

The background of the entire page is a photograph showing deep, vertical erosion gullies in a brown, textured soil. The gullies are filled with water, and the surrounding soil appears to be a mix of sand and silt. The lighting is bright, highlighting the textures of the soil and the shadows within the gullies.

# SOILS of ipswich

FIELD GUIDE

*Erosion and soil types*

# Rationale for the guide

We are all obligated under Queensland legislation to conduct our activities in a manner that prevents harm to the environment. In particular we are bound by:

*Environmental Protection Act 1994*

*Environmental Protection (Water) Policy 2009*

*Sustainable Planning Act 2009*

*Soil Conservation Act 1986*

This Soils of Ipswich Field Guide is designed to assist you to identify soils at risk of erosion, so that you can plan and undertake appropriate erosion and sediment control measures in conducting your activities. Activities you conduct to which this applies include:

*Building and maintaining roads and services.*

*Infrastructure (e.g. stormwater, potable water, sewers etc.).*

*Construction works (e.g. building, installation of minor infrastructure in parks etc) and landscaping.*

*Designing, approving and monitoring development activities.*

*Any other activities that require the excavation and/or trenching of soils.*

The ultimate aim of the Guide is to assist you in preventing the erosion and transport of sediment to infrastructure (e.g. roadways, stormwater systems etc) and vulnerable environments (creeks, rivers, lakes, dams, wetlands etc) which results in costly or irreversible damage.

The Guide includes a general description of landforms and erosion, how to describe basic soil features and assess rapidly the vulnerability of a soil to water erosion. It includes basic descriptions of the major soil types in the Ipswich area that include general soil properties and management options.

**Produced by AECOM Pty Ltd and Ipswich City Council**

**Published by Ipswich City Council**

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# Landforms, Water Flow and Soil Erosion

Landforms can determine the risk of soil erosion due to the type of water flow they receive, and the catchment area that delivers the flow. Side slopes often produce *Sheet Flow*, whereas valley floors and gullies produce *Concentrated Flow*.

In the diagram on the right, soils on the ridge at **1** have low catchment area and experience minimum Sheet Flow.

Soils on lower side slopes at **2** receive higher amounts of Sheet Flow and have a larger catchment area.

Soils at the valley head at **3** receive Concentrated Flow from surrounding slopes and have a large catchment area.

Soils in the lower valley at **4** receive the highest amounts of Concentrated Flow and have the largest catchment area.

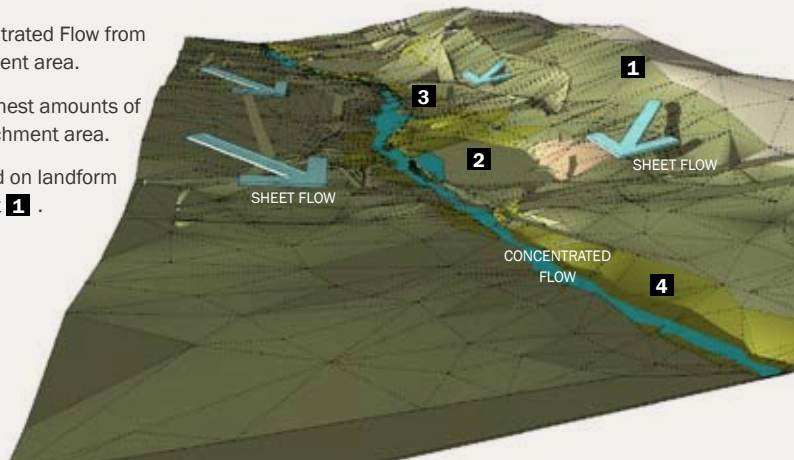
In this diagram, the risk of soil erosion based on landform is greatest at **4**, then **3**, **2**, and lowest at **1**.

When assessing the risk of soil erosion from a landform perspective, the following should be asked:

Is the soil situated on a ridge, side slope or valley?

What is the relative catchment area of the site?

Is the site expected to receive Sheet or Concentrated Flow?



# Types of soil erosion

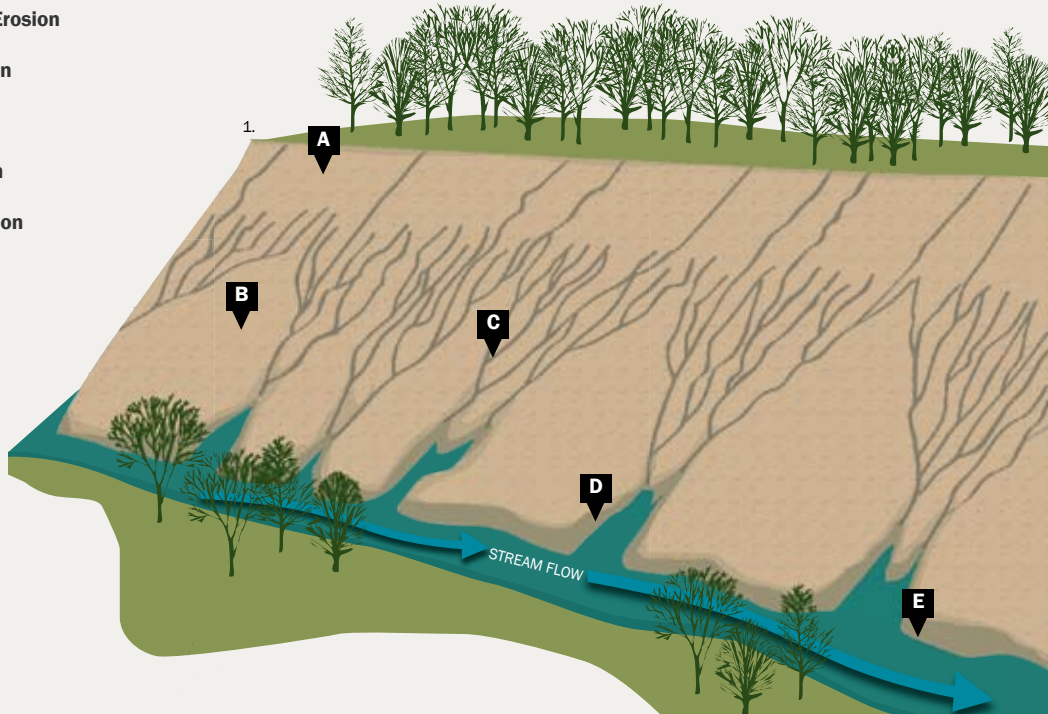
A. Rainsplash Erosion

B. Sheet Erosion

C. Rill Erosion

D. Gully Erosion

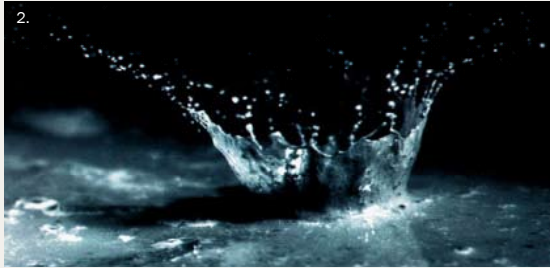
E. Stream Erosion



# Types of Soil Erosion

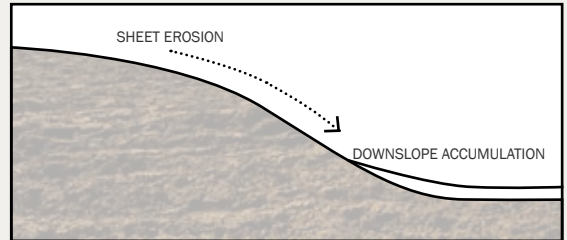
## Rainsplash Erosion

Erosion due to the impact of raindrops blasting soil particles from the soil surface. Particles can then be transported easily by sheet and other erosion types.



## Sheet Erosion

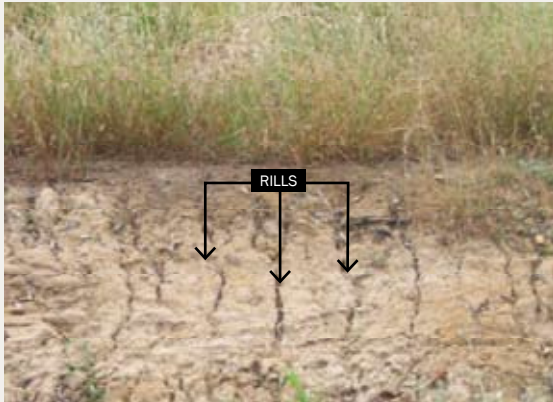
Removal of a shallow, uniform layer of soil from the surface. Often difficult to see due to no channels being formed, with downslope accumulation being the only indication.



# Types of Soil Erosion

## Rill Erosion

Removal of soil from the surface whereby small channels (rills) up to 300 mm deep are formed. These form where runoff concentrates into depressions caused naturally or by wheel tracks



## Gully Erosion

Removal of soil from the surface and subsurface caused by concentrated runoff eroding channels greater than 300 mm deep.

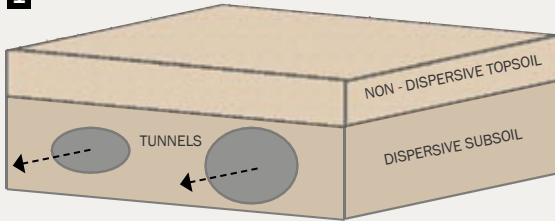


# Types of Soil Erosion

## Tunnel Erosion

Tunnelling occurs when infiltrating rainwater or overland flow causes subsoils to disperse, leading to subsurface piping and erosion. Dispersive soils are especially prone to tunnelling. If the topsoil collapses, sinkholes and gullies can form.

1



2

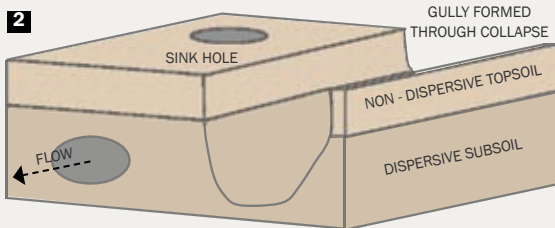


Photo by Matthew Hughes



# Erosion Control

Erosion control measures are the first line of defence in preventing onsite and offsite erosion effects and should be undertaken at all sites. Erosion controls are always the preferred option in managing on site and off site erosion effects. Erosion control is ultimately the cheapest control measure and achieves best outcomes when considering costs.

Erosion control aims to prevent or reduce soil erosion caused mainly by rainsplash and sheet erosion. The best form of erosion control is to maintain maximum plant cover on the soil surface, and minimise the “footprint” of soil disturbance. If plant cover is to be removed and soils disturbed, other typical erosion control measures may include:

- Bonded fibre matrix
- Compost blankets
- Erosion control blankets
- Graveling
- Mulching
- Revegetation
- Soil binders and surface stabilisers
- Surface roughening

Specific control measures will need to be selected depending on site conditions.

Focal points for erosion control are entry and exit points at work sites where heavy vehicles transit frequently. These need to be gravelled appropriately. These sites are dominated by finds due to constant vehicle movement.

Effective erosion control also means effective drainage control measures. Considerations should include:

- Diversion of up-slope stormwater runoff around soil disturbances and discharge off site
- Division of the work site into manageable drainage areas, and flow paths stabilised and managed. Dirty water is to be kept on site and disposed of appropriately e.g. evaporation, flocculation and discharge of clean water
- Minimise flow velocity and soil erosion within drainage channels and chutes (e.g. regular spacing of check dams etc.)

For detailed information see:

*IECA (2008). Best Practice Erosion and Sediment Control. International Erosion Control Association (Australasia)*

# Sediment Control

Sediment control measures are the *second line of defence* in preventing onsite and offsite erosion effects. They aim to trap and retain sediment eroded from the site (both very fine and larger particles).

*Typical sediment control measures include:*

- Buffer zones
- Construction exits
- Sediment fences
- Sediment basins / weirs
- Check dams
- Grass filter traps
- Rock filter traps
- Compost/mulch berms
- Drop inlet protection
- Flocculants

Specific control measures will need to be selected depending on site conditions.

Drainage control measures applicable to sediment control include:

- Diverting up-slope stormwater runoff away from excavations
- Diversion of “clean” water around sediment traps, reducing total volume of water to be trapped and treated and in turn reducing the size of the sediment control measure

For detailed information see:

*IECA (2008). Best Practice Erosion and Sediment Control. International Erosion Control Association (Australasia)*

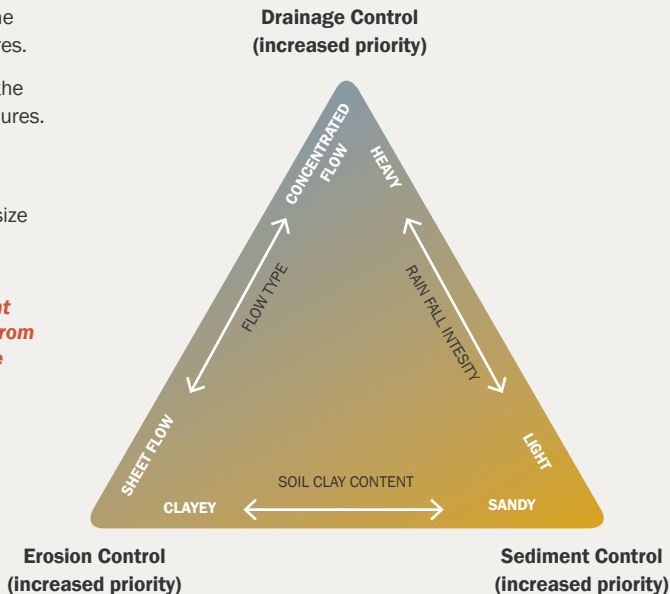
# Water Flow, Rainfall and Soil Clay Content

The higher the clay content of the soil, the greater the benefit normally obtained by erosion control measures.

The higher the sand content of the soil, the greater the benefit normally obtained by sediment control measures.

The diagram at right demonstrates how the general benefits of drainage, erosion and sediment control vary for various rainfall, water flow and soil particle size conditions.

***The diagram does not imply that erosion, sediment and drainage control should be used in isolation from each other. Each work site will probably use some combination of all three control types.***



# Describing Soils – Basic Features

## Non-Cracking clays and most other soils

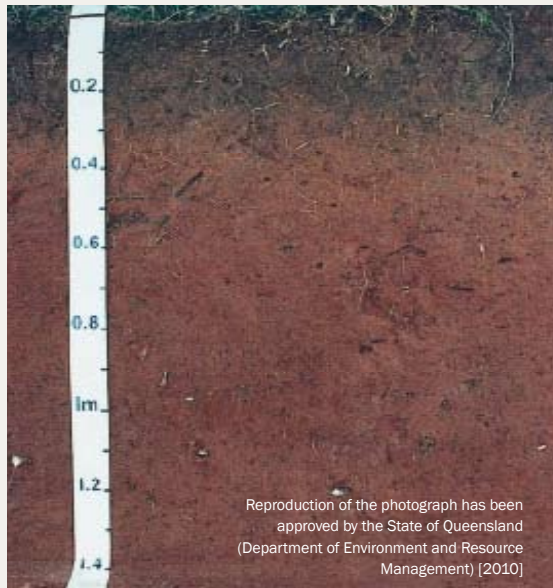
### TOPSOIL

Surface horizon with some accumulation of organic matter that is usually darker colour than lower horizons, or horizon which may be lighter in colour but has less clay than lower horizons

### UPPER SUBSOIL

Subsurface horizons characterised by one or more of: concentrations of clays, stronger colours (e.g. redder) than topsoils, structure and texture different to topsoils

### LOWER SUBSOIL



# Describing Soils – Basic Features

## Cracking Clays

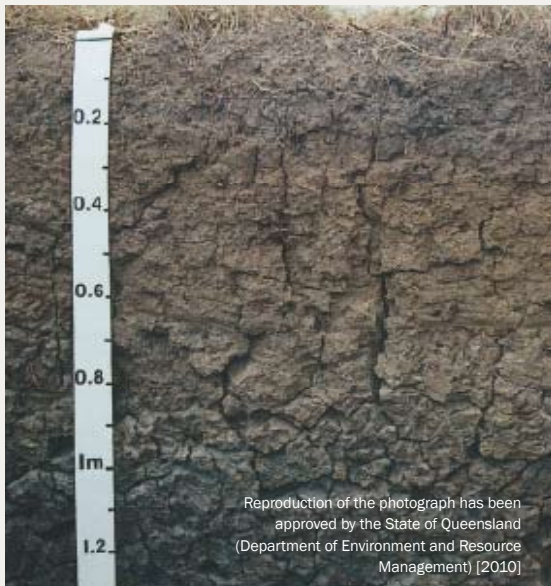
### TOPSOIL

Surface horizon comprised of crumb-like or larger soil aggregates, with irregular coarse spaces between them. Usually has same dark colour throughout

### UPPER SUBSOIL

Subsurface horizons characterised by larger, coarse blocky structures with usually only narrow spaces between them. Usually has same dark colour throughout

### LOWER SUBSOIL



# Describing Soils – What the Colours Mean

Soil colour	Characteristics	Constraints
Black	Soils high in organic matter, such as cracking clays, peats or organic soils	Excessive/prolonged wetness, vulnerable to compaction, salinity
Red	Well-drained soils with high content of iron oxides	Possibly vulnerable to compaction
Yellow or Yellow-brown	Imperfectly drained to moderately well-drained soils with high content of iron oxides	Excessive/prolonged wetness, possibly vulnerable to compaction
Brown	Moderate soil organic matter concentrations and some iron oxides	Subsoil may be dispersive
Grey or Blue Grey	Nearly permanent waterlogging	Excessive/prolonged wetness
Mottles (red,orange,yellow)	Intermittent waterlogging	Excessive/prolonged wetness

Adapted from Pattison et al. (2010). Soil health for vegetable production in Australia. State of Queensland, Department of Employment, Economic Development and Innovation. PR10-4543

# How to Assess Soil Erosion Slaking and Dispersion Potential

## Exposing the Soil

Depending on the nature of works, choose the most appropriate manner of observing the soil.

This may be as simple as using an auger to extract topsoil and subsoil for testing. Alternatively, a nearby road or stream cutting may provide sufficient information. If an excavator is being used due to the nature of works, such as trenching or landscaping, a pit or trench can be excavated.

***As with all trenching activities, appropriate health and safety precautions should be followed. No person should enter a trench or pit deeper than 1.2 metres.***

## Equipment Needed

- Spade or trowel
- Small glass or plastic jar
- Clean, clear water (1 litre)
- Timer (watch or mobile phone)

# How to Assess Soil Erosion Slaking and Dispersion Potential

## Assessing Soil Slaking (Collapse) and Dispersion

1. Using the spade or trowel, take a sample from the topsoil
2. Pour a small amount of water into the jar
3. Select 2 or 3 pea-sized soil aggregates you consider representative of the topsoil, and gently place them in the water
4. Leave on a stable surface and observe after 5 minutes
5. Repeat the process for the upper subsoil and the lower subsoil
6. Using your judgement, assign an overall rating to the subsoil e.g.

*If the aggregates stay together then the soil has good aggregate stability.*

*The soil is largely stable in water; or*

*If the aggregates fall apart, but the water remains clear, the aggregates have slaked.*

*The soil is vulnerable to slaking (collapse) in water, but shows little or no clay dispersion; or*

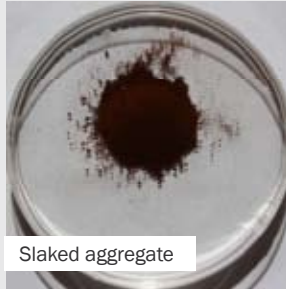
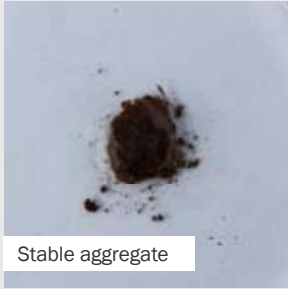
*If the aggregates fall apart and the water is cloudy, the soil is dispersive.*

*The soil is vulnerable to collapse in water and associated clay dispersion.*



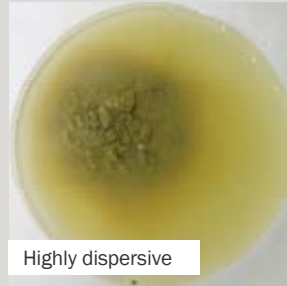
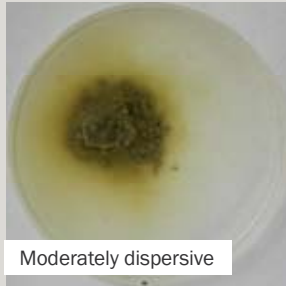
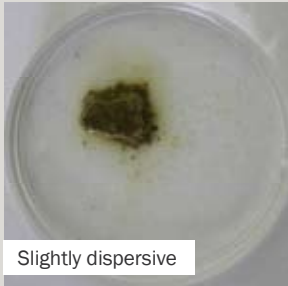
# How to Assess Soil Erosion Slaking and Dispersion Potential

## Slaked soil



© The State of Queensland, Department of Employment, Economic Development and Innovation (2010)

## Dispersive soil

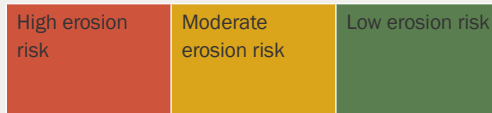


# Soil Erosion Risk Matrix

		Dispersion			Slaking	
		High	Moderate	Slight	Slaked	Stable
Concentrated Flow	High					
	Low					
Concentrated Flow	High					
	Low					

\* Overall dispersion or slaking rating for whole soil (Pages 14 and 15)

† Determine general flow conditions based on the diagram on Page 2



## Soil erosion and sediment control – the next steps

This Guide presents general advice only on assessing soil vulnerability to erosion. Once general site conditions have been assessed according to the Soil Erosion Risk Matrix, site checks to confirm soil types still need to be conducted and expert advice sought for erosion and sediment controls.

A comprehensive erosion and sediment control plan needs to be devised. This will include locations of:

- Erosion control measures
- Sediment control measures
- Drainage controls
- Site entry and exit controls
- Soil stockpiles

For comprehensive and detailed information see:

*IECA (2008). Best Practice Erosion and Sediment Control. International Erosion Control Association (Australasia)*

*Local Government Association of Queensland Inc. (2006). Introductory Erosion and Sediment Control Guidelines for Queensland Councils*

# Major soil types in the Ipswich area

The following section describes the six major Australian Soil Classification Orders mapped in the Ipswich City Council area. Where possible more than one example of a typical soil profile is presented.

It should be noted that this is not a comprehensive compilation of all possible soils found in the area, only the dominant ones. However, this is sufficient for conveying the general diversity of soils and their properties, especially as they relate to erosion present in the Ipswich area. The distribution of the six major soil types in the area is shown on the following map “Major soil types in the Ipswich area.” The six major soils are described on pages 20 - 31.

## **A note on terminology**

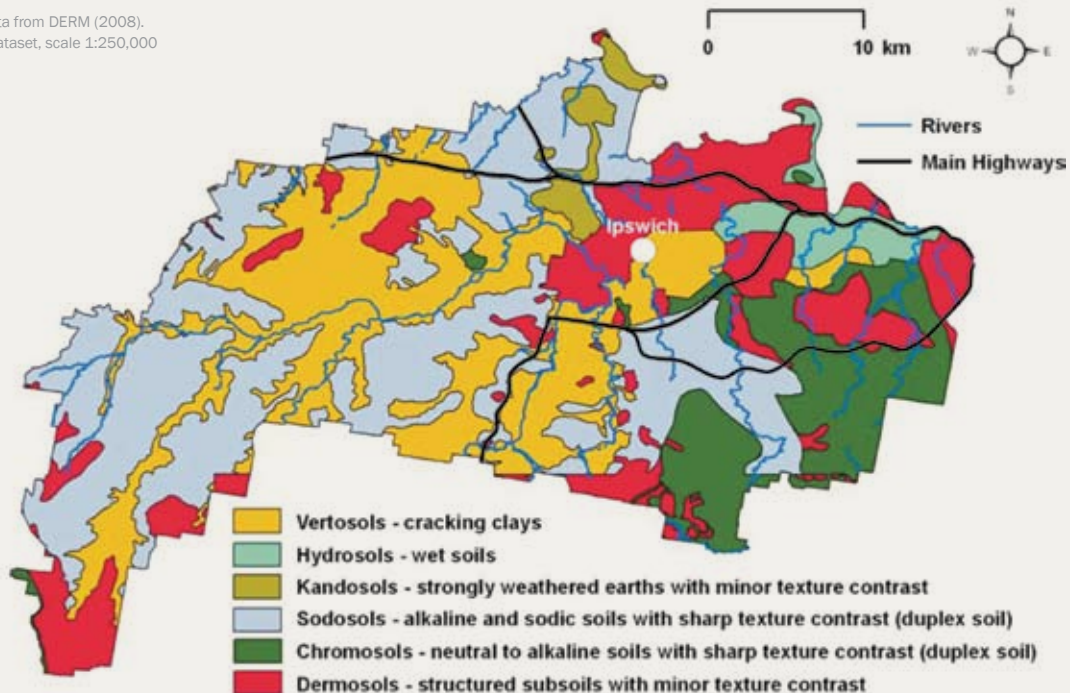
**Dispersive soils** – soils that are comprised largely of clays that are vulnerable to dispersion and erosion when wet. The soils known as Sodosols are particularly dispersive, but other clay-rich soils such as Chromosols, Dermosols, Vertosols and some Hydrosols and Kandosols are also vulnerable to dispersive erosion.

**Texture contrast** – those soils that have a significant change in soil particle size (texture) between topsoil and subsoil. This almost always refers to soils with sandy topsoils and clay-rich subsoils.

**Structured/well structured** – soils or individual soil horizons that exhibit organisation. This means that soil particles are amalgamated into large units called “aggregates”. Well structured soils have distinct aggregates of different sizes, with abundant cracks or pores throughout.

# Major soil types in the Ipswich area

Soil data from DERM (2008).  
Soils dataset, scale 1:250,000



## Vertosols – Cracking Clays



# Vertosols – Cracking Clays

## Landform and Distribution

Widespread on flat to undulating alluvial plains, creek flats and higher terraces

## Key Features

Clay-rich and often well-structured. Susceptible to water logging and compaction. Highly sticky when wet

## Erosion

Vulnerable to sheet and gully erosion on moderate slopes

## Erosion and Sediment Control

Surface cover should be maintained as much as possible. On site drainage should be diverted to reduce water flow velocity and to separate clean from dirty water. Sediment controls may require sediment basins

## Earthworks

Limitations due to water logging, clay content and cracking. Allow for 30% settling

## Fertility and Plant Growth

Some soils may be nutrient deficient, and aluminium and manganese toxicities may occur in some areas. Slow drainage may cause waterlogging and restrict plant growth



## Hydrosols — wet soils



Reproduction of the photograph has been approved by the State of Queensland (Department of Environment and Resource Management) [2010]



# Hydrosols – wet soils

## Landform and Distribution

Occur in the poorly drained sections of valley floors

## Key Features

Soil properties largely determined by height of water table, which is almost always relatively high. Grey colours and mottling indicate prolonged saturation. May be clay or sand throughout, or combinations of the two

## Erosion

Because they occur in the lowest parts of the landscape, sheet, rill, gully or tunnel erosion is rare, although flooding may be a problem. Disturbed soils exposed to stream flow may erode

## Erosion and Sediment Control

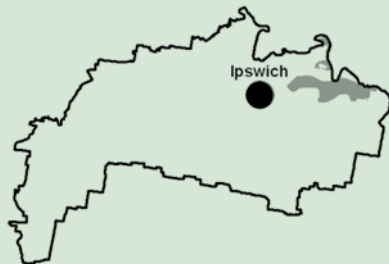
Upstream diversion should be considered to prevent site flooding and waterlogging. Sediment controls should be implemented to prevent downstream effects. Clay-rich soils may require sediment basins and the use of flocculants to settle out clays

## Earthworks

Suitable for roads and tracks except in the lowest positions

## Fertility and Plant Growth

Generally nutrient rich, although aluminium and manganese toxicities may occur in some areas. Soil surface may crust leading to poor soil-seed contact. Poor drainage may lead to oxygen-poor root conditions and inhibit plant growth



## Kandosols — strongly weathered earths with minor texture contrast



# Kandosols — strongly weathered earths with minor texture contrast

## Landform and Distribution

Occur on the crests and slopes of low hills

## Key Features

Usually deep (1.0 – 5.0 m). Weak soil profile development and gradual increase in clay content with depth

## Erosion

Highly erodible even on low slopes if bare

## Erosion and Sediment Control

Surface cover should be maintained as much as possible. On site drainage should be diverted to reduce water flow velocity and to separate clean from dirty water. Sediment controls for coarser (sandy) materials may include sediment fences, but finer materials may require sediment basins and the use of flocculants to settle out clays

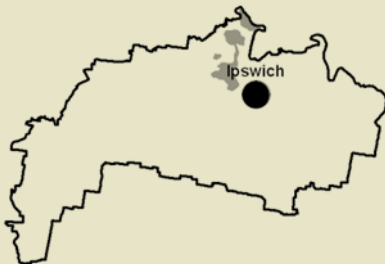
## Earthworks

Suitable for most earthwork operations. Allow for 30% settling

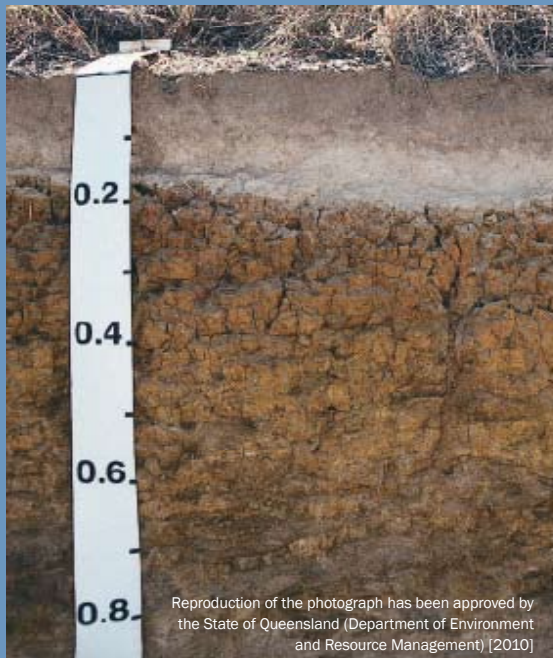
## Fertility and Plant Growth

Generally very low nutrient status, especially phosphorus and nitrogen.

Plant available water capacity is generally very low, and salinity may be a problem in some areas



## Sodosols – alkaline and sodic soils with sharp texture contrast



# Sodosols – alkaline and sodic soils with sharp texture contrast

## Landform and Distribution

Widespread on plains and low hills

## Key Features

Sharp contrast between sandy topsoils and clay-rich subsoils

## Erosion

Highly erodible. Vulnerable to sheet, tunnel and gully erosion due to highly dispersive subsoils

## Erosion and Sediment Control

Surface cover should be maintained as much as possible. On-site drainage should be diverted to reduce water flow velocity and to separate clean from dirty water. Sediment controls for coarser (sandy) materials may include sediment fences, but finer materials may require sediment basins and the use of flocculants to settle out clays

## Earthworks

Unsuitable for most earthwork operations

## Fertility and Plant Growth

Generally low to very low nutrient status. Plant available water is very low.

Plant growth is impeded by poor subsoil drainage due to high clay content, and is also impeded by tough clay subsoil



## Chromosols – neutral to alkaline soils with sharp texture contrast



# Chromosols – neutral to alkaline soils with sharp texture contrast

## Landform and Distribution

Yellower soils occur on gently undulating rises to rolling country. Redder soils occur on gently inclined and steep slopes in hilly country

## Key Features

Sharp texture contrast between sandy topsoils and clay-rich subsoils

## Erosion

Highly erodible even on shallow slopes. Prone to sheet erosion. Because subsoils are clay-rich, they are vulnerable to dispersion

## Erosion and Sediment Control

Surface cover should be maintained as much as possible. On site drainage should be diverted to reduce water flow velocity and to separate clean from dirty water. Sediment controls for coarser (sandy) materials may include sediment fences, but finer materials may require sediment basins and the use of flocculants to settle out clays

## Earthworks

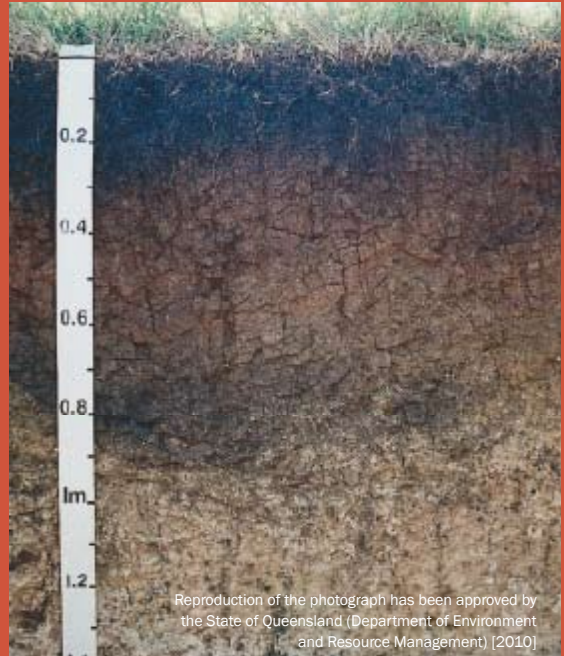
Suitable for most earthwork operations. Allow for 30% settling

## Fertility and Plant Growth

Generally low to very low nutrient status, and plant available water capacity is low



## Deromosols – structured subsoils with minor texture contrast





# Deromosols – structured subsoils with minor texture contrast

## Landform and Distribution

Widespread on mid to upper positions on low undulating hills

## Key Features

Clay-rich soils with well-structured subsoils

## Erosion

Highly erodible even on shallow slopes when bare. Because subsoils are clay-rich, they are vulnerable to dispersion

## Erosion and Sediment Control

Surface cover should be maintained as much as possible. On site drainage should be diverted to reduce water flow velocity and to separate clean from dirty water. Sediment controls may require sediment basins and the use of flocculants to settle out clays

## Earthworks

The cracking nature of these soils can be a limitation for earthworks. Allow for 30% settling. Limited suitability for roads and tracks, where accumulation of water in ruts and wheel tracks should be avoided

## Fertility and Plant Growth

Phosphorus may be low, and some soils may have elevated salt levels in the subsoils which may inhibit growth



## Further Reading

Harms, B.P. (1996). Field Manual, in Noble. K.E. (ed) Understanding and Managing Soils in the Moreton Region. Department of Primary Industries Training Series QE96003, Brisbane.

IECA (2008). Best Practice Erosion and Sediment Control. International Erosion Control Association (Australasia)

Local Government Association of Queensland Inc. (2006). Introductory Erosion and Sediment Control Guidelines for Queensland Councils.

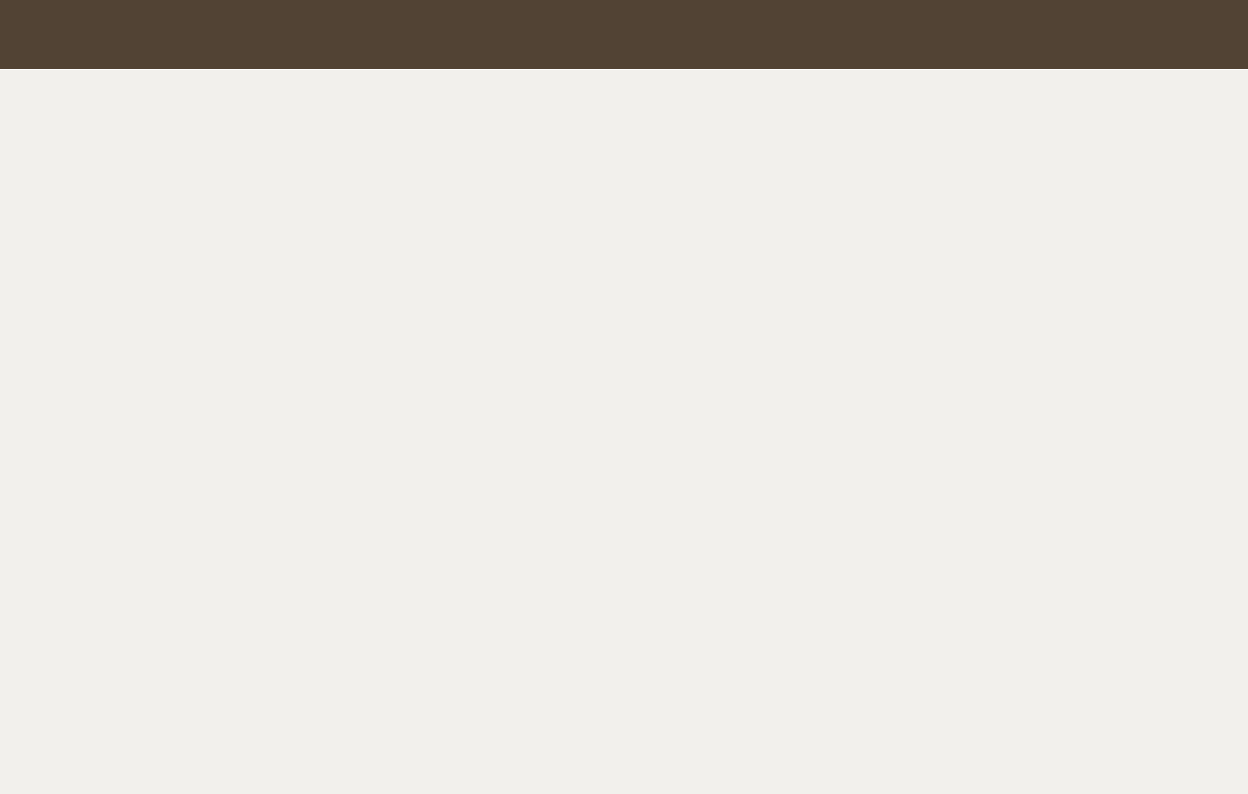
McKenzie, N., Jacquier, D., Isbell, R. and Brown, K. (2004). Australian Soils and Landscapes – An Illustrated Compendium. CSIRO Publishing

National Committee on Soil and Terrain (2009). Australian Soil and Land Survey Field Handbook, 3rd Edition. CSIRO Publishing.

Pattison, T. et al. (2010). Soil health for vegetable production in Australia. State of Queensland, Department of Employment, Economic Development and Innovation. PR10–4543

### Image Attributions

1. Adapted from: <http://saferenvironment.files.wordpress.com/2009/08/type-of-soil-erosion.jpg>.
2. From: <http://www.ipm.iastate.edu/ipm/icm/2005/5-2-2005/splash.jpg>.
3. Adapted from: [http://www.vbco.org/media/planningeduc/tn\\_raindrp.jpg](http://www.vbco.org/media/planningeduc/tn_raindrp.jpg).
4. From: <http://www.mo.nrcs.usda.gov/news/MOphotogallery/Erosion/sheet1.jpg>.





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