banana farm (Source: figure 7.1, Chapter 7 Soil Conservation Guidelines). Right: Example of well-maintained contour banks on a Queensland farm (Source: [Preventing and managing erosion](#)).

#### Further resources

You can access detailed information and specifications on the design and construction of contour banks at:

- [Soil Conservation Guidelines for Queensland: Chapter 7 Contour banks](#), available at [www.publications.qld.gov.au](http://www.publications.qld.gov.au)
- [Soil Conservation Guidelines for Queensland: Chapter 12 Soil conservation in horticulture](#), available at [www.publications.qld.gov.au](http://www.publications.qld.gov.au)
- [Run-off control measures for erosion control in cropping land](#), available at [www.publications.qld.gov.au](http://www.publications.qld.gov.au)
- [Banana Best Management Practices Environmental Guideline](#) (pages 45–46), available from the Australian Banana Growers' Council website at [www.abgc.org.au](http://www.abgc.org.au).

If contour banks are suitable for your property, you should implement them during re-planting. You may choose to establish crop beds along the contours of the block and use the crop bed as a contour bank.

#### f) Any other measure that minimises soil loss and surface water run-off

The measures listed in the previous sections are not exhaustive, and you may choose to implement other erosion and sediment control measures that achieve the outcome of minimising the loss of soil to waterways.

Some examples of alternative measures are:

- Managing run-off with mounds, either cross-slope or down-slope. Refer to [Soil Conservation Guidelines for Queensland: Chapter 12](#) (section 12.4.5), available at [www.publications.qld.gov.au](http://www.publications.qld.gov.au)
- Managing run-off with terraces, by converting steeper land into a series of benches running across the slope. Refer to [Soil Conservation Guidelines for Queensland: Chapter 12](#) (section 12.4.6), available at [www.publications.qld.gov.au](http://www.publications.qld.gov.au)
- Other innovative measures that minimise the disturbance and loss of soil.

## Additional information

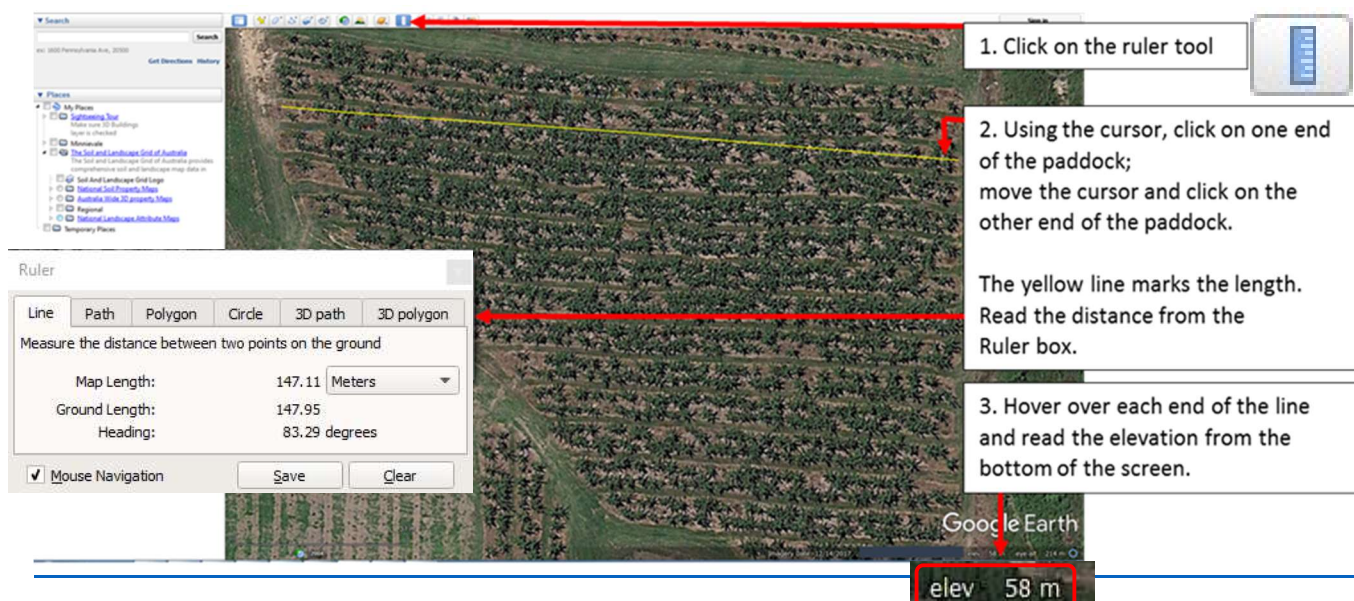
### How to calculate the slope of your property

Slope length is an important factor in determining erosion risk. For a given gradient, a longer slope allows run-off to concentrate, resulting in greater run-off volume and flow velocity with an associated greater potential for erosion (Carey et al., 2015a). You can measure the slope of specific blocks using Google Earth or using hand-held instruments such as a clinometer (Department of Infrastructure, Local Government and Planning, 2015).

To calculate slope using Google Earth, use the following steps:

- **Step 1:** find the length between the endpoints of your slope by using the ruler tool (Figure 12).
- **Step 2:** using the mouse cursor, click on one end of the slope, move the mouse and click on the other end of the slope. The length of the slope will be displayed on screen. Change the units to metres if this is not already displayed.
- **Step 3:** find the elevation of the top and bottom of your slope by hovering the mouse cursor over the area and reading the elevation from the bottom of the screen. Subtract the lower from the higher elevation to calculate the difference in elevation between the top and bottom of the slope.
- **Step 4:** the difference in elevation divided by the distance (in metres) between the two points will give you the slope percentage. Multiple your answer by 100 to calculate the slope as a percentage. You can find information on [How can I measure the slope of a landscape using Google Maps or Google Earth](#) via Quora, [www.quora.com](http://www.quora.com).

You can find detailed information on how to calculate slope using a variety of hand-held tools in the [RPI Act Statutory Guideline](#), available from the Department of Infrastructure, Local Government and Planning website at [www.dlgrma.qld.gov.au](http://www.dlgrma.qld.gov.au).



**Figure 12:** Example of how to use Google Earth to measure the slope of a particular area of land on your property. In this example, length of paddock = 147 m; elevation (top) = 58 m; elevation (bottom) = 48 m. To calculate the slope:  $58 \text{ m} - 48 \text{ m} / 147 \text{ m} \times 100 \text{ percent} = 6.8 \text{ percent}$ .

## Contacts

For professional advice on the measures described in this guide you can contact your local agronomist or the following organisations:

### **Department of Environment and Science (DES)**

☎ 13 QGOV (13 74 68)

✉ [officeoftheGBR@des.qld.gov.au](mailto:officeoftheGBR@des.qld.gov.au)

www [www.qld.gov.au/ReefRegulations](http://www.qld.gov.au/ReefRegulations)

### **Department of Agriculture and Fisheries (DAF)** extension officers can be contacted on:

☎ 13 25 23

✉ [callweb@daf.qld.gov.au](mailto:callweb@daf.qld.gov.au)

www [www.daf.qld.gov.au/about-us/contact-us](http://www.daf.qld.gov.au/about-us/contact-us)

Contact details for regional offices can be found here:

www [www.daf.qld.gov.au/contact/offices](http://www.daf.qld.gov.au/contact/offices)

### **Australian Banana Growers Council**

☎ 07 4015 2797

✉ [info@abgc.org.au](mailto:info@abgc.org.au)

www [www.abgc.org.au](http://www.abgc.org.au)

### **Natural Resource Management (NRM) groups**

www [www.nrmrq.org.au/find-your-regional-group](http://www.nrmrq.org.au/find-your-regional-group)

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