Soil Indicators of Queensland Wetlands

Soil Indicators of Queensland Wetlands: Field Guide

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1. Purpose

This guide has been developed to assist in the field identification of wetland soil indicators in Queensland, and is intended to be read and used in conjunction with the State-wide Assessment and Methodology report produced by Natural Resources and Water[1]. The soil indicators described in this guide are those recommended for wetland identification and delineation in Queensland.

This guide has been developed for use by people with knowledge of Australian soil sampling and description techniques as outlined in The Australian Soil and Land Survey Field Handbook[2]. Interpreting if a soil is considered a wetland soil requires the user has a basic knowledge of soil and landscape processes.

A Key for wetland identification using soil indicators was developed during the State-wide Assessment and underpins this field guide. The Key uses a "weights of evidence" based approach which allows more conclusive indicators of a wetland to be utilised on their own for wetland identification, whilst less conclusive indicators are used with landscape information.

The guide is intended to assist in the identification of wetland soil indicators in the field only. To determine whether a soil is considered a wetland soil, indicators should be assessed against the Key and interpreted with reference to the State-wide Assessment and Methodology report[1].

2. Background

Queensland's wetlands are diverse and widespread with more than 4% of the state classified as wetlands[3]. Wetlands play a number of roles in the environment and are vital for ecosystem function because they act as the ecotone between aquatic and terrestrial environments[4]. As wetlands perform numerous beneficial functions, mapping wetlands and defining the location of individual wetlands is a critical component of wetland management.

In Australia wetland identification has traditionally been conducted by examining biotic indicators and surface hydrology. Using these indicators alone to determine wetland boundaries can be difficult, especially at a finer scale and in wetlands that have been modified, are predominantly ephemeral or where there is a broad ecotone (transition zone) between the wetland and adjacent landscape. Soils, specifically the features that develop under wet conditions, change relatively slowly over time and therefore can provide useful information to support wetland identification, delineation and subsequently mapping.

3. Methods

3.1. Site sampling procedures

Site description

Soils are described according to the standards set out in the Australian Soil and Land Survey Field Handbook[2] to a depth of 1.0 m (where possible), with the presence or absence of wetland indicators recorded. A suggested field record sheet is included in this guide.

Microrelief and other surface characteristics, as well as hydrophytic flora and fauna should also be recorded.

Transect sampling

To interpret the processes occurring in a wetland and to capture the changes in soil features across the ecotone, it is recommended that transect sampling be used.

Transects should traverse the margin of the wetland, travelling from the saturated zone (wettest or lowest lying area) to areas outside of the wetland.

Sites along the transect should be chosen with reference to landform and vegetation changes as depicted in Figure 1.

Basic field equipment list for site sampling

- Auger/Shovel
- Australian Soil and Land Survey Field Handbook[2]
- Tape measure
- pH kit
- Soil colour chart
- Field record sheets
- Camera
- GPS
- Water

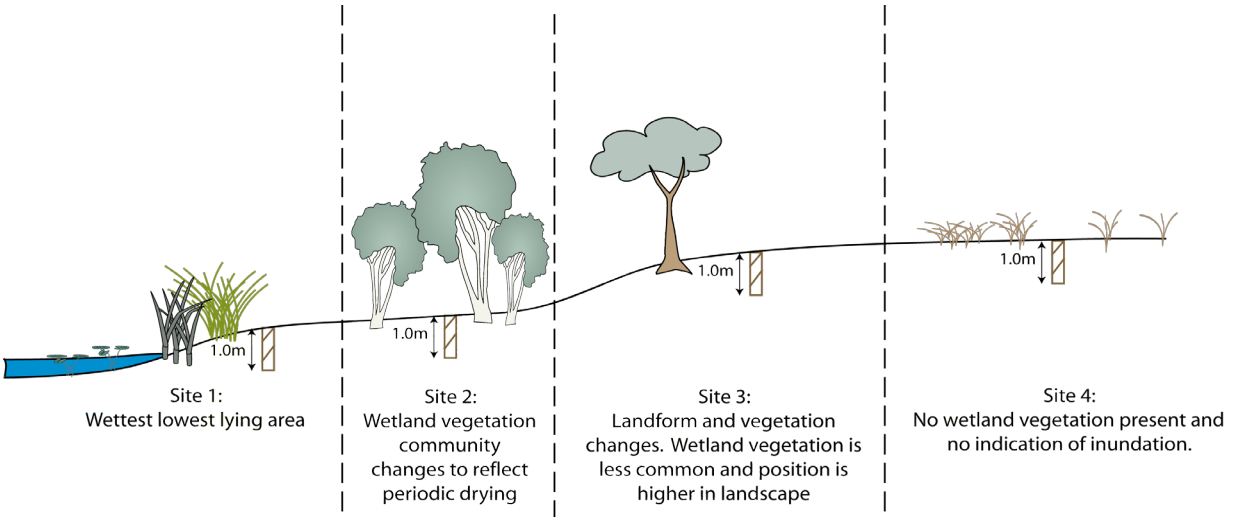


Figure 1. Diagrammatic representation of transect sampling with idealised example sites

4. Using the field guide and the Key

The field guide is divided into the three parts of the Key (Figure 2) and describes the indicators used to identify a wetland soil under each part. Once indicators and the soil profile have been described they can be Keyed out with reference to the State-wide Assessment and Methodology report[1] to determine whether the profile is considered a wetland soil.

There are three well defined steps for using the Key to determine if a soil is classed as a wetland soil:

PART 1) From the classification of the soil profile using the Australian Soil Classification[5].

PART 2) From the wetland soil indicators present, as outlined in this field guide and described using methods from the Australian Soil and Land Survey Field Handbook[2].

PART 3) From the soil indicators and landscape information to assess the current hydrologic regime.

Key to wetland identification using soil indicators

Part 1: Wetland soils

1) Is the soil an Organosol in the Australian Soil Classification*?

Yes	.....	Within wetland
No	.....	Go to 2

2) Does a P horizon occur within 0.3 m of the soil surface**?

Yes	.....	Within wetland
No	.....	Go to 3

Part 2: Wetland soil indicators

3) Which climatic region is the site in?

Tropical/Equatorial	.....	Go to 4
Subtropical	.....	Go to 4
Semiarid	.....	Go to 5
Arid	.....	Go to 5

4) Are organic materials present within 0.3 m of the soil surface and is the thickness of the organic materials layer at least 0.2 m?

Yes	.....	Within wetland
No	.....	Go to 5

5) Is there evidence of acid sulfate soils within 0.3 m of the soil surface?

Yes	.....	Within wetland
No	.....	Go to 6

6) Is there evidence of gleyed soil matrix colours in a horizon starting within 0.3 m of the soil surface?

Yes	.....	Within wetland
No	.....	Go to 7

7) Are redox features present within the 0.3 m of the soil surface?

Yes	.....	Go to 8
No	.....	Not a wetland soil

Part 3: Landscape features

8) Do the surrounding landscape features provide supporting evidence of a current hydrologic regime?

Yes	.....	Within wetland
No	.....	Insufficient evidence to identify a wetland soil

* Isbell (2002)
** P horizon as defined by Mcdonald *et al* (1990)

Figure 2. Key to wetland identification using soil indicators

Identifying Wetland Soil Indicators

Part 1 - Wetland Soils

Organosols

Under the Australian Soil Classification (ASC)[5] only Organosols can be called a wetland soil. The exception is Organosols present at higher altitudes which may not form under saturated conditions.

The definition of an Organosol from the ASC[5] is:
Soils that are not regularly inundated by saline tidal waters and either:

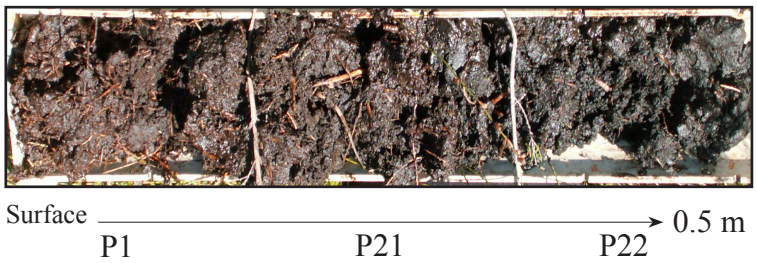
i. Have more than 0.4 m of organic materials within the upper 0.8 m. The required thickness may either extend down from the surface or be taken cumulatively within the upper 0.8 m, or

ii. Have organic materials extending from the surface to a minimum depth of 0.1 m; these either directly overlie rock or other hard layers, partially weathered or decomposed rock or saprolite, or overlie fragmental material such as gravel, cobbles or stones in which the interstices are filled or partially filled with organic material. In some soils there may be layers of humose and/or melacic horizon material underlying the organic materials and overlying the substrate.

Example: Organosol

Peat Horizons

Peat horizons (or P horizons) are defined in the Australian Soil and Land Survey Field Handbook[2] as “horizons dominated by organic materials in various stages of decomposition that have accumulated either under water or in conditions of excessive wetness”.



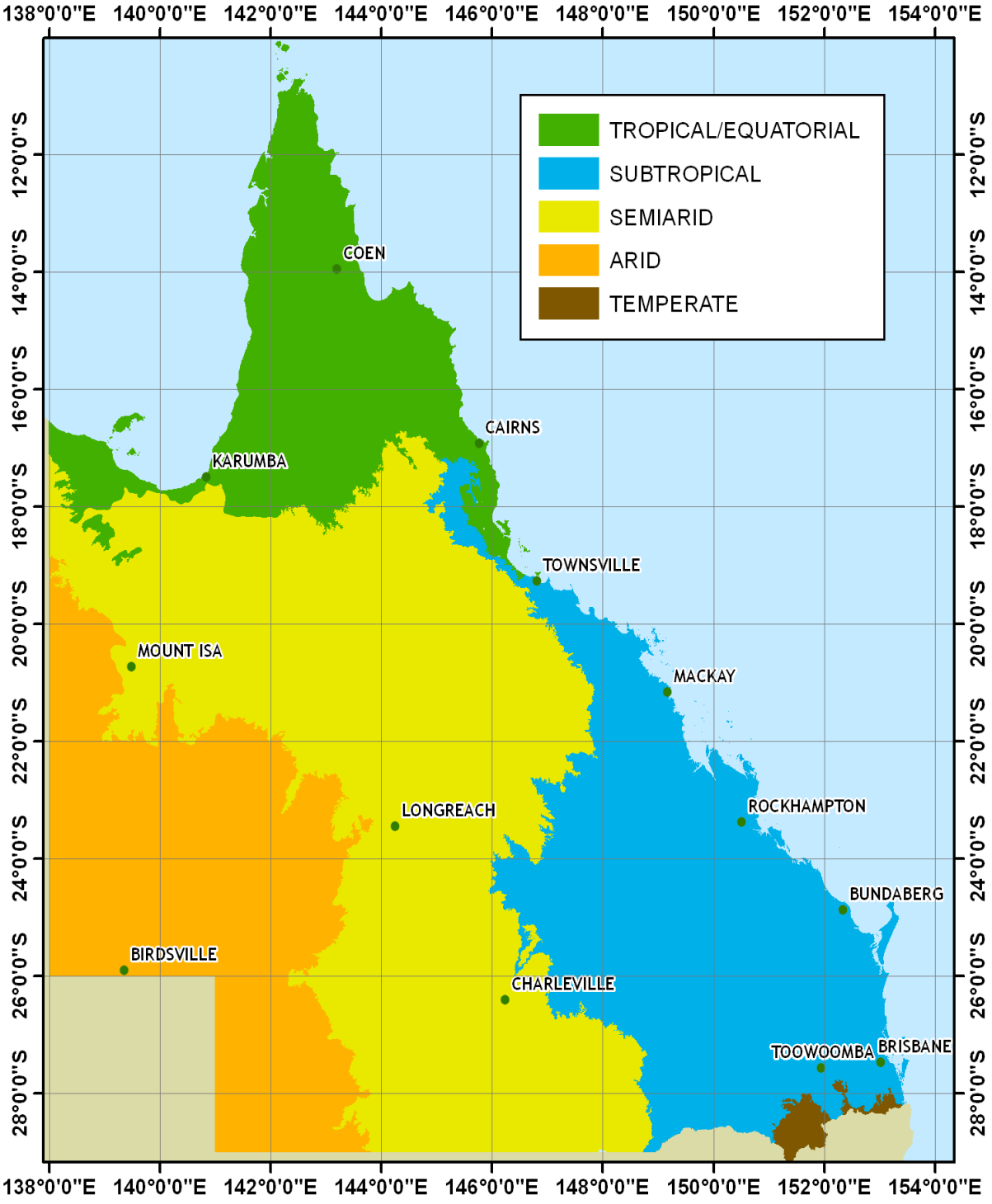
Example: P Horizons

Part 2 - Wetland soil indicators

Climatic region

Climate is an important factor that influences the presence and type of soil indicators that form within wetlands. The climatic region the site is located within, must be defined prior to further analysis of wetland soil indicators.

For the purposes of the Key, wetlands in the temperate climatic region are classed as occurring within the subtropical region.



Part 2 - Wetland soil indicators

Organic materials

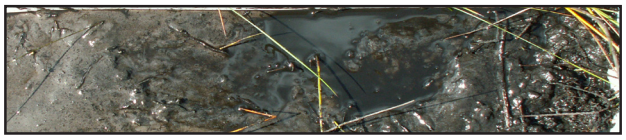
Wet soil conditions favour the accumulation of organic horizons, that consist predominantly of decomposed plant material (e.g. fibric, hemic or sapric peat), have a thick layer of decomposing plant material on the surface, or have a dark surface.

Fibric: Undecomposed or weakly decomposed organic materials
Hemic: Moderately to well decomposed organic materials
Sapric: Strongly to completely decomposed organic materials
Streaked organic materials: Soil is sandy and has dark stains (streaks) of organic materials

Streaked organic materials

Fibric organic materials

Sapric and hemic organic materials



** It is recommended presently that to classify as a wetland soil, a layer with fibric, hemic or sapric textures (which are not part of a P horizon) must have a thickness of at least 0.2 m which starts within 0.3 m of the soil surface.*

Acid sulfate soils

Acid sulfate soils (ASS) are the common name given to soils and sediments containing iron sulfides, the most common being pyrite. When exposed to air, these soils produce sulfuric acid, often releasing toxic quantities of iron, aluminium and heavy metals[6] . Acid sulfate soils must occur within a horizon in the top 0.3 m of the soil profile to be classed as a wetland soil indicator. Common indicators of acid sulfate soils are:

Sulfurous Segregations (yellow jarosite): The presence of jarosite is a conclusive field indicator of acid sulfate soils. It is yellow in colour and requires very acidic conditions to form[7].

Monosulfidic Black Ooze: The presence of organic oozes enriched with monosulfides, known as monosulfidic black ooze (MBO), are a common feature of acid sulfate soils.

Hydrogen Sulfide Gas: When disturbed acid sulfate soils may smell like rotten eggs (hydrogen sulfide gas).

Example: Monosulfidic Black Ooze

Example: Jarosite*

** Jarosite photo courtesy of Queensland Acid Sulfate Soils Investigation Team, NRW, Brisbane*

Part 2 - Wetland soil indicators

Gleyed matrix colours

A gleyed matrix is a bluish-grey or grey colour that occupies 50% or more of a layer starting within 0.3 m of the soil surface.

Redox Features: For the purposes of the Key redox features include mottles, segregations (iron and manganese), ferruginous root channel and pore linings and decreasing soil matrix chroma. These features can be an indication of a current OR relict hydrologic regime and need to be interpreted in the context of current hydrologic information or landscape features.

Mottles: Are usually an indicator of poor drainage or water fluctuation throughout a profile.

Clay

Sand

Segregations: Develop in areas that have been subject to air penetrating quickly in a saturated environment.

Ferruginous

Manganiferous

Ferromanganiferous

Ferruginous root channel linings: Are evidence of a plant growing in a saturated environment.

Ferruginous pore linings: Are where oxygen has been able to move through the soil pores causing a ferric iron coating to form.

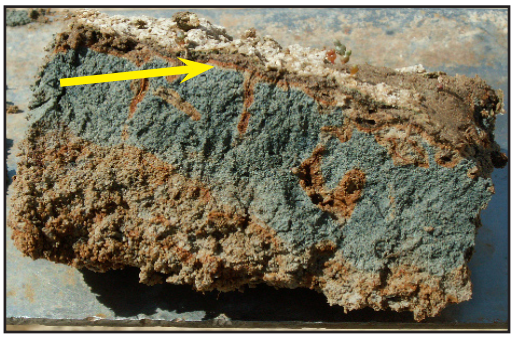
Soil matrix chroma: Is a method for describing soil colour that depicts the purity or strength of the colour. Matrix chroma values decrease with increasing duration of saturation.

Part 2 - Wetland soil indicators

Soil Water Interface

A thin layer of red or orange soil colour at the surface of the soil water interface is evidence of iron oxidation reactions.

** Given the limited occurrence of this indicator it is not recommended as a primary wetland soils indicator but if present it provides a clear indication of the water table depth.*



Part 3 - Landscape Features

Microrelief

Refers to the relief up to a few meters about the plane of the land surface[2]. Of particular relevance to wetlands is hummocky microrelief.

Debil Debil: Are small hummocks which rise above a planar surface. They can vary from rounded to flat topped, relatively steep sided and elongate[2].

Swamp Hummock: Are steep sided hummocks rising above a flat surface. Hummocks are frequently occupied by trees and shrubs while the lower surface may be vegetation free or occupied by sedges or reeds[2].

Soil core dug at base of swamp hummock. Vertical height of hummock is 0.4 m

Algal Mats

Algal mats are a continuous crust of biologically stabilised soil material and are an indicator of recent ponding.

Aerial Roots

Aerial roots are an adaptation of plants to a waterlogged environment and are an indicator of a current hydrologic regime (e.g. Mangroves).

Part 3 - Landscape Features

Floodmarks

Floodmarks consist of water transported debris, silt lines, or water marks on trees or leaves. When applying the use of water carried debris and silt lines as evidence of a current hydrologic regime, it is important to note these indicators can persist in the environment from a once-off event.

Floodmarks

Water carried debris

Silt lines

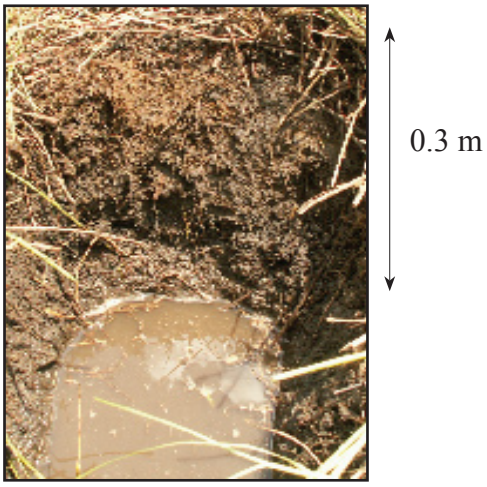
Iron Staining

Extensive iron staining is usually a by-product of the oxidation of acid sulfate soils. This leads to the formation of rust coloured stains which coat the surrounding environment[7].

Water table depth

Observing a water table within 0.3 m of the soil surface is a good indicator of wetland status, however it is not conclusive. A water table is needed to be observed for a period of time as the duration of saturation cannot be determined from a single site inspection.

The exact period of time a water table should be present is not currently defined in Queensland. The lack of a water table however does not mean that the soil is not saturated at some time and may therefore be classed as a wetland.



Field record sheet

Date: ..... Described by: .....

Wetland name (if known): .....

Location: Latitude ..... Longitude .....

Zone: ..... Easting ..... Northing .....

Climatic region: Tropical ☐ Subtropical ☐ Semiarid ☐ Arid ☐

Wetland Soils

ASC .....

P Horizon Present ☐ Not Present ☐

Thickness of P Horizon layer .....

Wetland Soil Indicators

Organic Material (within 0.3 m of the soil surface)

Present ☐ Not Present ☐

Thickness of organic materials layer .....

Texture qualifier Fibric ☐ Sapric ☐ Hemic ☐

Acid Sulfate Materials (within 0.3 m of soil surface)

Hydrogen sulfide gas (rotten egg gas) ☐ Monosulfidic black ooze ☐

Sulfurous segregations ☐

Gley Colours Present ☐ Not present ☐

Thickness of gley layer ..... Depth to gley layer .....

Soil Water Interface Present ☐ Not present ☐

Depth to soil water interface .....

Mottles (within 0.3 m of the soil surface) Present ☐ Not present ☐

Segregations (within 0.3 m of the soil surface) Present ☐ Not present ☐

Ferruginous root channel and pore linings (within 0.3 m of the soil surface)

Present ☐ Not present ☐

Soil Matrix Chroma

Are chroma values less than or equal to 2 in the wettest lowest lying area? Y ☐ N ☐

Do chroma values decrease moving into the wetland from sites considered outside?

Y ☐ N ☐

Landscape Features

Microrelief

Debil Debil Present ☐ Not present ☐

Swamp Hummock Present ☐ Not present ☐

Algal mat Present ☐ Not present ☐

Aerial roots Present ☐ Not present ☐

Floodmarks Present ☐ Not present ☐

Flood carried debris Present ☐ Not present ☐

Silt lines Present ☐ Not present ☐

Iron staining Present ☐ Not present ☐

Depth to water table .....

NOTES

5. References

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