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Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Prepared for: Department of Environment, Water and Natural Resources, as part of the Coorong, Lower Lakes and Murray Mouth Program

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Contents

List of Figures

List of Tables

Acknowledgments

EXECUTIVE SUMMARY

Prior to mid 2010, drought in south eastern Australia led to lowered water levels and exposure of large areas of previously submerged soils and sediments in the Lower Lakes (Lakes Alexandrina and Albert) and adjacent tributaries (Finniss River and Currency Creek). The exposure and drying of hypersulfidic materials caused a number of impacts related to Acid Sulfate Soils (ASS) in the Lower Lakes. These included soil acidification and more locally, water acidification and metal mobilisation.

From March 2010, increased rainfall within the Murray-Darling Basin catchment resulted in high flows and increased water levels in Lakes Alexandrina and Albert increasing from approximately -0.8 m to managed levels around +0.75 m Australian Height Datum (AHD). Hence, oxidised acidic soils that had formed along the previously dried margins of the Lower Lakes became inundated.

Prolonged inundation of oxidised ASS material can promote the onset of reducing conditions, that ultimately results in the reduction of sulfate to sulfide. Although this process typically results in a trend back towards previous conditions when the soils were inundated, the timescales were poorly known and in the interim period acidity and contaminants may be released to the soil porewaters. Surface water may flush acidity (H^+) and trace metals either down through the profile and/or into the water column. The degree to which acidic soils had been neutralised following reflooding generally fell into four categories depending on time of inundation and degree of neutralisation (increase in soil pH/alkalinity):

1. Limited neutralisation throughout profile (inundated: 2½ and 3 years)

2. Limited neutralisation throughout profile (inundated: 21 months)

3. Neutralisation of upper 20 to 40 cm of profile (inundated: 21 months)

4. No significant neutralisation (inundated: 21 months)

Generally, soil material that had remained non-acidic during drought conditions was relatively unaffected by reflooding and transformed from hyposulfidic/hypersulfidic to hyposulfidic/hypersulfidic subaqueous.

Changes in soil conditions have resulted in cycling of acidity from potential to actual acidity and a partial return to potential acidity. The rate and processes which control acidic soil neutralisation in the Lower Lakes has been poorly understood. It is dependent *inter alia* on duration of inundation, landscape position, soil texture, mineralogy and organic carbon content. Additionally, when future droughts cause these sediments to become exposed again, it is unclear how rapidly they will re-acidify.

Contaminant and metalloid dynamics tests were undertaken to determine contaminant hazards and temporal changes in solute chemistry. These highlighted the presence and bioavailability of a range of contaminants in the selected study areas around Lake Alexandrina (Dog Lake, Boggy Lake and Point Sturt), many above ANZECC Guideline values for freshwater ecosystems.

Follow-on work should include annual monitoring of ASS in the Lower Lakes to provide important information about soil acid-neutralisation rates following inundation which will be used for management decision making. In-situ sampling should be undertaken to determine porewater concentrations at a greater resolution, the latter being related to advective vs. diffusive fluxes as well as chemical buffering reactions within the soil, required for an understanding of transport mechanisms and prediction of impact. Future work could also focus on imposed changes e.g. wetting and drying, but should be undertaken at least at soil core scale to better mimic reaction-transport in the complex profiles in the Lower Lakes. Finally, the impacts on soil ecosystem function and biodiversity are poorly understood and should be given some scope in future research programs.

1. INTRODUCTION

1.1 Background

Prior to mid 2010, reduced inflows from the River Murray to Lakes Alexandrina and Albert (the Lower Lakes) in South Australia resulted from the persistent drought in the Murray-Darling Basin. In the Lower Lakes, the combination of decreasing water levels and gently sloping near-shore lake beds caused large expanses of previously inundated sediments and subaqueous soils to be exposed. With continued lowering of water levels, to as low as -1.0 m AHD, hypersulfidic and hyposulfidic materials became progressively oxidised to greater depths in the soil profiles. The resultant formation of sulfuric material (pH < 4) produced water quality, ecological and public health issues from metal/metalloid mobilisation, de-oxygenation, wind erosion and noxious gas release.

Increased rainfall within the Murray Darling Basin catchment, from March 2010, caused increased water levels and inundation of sulfuric materials that had formed in the previously dried margins of the Lower Lakes.

1.2 Aims and scope of work

This work was co-funded by CSIRO and the Department of Environment, Water and Natural Resources (DENR). The aims of this investigation were to:

1. Assess the rate and extent of neutralisation of previously acidified ASS material in the Lower Lakes (Alexandrina and Albert) and adjacent tributaries (Finniss River and Currency Creek) following re-flooding.

2. Continue a soil monitoring program around the margins of the lakes and adjacent tributaries to evaluate any changes associated with rewetting.

3. Complete contaminant and metalloid dynamics tests to assess the potential of metals and metalloids to be mobilised from ASS.

4. Provide briefings, short monthly summary reports and interim reports of baseline data to underpin long-term management and ongoing monitoring options.

5. Provide data/information to inform DEWNR's development of future Drought Response Strategies.

6. Publish a final report on all findings in relation to envisaged outcomes with maps, diagrams and detailed appendices (including all field and laboratory data).

The investigation encompassed 17 study areas that were located around the margins Lake Alexandrina, Lake Albert and tributaries (Figure 1-1). These were generally representative of the diverse environments encountered around the lakes based on ASS investigations in the region since 2007 (e.g. Baker *et al.* 2010; Fitzpatrick *et al.* 2010a; Fitzpatrick *et al.* 2008a; Fitzpatrick *et al.* 2008b; Fitzpatrick *et al.* 2009b; Fitzpatrick *et al.* 2008c).

Figure 1-1 Map of the Lower Lakes and adjacent tributaries showing the locations of the 17 study areas.

1.3 Definitions

The Acid Sulfate Soil Working Group of the International Union of Soil Sciences has recently agreed in principle to adopt changes to the classification of ASS materials and horizons (Sullivan *et al.* 2010). This report follows these recommendations. ASS are essentially soils containing detectable sulfide minerals, principally pyrite (FeS_2) or monosulfides (FeS). The definitions used in this report are:

Sulfuric: Soil material that has a pH less than 4 (1:1 by weight in water, or in a minimum of water to permit measurement as currently defined by the Australian Soil Classification, Isbell 1996).

Sulfidic materials* – soil materials containing detectable sulfide minerals (defined as containing greater than or equal to 0.01% sulfidic S). The intent is for this term to be used in a descriptive context (e.g. sulfidic soil material or sulfidic sediment) and to align with general definitions applied by other scientific disciplines such as geology and ecology (e.g. sulfidic sediment). The method with the lowest detection limit is the Cr-reducible sulfide method, which currently has a detection limit of 0.01%; other methods (e.g. X-ray diffraction, visual identification, Raman spectroscopy or infra red spectroscopy) can also be used to identify sulfidic materials.

*This term differs from previously published definitions in various soil classifications (e.g. Isbell 1996).

Hypersulfidic material – (adapted from Isbell (1996) with modifications to *inter alia* account for recent improvements to the incubation method (Sullivan *et al.* 2010)): Hypersulfidic material is a sulfidic material that has a field pH of 4 or more and is identified by experiencing a substantial** drop in pH to 4 or less (1:1 by weight in water, or in a minimum of water to permit measurement) when a 2 - 10 mm thick layer is incubated aerobically at field capacity. The duration of the incubation is either: a) until the soil pH changes by at least 0.5 pH unit to below 4, or b) until a stable*** pH is reached after at least 8 weeks of incubation.

Hyposulfidic material - (adapted from Isbell (1996) with modifications to *inter alia* account for recent improvements to the incubation method (Sullivan *et al.* 2010): Hyposulfidic material is a sulfidic material that (i) has a field pH of 4 or more and (ii) does not experience a substantial** drop in pH to 4 or less (1:1 by weight in water, or in a minimum of water to permit measurement) when a 2 - 10 mm thick layer is incubated aerobically at field capacity. The duration of the incubation is until a stable*** pH is reached after at least 8 weeks of incubation.

**A substantial drop in pH arising from incubation is regarded as an overall decrease of at least 0.5 pH unit.

***A stable pH is assumed to have been reached after at least 8 weeks of incubation when either the decrease in pH is < 0.1 pH unit over at least a 14 day period, or the pH begins to increase.

Monosulfidic materials - soil materials with an acid volatile sulfide content of 0.01%S or more. Monosulfidic materials are subaqueous or waterlogged organic-rich materials that contain appreciable concentrations of monosulfides. Monosulfidic black oozes are specific materials characterised by their gel-like consistence.

2. FIELD AND LABORATORY METHODS

2.1 Field sampling of soils

As part of this study, sampling was carried out in November/December 2011 and June 2012 (phase "e" and "f"; Table 2-1).

Representative study areas were selected around the margins of Lakes Alexandrina and Albert as well as from the tributaries (Finniss River and Currency Creek). At each study area, sampling sites were generally located along toposequences on the margins of the lake or tributary wetland. Where possible, the sites sampled for this project were positioned within a few metres of former sampling sites that had been established as part of studies of ASS in Lake Alexandrina and Lake Albert (Baker *et al.* 2010; Baker *et al.* 2011; Fitzpatrick *et al.* 2010a; Fitzpatrick *et al.* 2008a; Fitzpatrick *et al.* 2008b; Fitzpatrick *et al.* 2009b; Fitzpatrick *et al.* 2008c). A summary of earlier samplings (phases "a", "b", "c", "d" and "h#") are presented in Appendix 3 and in Baker *et al.(Baker et al. 2011)*.

The approach adopted was to monitor these environments over a six month period to help understand changes associated with inundation and seasonality. On each sampling occasion, soil sites were re-sampled within a few metres of original soil pits. A GPS was used to re-locate sample sites on each monitoring occasion. Soil profile sampling was carried out by observable horizon, not fixed sampling depths and was achieved using spades and a range of auger types. Sampling was relatively shallow (< 1.0 m) to encompass the materials most likely to be influenced by oxidation.

At each site, GPS co-ordinates and site descriptions were recorded. Grid coordinate locations (WGS84 datum) are presented in Table 2-1. Photographs of the site were taken at photographic points that had been established in previous studies. Approximately four soil cores were collected at each study site (refer to Appendix 9 for sampling methods). Cores were stored in ice for transportation to the laboratory. In the laboratory, each core was photographed with a scale and horizons were subsampled. Soil material was described and physical properties such as colour, consistency, structure and texture follow McDonald *et al.* (1990). The presence of 'sulfidic' smells (e.g., H_2S – rotten egg gas and methyl thiols) as well as oxidising odours (SO_2) were recorded. Representative sub-samples were placed in plastic jars for acid-base accounting, electrical conductivity and pH measurements. Additional subsamples were collected in chip trays for morphological study and ageing experiments. The analytical data for these analyses are appended to this report (Appendices 4 to 7).

Table 2-1 Sampling e: November and December 2011 sampling dates and location of soil sampling sites. Eastings and Northings are based on the WGS84 datum, Zone 54H.

Site ID	Locality	Sampling Date	Easting	Northing
LFe01-A	Wallys Landing and Wetland	13/12/2011	303198	6079714
LFe01-D	Wallys Landing and Wetland	13/12/2011	303081	6079604
LFe02-A	Point Sturt North	29/11/2011	321247	6070294
LFe02-B	Point Sturt North	29/11/2011	321290	6070414
LFe03-A	Milang	06/12/2011	316106	6079440
LFe03-B	Milang	06/12/2011	316461	6079069
LFe04-A	Tolderol	07/12/2011	331889	6083697
LFe04-C	Tolderol	07/12/2011	331944	6083033
LFe06-A	Poltalloch	12/12/2011	338984	6070340
LFe06-B	Poltalloch	12/12/2011	338876	6070502
LFe07-A	Waltowa	05/12/2011	352351	6059112
LFe07-B	Waltowa	05/12/2011	352290	6059048
LFe08-A	Meningie	15/12/2011	349066	6049328
LFe08-B	Meningie	15/12/2011	349053	6049398
LFe10-A	Campbell Park	19/12/2011	341307	6056483
LFe10-C	Campbell Park	19/12/2011	341114	6056623
LFe10-D	Campbell Park	19/12/2011	341097	6056787
LFe12-A	Loveday Bay	19/12/2011	326796	6061286
LFe12-B	Loveday Bay	19/12/2011	326711	6061362
LFe12-C	Loveday Bay	19/12/2011	326420	6061713
LFe13-A	Tauwitcherie	13/12/2011	319050	6060550
LFe15-B	Boggy Creek	16/11/2011	311139	6065855
LFe15-C	Boggy Creek	16/11/2011	311147	6065827
LFe17-A	Point Sturt South	06/12/2011	314849	6069780
LFe17-B	Point Sturt South	06/12/2011	314806	6069675
LFe19-A	Dog Lake	07/12/2011	332033	6086787
LFe19-B	Dog Lake	07/12/2011	331011	6085785
LFe20-A	Boggy Lake	07/12/2011	335054	6089352
LFe20-B	Boggy Lake	07/12/2011	334841	6090032
LFe21-A	Windmill Site	12/12/2011	345597	6064184
LFe21-B	Windmill Site	12/12/2011	345519	6064056
LFe23-A	Lower Currency	14/12/2011	301055	6072892
LFe24-A	Lower Finniss	14/12/2011	305780	6073929
LFe24-B	Lower Finniss	14/12/2011	305780	6073929

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Table 2-2 Sampling f: June 2012 sampling dates and location of soil sampling sites. Eastings and Northings are based on the WGS84 datum, Zone 54H.

Site ID	Locality	Sampling Date	Easting	Northing
LFf01-A	Wallys Landing and Wetland	21/06/2012	303198	6079714
LFf01-D	Wallys Landing and Wetland	21/06/2012	303081	6079604
LFf02-A	Point Sturt North	15/06/2012	321247	6070294
LFf02-B	Point Sturt North	15/06/2012	321290	6070414
LFf03-A	Milang	15/06/2012	316106	6079440
LFf03-B	Milang	21/06/2012	316461	6079069
LFf04-A	Tolderol	21/06/2012	331889	6083697
LFf04-C	Tolderol	18/06/2012	331944	6083033
LFf06-A	Poltalloch	18/06/2012	338984	6070340
LFf06-B	Poltalloch	19/06/2012	338876	6070502
LFf07-A	Waltowa	19/06/2012	352351	6059112
LFf07-B	Waltowa	13/06/2012	352290	6059048
LFf08-A	Meningie	13/06/2012	349066	6049328
LFf08-B	Meningie	13/06/2012	349053	6049398
LFf10-A	Campbell Park	13/06/2012	341307	6056483
LFf10-C	Campbell Park	20/06/2012	341114	6056623
LFf10-D	Campbell Park	20/06/2012	341097	6056787
LFf12-A	Loveday Bay	20/06/2012	326796	6061286
LFf12-B	Loveday Bay	13/06/2012	326711	6061362
LFf12-C	Loveday Bay	13/06/2012	326420	6061713
LFf13-A	Tauwitcherie	13/06/2012	319050	6060550
LFf15-B	Boggy Creek	21/06/2012	311139	6065855
LFf15-C	Boggy Creek	14/06/2012	311147	6065827
LFf17-A	Point Sturt South	14/06/2012	314849	6069780
LFf17-B	Point Sturt South	15/06/2012	314806	6069675
LFf19-A	Dog Lake	15/06/2012	332033	6086787
LFf19-B	Dog Lake	18/06/2012	331011	6085785
LFf20-A	Boggy Lake	18/06/2012	335054	6089352
LFf20-B	Boggy Lake	18/06/2012	334841	6090032
LFf21-A	Windmill Site	18/06/2012	345597	6064184
LFf21-B	Windmill Site	19/06/2012	345519	6064056
LFf23-A	Lower Currency	19/06/2012	301055	6072892
LFf24-A	Lower Finnis	14/06/2012	305780	6073929
LFf24-B	Lower Finnis	14/06/2012	305780	6073929

2.2 Laboratory soil analysis methods

The general flowchart for soil sample collection and analysis is shown in Figure 2-1. Air was excluded as far as possible from the samples. Following sampling, the soils were kept cool at 4°C until analysed. Samples for acid-base accounting were air dried at 80°C. Moisture contents were recorded and bulk densities estimated. Samples for sulfur suite analysis were sent to the Environmental Analysis Laboratory of Southern Cross University. Samples were also stored in chip trays to conduct incubation experiments to follow the course of potential acidification and confirm ASS status. Oven and air dried/moist samples and chip tray samples were kept for long-term storage to allow for future re-sampling and analysis, if required.
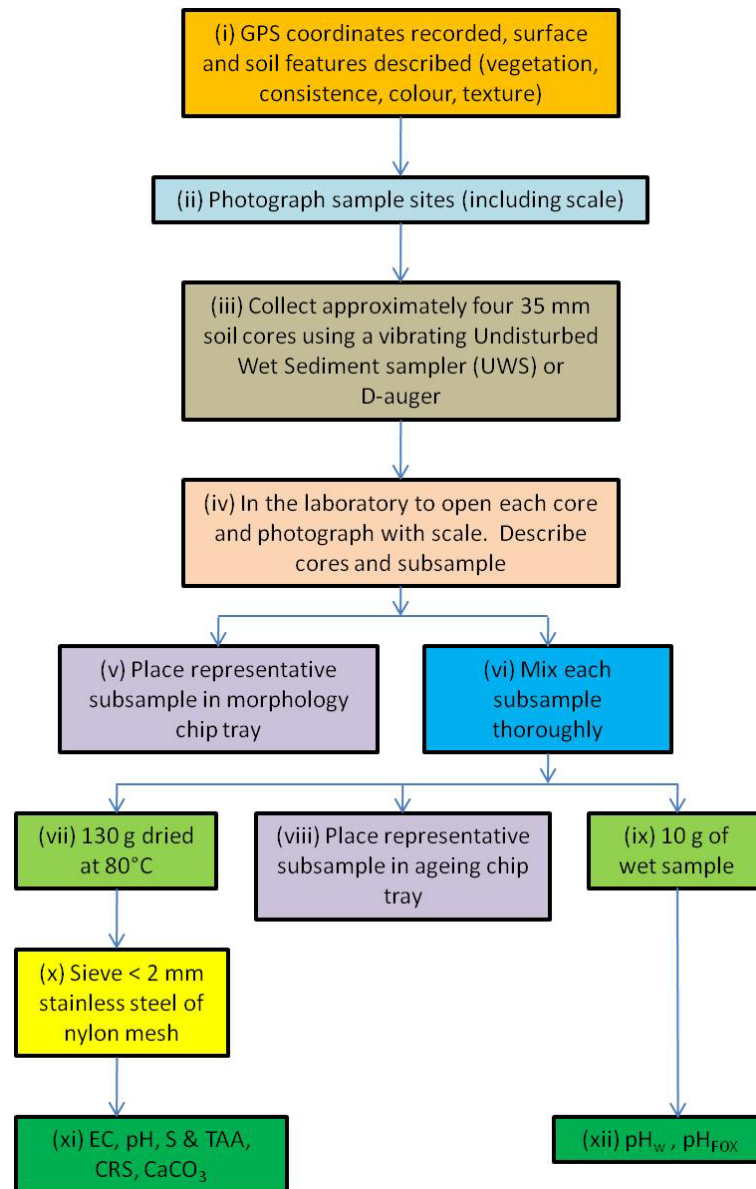
Figure 2-1 General flow chart for soil sampling and analysis.

2.3 Methods used to assess acid generation potential

In order to assess the acid generation potential (AGP) of ASS, a range of methods were used. This required several parameters to be measured, as highlighted in Figure 2-1. An important consideration was also the mineralogical make-up of the soils, which may have enhanced or neutralised AGP. These also needed to be combined with field observations and placed into the geological and hydrological framework, so that laboratory-scale data could be interpreted at the larger landscape scale.

In nature, a number of oxidation reactions of sulfide minerals (principally pyrite: FeS_2) may occur, which produce acidity, including:

$$2FeS_2 + 7O_2 + 2H_2O \rightarrow 2Fe^{2+} + 4SO_4^{2-} + 4H^+$$

$$4FeS_2 + 15O_2 + 10H_2O \rightarrow 4FeOOH + 8H_2SO_4$$
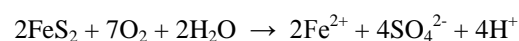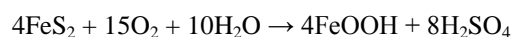
A range of secondary minerals, such as jarosite, sideronatrite and schwertmannite may also form. Such minerals act as stores of acidity i.e. they may produce acidity upon dissolution. Therefore, any assessment needs to include the presence of such minerals in the soil catena.

There is debate as to the most realistic method to estimate if a soil will acidify, and the most effective method may vary according to the local environment and associated mineralogy of the soils. In this study, the three most generally accepted methods for ASS testing have been used:
i) pH testing after peroxide treatment,
ii) acid-base accounting, and
iii) incubation (ageing) testing using the chip-tray method.

These have different strengths and weaknesses and therefore all have been assessed in the current project. A summary is presented below.

pH testing after peroxide treatment
Hydrogen peroxide (H_2O_2) is a strong oxidising agent and is used to encourage the full oxidation of sulfide minerals (principally pyrite: FeS_2) and the subsequent production of acidity. Since peroxide is a strong oxidising agent, it can be argued that the resultant pH measured is a worst-case scenario, as in nature oxidation is rarely complete. In nature, the presence of carbonate minerals such as calcite ($CaCO_3$) may neutralise acid produced, however, in some cases the carbonate may not fully dissolve due to slow dissolution rates (reaction kinetics). The dissolution rates of individual minerals may be controlled by a number of factors, hence additional tests based on measuring the carbonate content are recommended.

Acid-base accounting
Acid-base accounting is a technique which balances the potential acid generated from the sum of sulfide-S (S_{CR} or chromium-reducible S) and the titratable actual acidity (TAA) of the soil (AGP) with the total amount of potential alkalinity (ANC) generated. Details of the chemical methods used are given in Ahern *et al*. (2004). The ANC is usually only routinely measured when soil pH_{KCl} (measured in a high ionic strength KCl solution) is greater than pH 6.5. When pH_{KCl} is less than 4.5, this indicates that secondary less soluble acid-producing minerals such as jarosite are present. This is measured as retained acidity. The net acid generating potential (NAGP) is the acid generating potential (AGP) plus retained acidity minus ANC, which gives an indication of acid generation *if all components react fully*. Arguments against this technique include the fact that the form of carbonate may not be available to soil solutions (e.g. if it is coated and protected with organic material or iron oxides) or if it is in a form that is not particularly reactive (e.g. iron carbonates and dolomite ($CaMgCO_3$) have much slower reaction kinetics than calcite). Net acidity aims to take this into account by introducing a "fineness factor", whereby net acidity is calculated by dividing the ANC by a factor of 1.5. However, the oxidation of pyrite to insoluble Fe oxides may also cause pyrite to not react fully if it becomes coated with protective secondary minerals. Thus, it may be difficult to assess acidification scenarios effectively.

Net Acidity (NA) = Potential Sulfidic Acidity (AGP) + Existing Acidity (TAA) + Retained Acidity (RA) – measured Acid Neutralising Capacity (ANC) / Fineness Factor (FF)

and

Net Acid Generating Potential (NAGP) = Potential Sulfidic Acidity (AGP) – measured Acid Neutralising Capacity (ANC)

Ageing experiment
The third method used, which is often considered to represent a more realistic scenario for ASS testing is based on the 'incubation' of soil samples. A number of specific techniques are employed, but all are based on keeping the sample moist for a specified period (usually a number of weeks or months), which allows a more realistic oxidation of sulfide minerals to occur than that produced during peroxide testing. Although this may mimic nature more closely and does not force reactions to occur (as in the peroxide test) or rely on total 'potential' reaction, it can be argued that the complex processes occurring in the field

are not represented e.g. exchange with sub-surface waters (containing ANC) or biogeochemical reactions. These should also be assessed, where possible, but often require a thorough understanding of water movement (e.g. groundwater) which, is often scenario specific.

The current practice in CSIRO Land and Water is to use all of the above techniques and, where possible, to monitor changes in the field during periods of drying to assess the most likely scenarios of acid generation and neutralisation.

2.4 Acidification potential method

Acidification potential was based on the above methods: peroxide pH (pH_{OX}), incubation pH (pH_{INC}) and net acidity (NA). The criteria listed below were used to assign acidification potential rankings.

(a) peroxide pH ≤ 2.5
(b) NAGP > 0
(c) Ageing pH ≤ 4.0

When a criterion was met, an acidification ranking point was allocated. These were then summed and an acidification potential category value was assigned between 0 and 3.

The acidification potential categories were: (i) 0 = very low potential, (ii) 1 = low potential, (iii) 2 = medium potential and (iv) 3 = high potential.

Where all three criteria were met for a soil sample (i.e. high potential), material was considered more likely to become sulfuric (Shand *et al.* 2009).

2.5 Contaminant and metalloid dynamics method

The guidelines for the contaminant and metalloid dynamics method are outlined in Appendix 7 of the detailed assessment protocols (MDBA 2010). The contaminant and metalloid dynamics method was designed to determine the release of metals and metalloids in soils after 24 hours. The data represent the availability of metals and metalloids from a weak extraction (water, and thus easily bioavailable) of saturated soils, and for dry wetland soils, those easily mobilised from mineral surfaces and readily soluble mineral phases (such as salts). The exercise was repeated in a batch process for longer time periods (7 days, 14 days and 35 days). The latter approach was aimed at understanding changes in concentrations over time. This is particularly important for dried soils which have been in contact with the atmosphere. The soil materials and the release/uptake of metals/metalloids are expected to change as the chemical environment changes from oxidising to reducing. The data can be compared to existing water quality guidelines, although care should be taken when extrapolating to surface waters without knowledge of hydrological conditions and natural chemical barriers. The impact on surface waters will be governed by the upward chemical flux which is a function of soil type, water flow, diffusion and the chemistry of the soils near the sediment-water interface.

Redox potential (Eh) and pH were determined using calibrated electrodes linked to a TPS WP-80 meter; Eh measurements were undertaken in an anaerobic chamber to minimise the rapid changes encountered due to contact with the atmosphere, and are presented relative to the standard hydrogen electrode (SHE). Specific electrical conductance (SEC) was determined using a calibrated electrode linked to a TPS WP-81 meter. All parameters were measured on filtered (0.45 μm) water samples.

3. OVERVIEW OF DATA

3.1 Acid-base accounting analyses

The total amount of non-organic reduced-S (or reduced inorganic sulfur – RIS), contained mainly within sulfide minerals (S_{CR}), is determined by the Cr-reducible S technique (Ahern *et al.* 2004). The total amount of acid generated, assuming complete oxidation, can be quantified, usually in mol H$^+$ tonne^{-1}, or taking into account the bulk density, as mol H$^+$ m^{-3}. However, shielding of sulfide minerals, e.g. by iron (oxy) hydroxides, may limit sulfide oxidation, in effect decreasing the amount of potential acid available for reaction. As well as potential acidity, the amount of acidity already present in the soil can be quantified as titratable actual acidity (TAA). In sulfuric materials, retained acidity may form a major component of stored acid (e.g. stored in mineral phases such as jarosite). The sum of acidity generated by S_{CR}, TAA and retained acidity represents the acid generating potential (AGP) of the sample. As well as taking into account the total acid potential of the sample, acid generated post-sampling and prior to analysis is included as part of total potential of the sample.

S_{CR} concentrations vary widely across the different study areas as well as within individual soil profiles (Appendix 5). Figure 3-1 and Figure 3-2 show histograms of S_{CR} in all samples collected during samplings-f and e respectively. Many of the soil samples tested exceeded the Australian (coastal) action criteria or trigger values for the preparation of an ASS management plan (Dear *et al.* 2002)(Figure 3-1 and Figure 3-2). The trigger values are texture dependent, as coarser-grained soils are often more prone to acidification, since they typically comprise larger amounts of quartz sand or relatively unreactive aluminosilicate minerals such as K-feldspar.
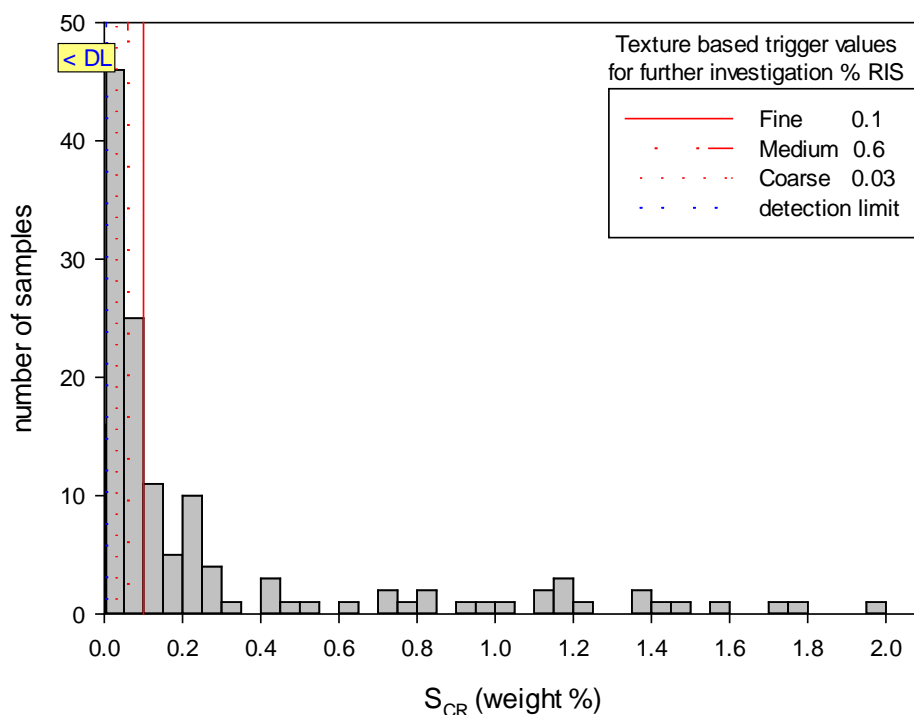
Figure 3-1 Concentrations of S_{CR} in all the soil samples collected from the various study areas during Sampling-f (June 2012). <DL is less than detection limit. Trigger values for more detailed assessment, relative to the soil type are also shown for coastal ASS
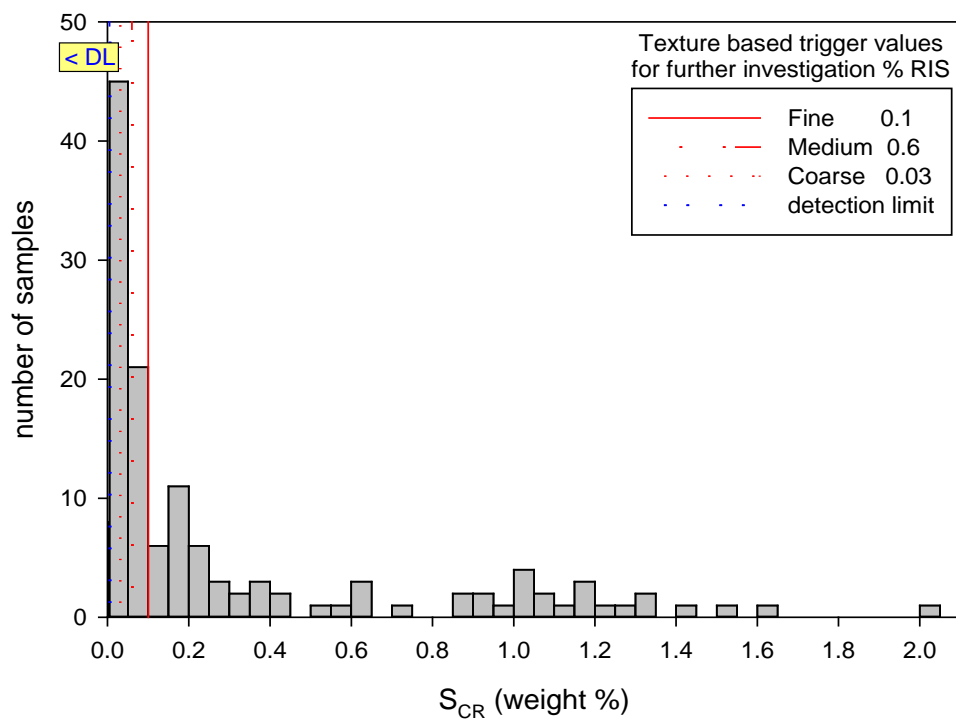
Figure 3-2 Concentrations of S_{CR} in all the soil samples collected from the various study areas during Sampling-e (November/December 2011). <DL is less than detection limit. Trigger values for more detailed assessment, relative to the soil type are also shown for coastal ASS

A cumulative frequency plot of S_{CR} in soil samples collected from Samplings-a to Sampling-f is shown in Figure 3-3. Samplings-a and b were carried out under drought conditions. Samplings-c to f were carried out after the study areas had been reflooded. This plot indicates that S_{CR} concentrations have increased in soil samples since reflooding. Inundation most likely encouraged reducing conditions, which resulted in sulfate reduction and the formation of pyrite.
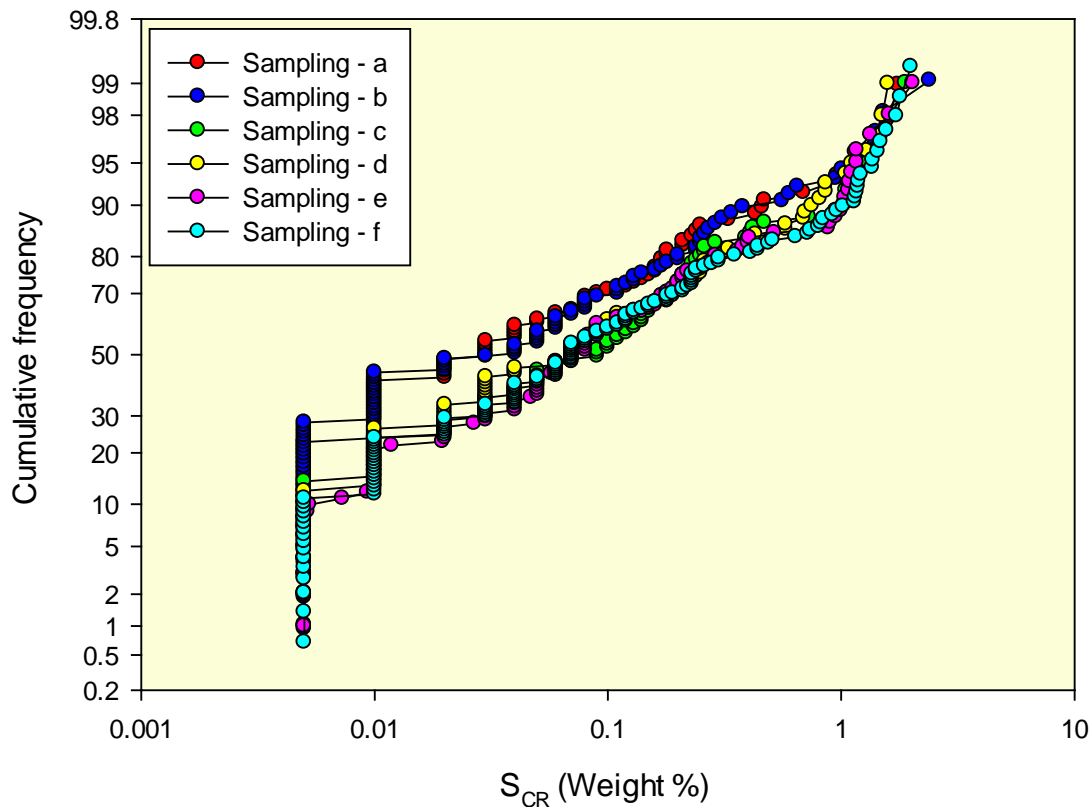
Figure 3-3 Cumulative frequency plot for S_{CR} in the soil samples collected from the various study areas during Sampling-a (October/November 2009) (●), Sampling-b (March 2010) (●), Sampling-c (January/February 2011) (●), Sampling-d (May/June 2011) (●), Sampling-e (November/December 2011) (●) and Sampling-f (June 2012) (●) Note: only soil samples collected during all five monitoring rounds were included in this plot. Samples from LF18 to LF24 were not included

Net acidity (TAA + S_{CR} – ANC/1.5) for the soil layers is shown in Figure 3-4. Net acidity has generally remained constant throughout the monitoring period, irrespective of whether the soil profiles were dry or inundated. This suggests that there has been little net loss or gain of acidity in the soils that were monitored. As a result, during the monitoring period, acidification hazard has remained relatively constant around the lakes. Net acidities in some samples were extremely high (up to 1114 H+/tonne from Sampling-e, 1089 H+/tonne from Sampling-d, 1197 H+/tonne from Sampling-c, 1745 mol H+/tonne from Sampling-b and 1099 H+/tonne from Sampling-a).
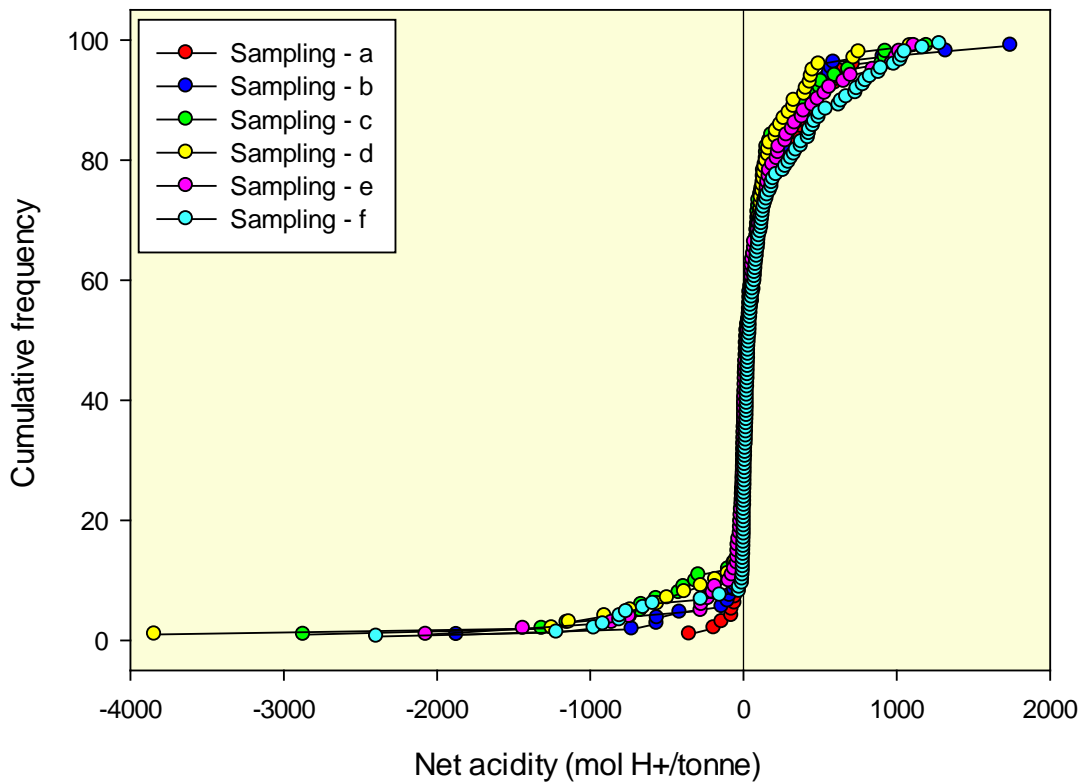
Figure 3-4 Cumulative frequency plot of Net acidity in the soil samples collected from the various study areas during Sampling-a (October/November 2009) (●), Sampling-b (March 2010) (●), Sampling-c (January/February 2011) (●), Sampling-d (May/June 2011) (●), Sampling-e (November/December 2011) (●) and Sampling-f (June 2012) (●) Note: only soil samples collected during all five monitoring rounds were included in this plot. Samples from LF18 to LF24 were not included

A summary of soil pH (pH_{KCl}) is shown in Figure 3-5. During the monitoring period, the most significant changes in pH_{KCl} occurred below pH 5. Under drought conditions (Samplings-a & b) approximately 5 % of soil samples had pH_{KCl} of less than 3.4 (Figure 3-5). Following reflooding (Samplings-c to f), there were no soil samples collected with pH_{KCl} of less than 3.4. This suggests inundation has caused a relatively slow neutralisation of sulfuric samples (pH < 4). Samples collected before the drought, in 2007 and 2008, whilst the study areas were still inundated have also been included in Figure 3-5 (Fitzpatrick *et al.* 2008b). Generally, these samples do not correspond to the ones collected during the subsequent samplings. However, they do provide a useful pH_{KCl} baseline for subaqueous soil material collected around Lakes Alexandrina and Albert prior to the onset of drought conditions. This indicates that drying and the oxidation of sulfide minerals caused the soil pH to drop significantly at many sites around the Lower Lakes. Subsequent rewetting has caused a slight increase in pH. However, soil pH is still much lower than was measured before the drought.
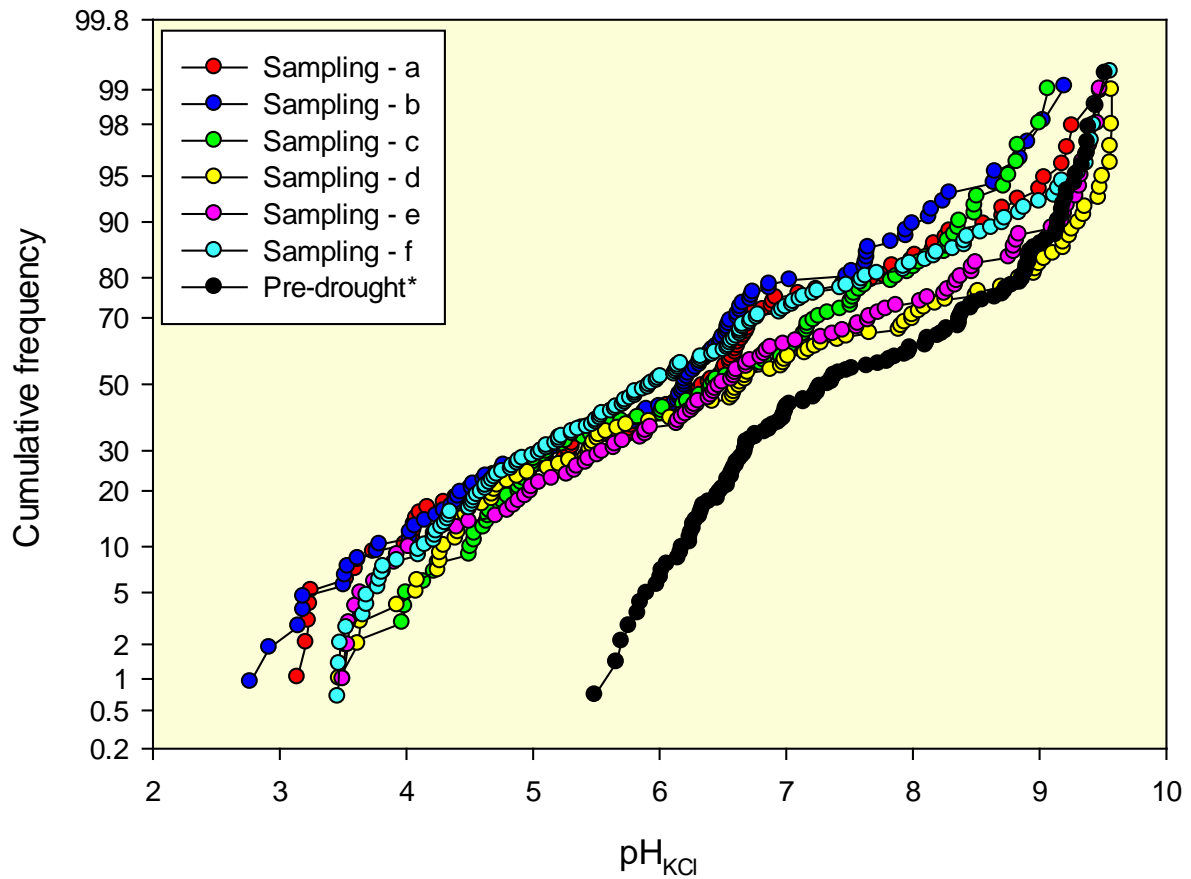
Figure 3-5 Cumulative frequency plot for pH$_{KCl}$ in the soil samples collected from the various study areas during Sampling-a (October/November 2009) (●), Sampling-b (March 2010) (●), Sampling-c (January/February 2011) (●), Sampling-d (May/June 2011) (●), Sampling-e (November/December 2011) (●) and Sampling-f (June 2012) (●) Note: only soil samples collected during all five monitoring rounds were included in this plot. Samples from LF18 to LF24 were not included. *Pre-drought sampling (●) was carried out in 2007 and 2008, whilst the study areas were still inundated (Fitzpatrick *et al.* 2008b). Generally, these samples do not correspond to the ones collected during the subsequent samplings.

4.   LF01 – WALLYS LANDING AND WETLAND

Summary

Overall, soil at Wallys Landing and Wetland was considered to pose a high acidification hazard.

At Wallys Landing and Wetland, extreme drought conditions between 2007 and 2009 and the partial drying of the wetland caused hypersulfidic subaqueous clays to oxidise and transform to sulfuric clays. When the sulfuric clays were rewetted, after summer rainfall in 2009, surface water in the channel became acidic (pH < 3.5). Further inundation, following winter rainfall in 2009, neutralised the surface water acidity and caused the formation of sulfuric subaqueous clays. Prolonged inundation most likely encouraged reducing conditions resulting in sulfate reduction and the formation of hypersulfidic subaqueous clays. Although sampling sites remained subaqueous for a period of 3 years, net acidities remained very high and TAA and RA was still present in the soil profiles. Neutralisation of acidity was limited at this site and the soil material was considered to pose a high acidification hazard. On drying, soil material is likely to re-acidify rapidly and may impact surface waters upon rewetting.

4.1 Background

Study area LF01 was located on the northern side of the Finniss River (Figure 1-1). As part of this study, sampling was carried out in December 2011 and June 2012 (Samplings-e/f). Previous samplings were undertaken in May and June 2011 (Sampling-d), January and February 2011 (Sampling-c), March 2010 (Sampling-b) and November 2009 (Sampling-a). Additionally, data from historic sampling (Sampling-h_3), carried out in May 2009, were reassessed as part of this study. Sampling sites were located in the drainage ditch to the north east of the Finniss River (LF01-A) and in the Finniss River itself, at Wallys Landing (LF01-D) (Figure 4-1).
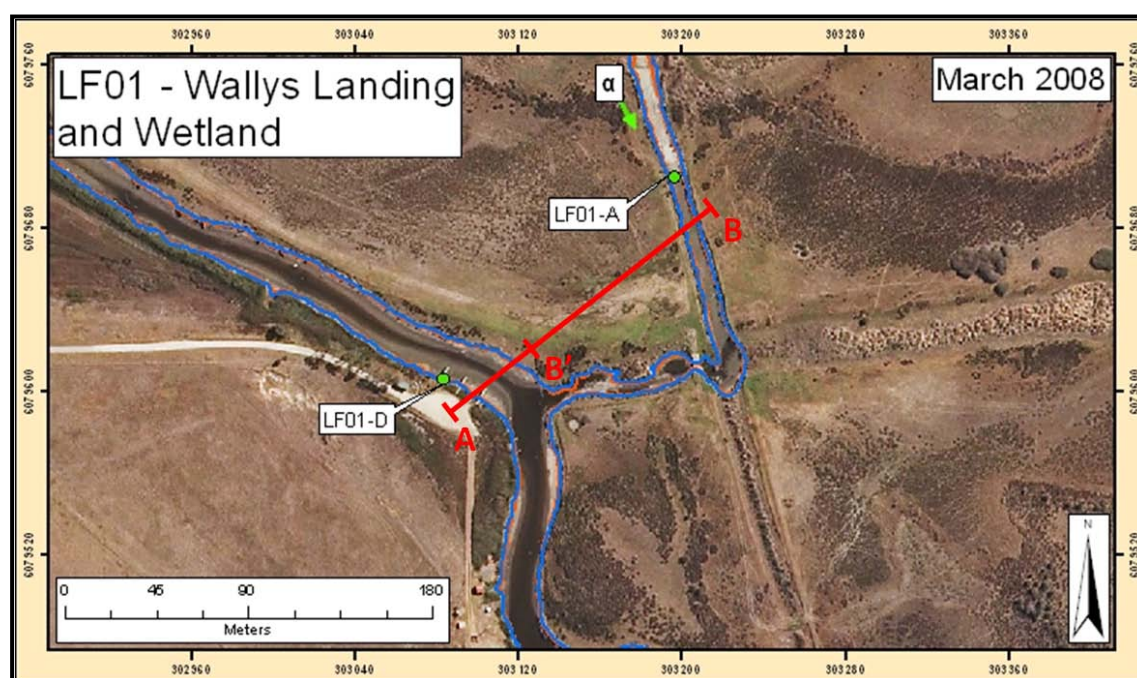
Figure 4-1 Sample location map. Aerial photograph taken in March 2008 (Orange line: sampling-a & b water level, Blue line: sampling-c, d, e & f water level). Red line indicates cross section presented in Section 22.3

The study area comprised a wetland zone located north of the Finniss River (Figure 4-1). Water levels fluctuated significantly in both the Finniss River and the drainage ditch to the north during the monitoring period (Figure 4-1). The aerial photograph indicated that, in March 2008, the drainage ditch was dry and the Finniss River had shrunk to a narrow stream in the middle of the channel (Figure 4-1). At the time of Sampling-h_3, in May 2009, a few centimetres of water had collected in the drainage ditch (Figure 4-2). At the time of Sampling-a, in November 2009, the water level in the ditch had increased to a depth of 1.1 m (Figure 4-2), the Finniss River was at full flow and the surrounding vegetation was green and lush. Following a relatively dry summer, at the time of Sampling-b, in March 2010, the water level in the ditch had dropped to a depth of 30 cm and the river level had dropped by approximately 75 cm since November 2009 (Figure 4-2). During Samplings-c/d/e/f, the water level in the ditch had increased to 1.1 m (Figure 4-2) and the Finniss River was at full flow.
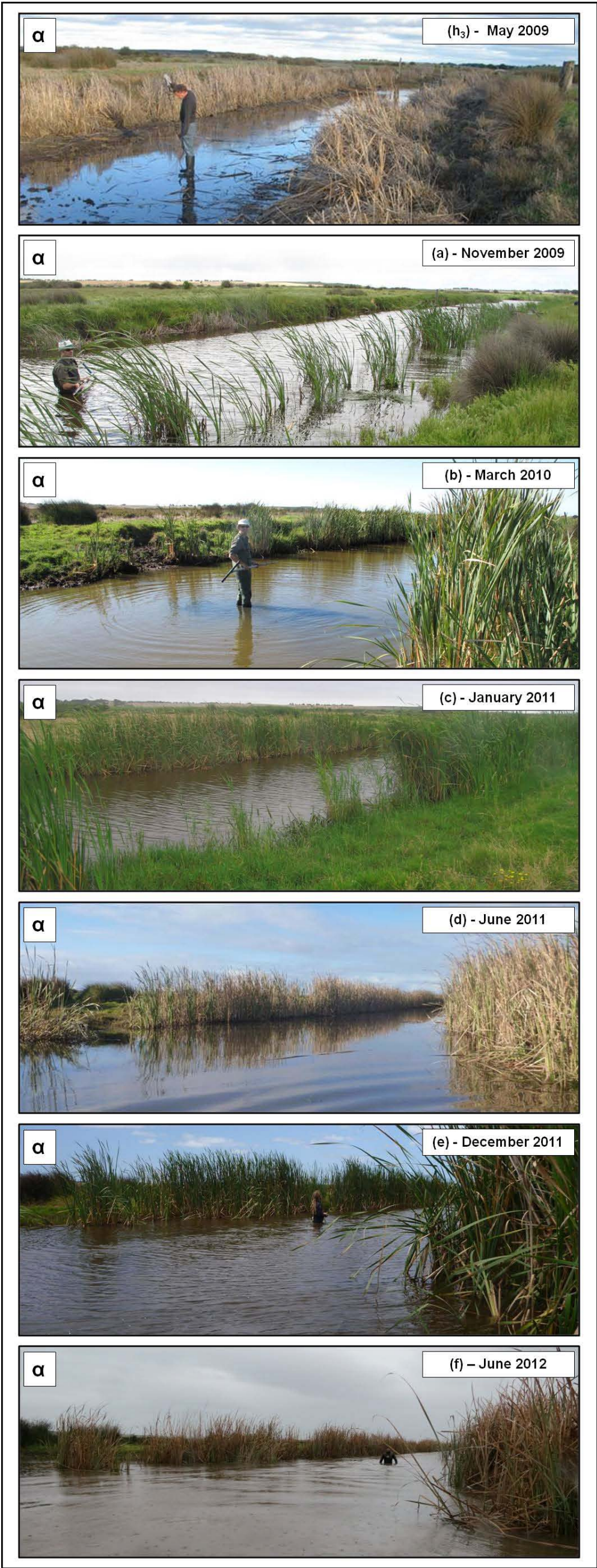
Figure 4-2 Site photographs. Refer to Figure 4-1 for the location and direction that photographs were taken, indicated by α (photographs were selected that best depicted the environmental conditions at the study area during each sampling)

4.2 Soils

Soils at Wallys Landing and Wetland generally comprised hypersulfidic and sulfuric clay. A summary of encountered soils is provided below and site locations are presented in Figure 4-1. Detailed profile descriptions are presented in Appendix 4 and Appendix 8. Profile photographs are presented in Appendix 5.

LF01-A

During previous studies, a gouge auger (Samplings-h_3/a/b) and an Undisturbed Wet Sampler (UWS) (Appendix 9) (Samplings-c/d) were used to collect subaqueous soil profiles on five occasions. These investigations encountered between 20 and 40 cm of dark grey brown to black medium clay. Orange coatings on ped surfaces were noted in Sampling-h_3. In Samplings-a/b, the medium clay contained vertical cracks that were coated in jarosite and infilled with medium sand. Underlying this, to the maximum depth of investigation (50 and 90 cm), was dark grey to green grey medium clay. Yellow jarosite mottles were noted during Sampling-h_3, which were not present during Samplings-a/b. In Sampling-c, pale yellow jarosite mottles were present between 28 and 45 cm. No jarosite mottling was noted during Sampling-d.

As part of this study, a UWS was used to collect subaqueous soil profiles (Samplings-e/f). The investigations encountered black hemic peat and clay gel to depths of 11 and 14 cm, which was underlain by dark grey sand and coarse quartz gravel to a depth of 16 cm. Underlying this, to a depth of approximately 60 cm was very dark grey heavy clay. Underlying this, to the maximum depth of investigation (86 and 89 cm), was very dark grey to black heavy clay.

LF01-D

During previous studies, a spade (Samplings-a/b) and a UWS (Samplings-c/d) were used to collect soil profiles in the reeds near the foot of Wallys Landing on four separate sampling occasions. All samplings were subaqueous. Samplings-a/b encountered 5 cm of dark grey to black silty clay with common roots and distinct brown and orange brown mottles. Underlying this, to the maximum depth of investigation (15 cm) was grey brown to brown sandy clay with jarosite mottles associated with common roots. Samplings-c/d encountered dark grey clay to depths of 5 and 10 cm. This was underlain by black and greyish brown clay to depths of 20 and 40 cm. Underlying this, to the maximum extent of investigation (60 and 84 cm), was black to dark grey clay with fine rootlets. Sand was noted throughout the profile collected during Sampling-c but was not present in Sampling-d.

As part of this study, a UWS was used to collect subaqueous soil profiles (Samplings-e/f). The investigations encountered a mixture of very dark brown clay and peat to depths of 12 and 15 cm that was underlain by very dark brown sapric peat and clay with some sand layers to depths of 41 to 51 cm. Underlying this, to the maximum depth of investigation (87 and 90 cm), was very dark greyish to black heavy clay.

4.3 Soil acidity and acid-base accounting

Acid-base accounting was carried out according to the methods described in Section 2.3 and comprised analyses for sulfide-S (S_{CR} or Cr-reducible S), Retained Acidity (RA), Titratable Actual Acidity (TAA), Acid Neutralising Capacity (ANC) and Net Acidity (NA). Acid-base accounting and pH data (pH_{OX}, pH_{INC} & pH_W), for each soil layer, are presented in Figure 4-3. These data were used to inform the acidification hazard assessment that is presented in Table 4-1.
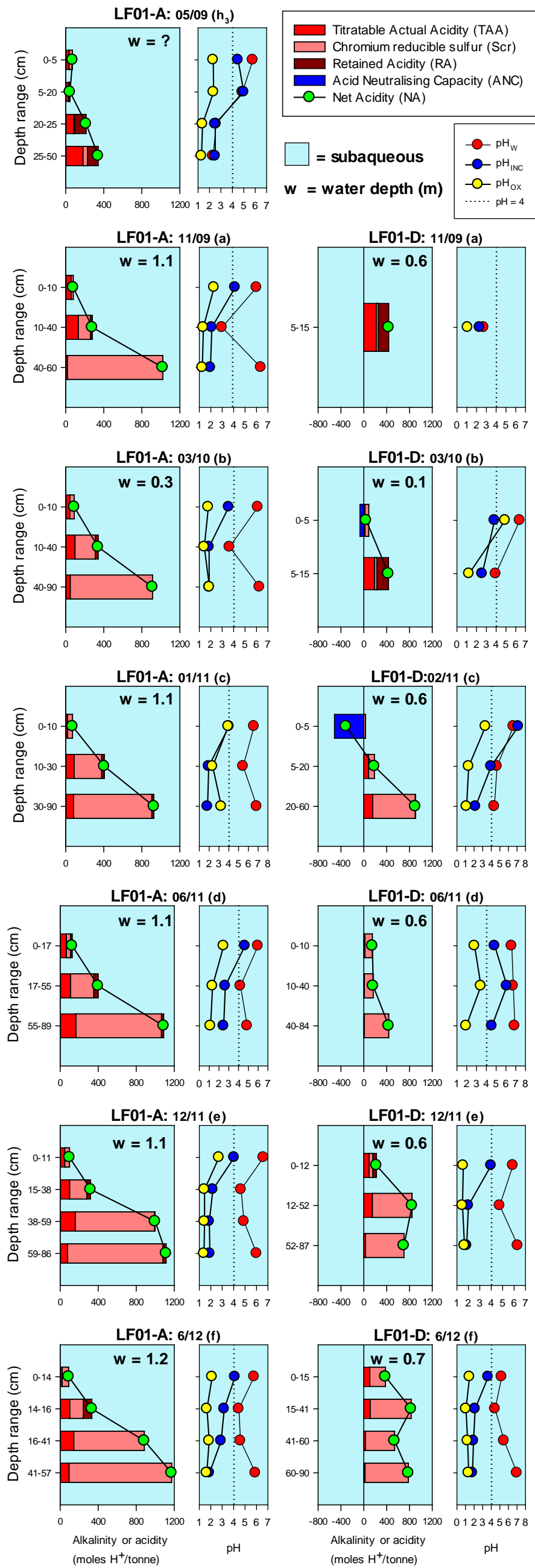
Figure 4-3 pH and acid-base accounting data plotted against depth for each profile collected

4.4 Summary and discussion

Acidification potential assessment and ASS material classification were carried out for each soil sample collected, according to the definitions and methods presented in Section 1.3 and Section 2.4 respectively. A summary of acidification potential and ASS material classification is presented in Table 4-1.

Acidification hazard assessment and ASS subtype classification were carried out for each soil profile collected. ASS subtype classification was achieved using the methods described in Appendix 2. Acidification hazard assessment was based on: (i) landscape position (Figure 4-1), (ii) soil morphology (Section 4.2), (iii) acid-base accounting (Figure 4-3), (iv) pH data (Figure 4-3), (v) acidification potential (Table 4-1) and (vi) ASS material and subtype classification (Table 4-1). Acidification hazard categories were: (i) very low, (ii) low, (iii) medium and (iv) high. A summary of ASS subtype classification and acidification hazard for each profile collected between May 2009 and June 2012 is presented in Table 4-1.

Soil profiles sampled at Wallys Landing and Wetland comprised hypersulfidic and sulfuric subaqueous clay soils with high acidification hazard (Table 4-1). At each site, net acidity was very high (maximum of 1100 moles H^+/tonne) and increased with depth (Figure 4-3). There was little ANC (Figure 4-3) and acidification potentials were generally medium and high (Table 4-1).

During extreme drought conditions, between 2007 and 2009, the partial drying of the wetland caused the hypersulfidic subaqueous clays to oxidise and transform to sulfuric clays. When the sulfuric clays were rewetted, after summer rainfall in 2009, surface water in the channel became acidic (pH < 3.5). Further inundation, following winter rainfall in 2009, neutralised the surface water acidity and caused the formation of sulfuric subaqueous clays. Prolonged inundation most likely encouraged reducing conditions, leading to sulfate reduction and the formation of hypersulfidic subaqueous clays (Table 4-2).

At Wallys Landing, at the foot of the jetty, hypersulfidic subaqueous clays transformed to sulfuric clays. On rewetting, sulfuric subaqueous clays were formed. Prolonged inundation most likely encouraged reducing conditions, leading to sulfate reduction and the formation of hypersulfidic and hyposulfidic subaqueous clays (Table 4-2).

At Wallys Landing and Wetland, since 2009, sampling sites remained subaqueous for a period of 3 years. Soils converted from sulfuric to hypersulfidic and hyposulfidic subaqueous and the proportion of TAA and RA, relative to S_{Cr}, decreased in the upper part of the profile. However, net acidities remained very high, TAA was present throughout the profile and RA was present at intermediate depths (consistent with visual observations of pale yellow mottles, possible natrojarosite) (Figure 4-3). Neutralisation of acidity was limited at this site, little or no ANC was present in the profiles and the soil material was considered to pose a high acidification hazard (Table 4-1). On drying, soil material is likely to re-acidify rapidly and may impact surface waters upon rewetting.

Table 4-1 Summary of acidification potential, ASS material classification, ASS subtype classification and acidification hazard (* indicates sulfuric soil material). The soil texture in brackets following the ASS subtype classification indicates the dominant texture of the profile

Sample	Sampling	Depth (cm)	pH$_{OX}$ < 2.5	pH$_{INC}$ < 4.0	NA > 0	Acidification potential	ASS material classification	ASS subtype classification	Acidification hazard
LF01-A									
FIN 26M3 5.1	h$_3$	0-5	1	0	1	2	Hyposulfidic clay	Sulfuric subaqueous clay soil (clay)	High
FIN 26M3 5.2	h$_3$	5-20	1	0	1	2	Hyposulfidic clay		
FIN 26M3 5.3	h$_3$	20-25	1	1	1	3*	Sulfuric sandy clay		
FIN 26M3 5.4	h$_3$	25-50	1	1	1	3*	Sulfuric clay		
LFa01-A.1	a	0-10	1	0	1	2	Hyposulfidic clay	Sulfuric subaqueous clay soil (clay)	High
LFa01-A.2	a	10-40	1	1	1	3*	Sulfuric clay		
LFa01-A.3	a	40-60	1	1	1	3	Hypersulfidic clay		
LFb01-A.1	b	0-10	1	1	1	3	Hypersulfidic clay	Sulfuric subaqueous clay soil (clay)	High
LFb01-A.2	b	10-40	1	1	1	3*	Sulfuric clay		
LFb01-A.3	b	40-90	1	1	1	3	Hypersulfidic clay		
LFc01-A.1	c	0-10	0	0	1	1	Hyposulfidic clayey gel	Hypersulfidic subaqueous clay soil (clay)	High
LFc01-A.2	c	10-30	1	1	1	3	Hypersulfidic clay		
LFc01-A.3	c	30-90	0	1	1	2	Hypersulfidic clay		
LFd01-A.1	d	0-17	1	0	1	2	Hyposulfidic loamy clay	Hypersulfidic subaqueous clay soil (clay)	High
LFd01-A.2	d	17-55	1	1	1	3	Hypersulfidic clay		
LFd01-A.3	d	55-89	1	1	1	3	Hypersulfidic clay		
LFe01 A.1	e	0-11	0	0	1	1	Hyposulfidic hemic peat	Hypersulfidic subaqueous clay soil (clay)	High
LFe01-A.3	e	15-38	1	1	1	3	Hypersufilidic sand		
LFe01-A.4	e	38-59	1	1	1	3	Hypersufilidic heavy clay		
LFe01-A.5	e	59-86	1	1	1	3	Hypersufilidic loamy clay		
LFf01-A.1	f	0-14	1	0	1	2	Hyposulfidic hemic peat	Hypersulfidic subaqueous clay soil (clay)	High
LFf01-A.2	f	14-16	1	1	1	3	Hypersufilidic sand		
LFf01-A.3	f	16-41	1	1	1	3	Hypersufilidic heavy clay		
LFf01-A.4	f	41-57	1	1	1	3	Hypersufilidic heavy clay		
LF01-D									
LFa01-D.2	a	5-15	1	1	1	3*	Sulfuric silty clay	Sulfuric subaqueous clay soil (clay)	High
LFb01-D.1	b	0-5	0	1	1	2	Hypersulfidic silty clay	Sulfuric subaqueous clay soil (clay)	High
LFb01-D.2	b	5-15	1	1	1	3*	Sulfuric sandy clay		
LFc01-D.1	c	0-5	0	0	0	0	Hyposulfidic sandy clay	Hypersulfidic subaqueous clay soil (clay)	High
LFc01-D.2	c	5-20	1	1	1	3	Hypersulfidic sandy clay		
LFc01-D.3	c	20-60	1	1	1	3	Hypersulfidic clay		
LFd01-D.1	d	0-10	0	0	1	1	Hyposulfidic peaty clay	Hyposulfidic subaqueous clay soil (clay)	Medium
LFd01-D.2	d	10-40	0	0	1	1	Hyposulfidic clay		
LFd01-D.3	d	40-84	1	0	1	2	Hyposulfidic clay		
LFe01-D.1	e	0-12	1	1	1	3	Hypersufilidic peaty clay	Hypersulfidic subaqueous clay soil (clay)	High
LFe01-D.2	e	12-52	1	1	1	3	Hypersufilidic sapric peat		
LFe01-D.3	e	52-87	1	1	1	3	Hypersufilidic loamy clay		
LFf01-D.1	f	0-15	1	1	1	3	Hypersufilidic organic clay	Hypersulfidic subaqueous clay soil (clay)	High
LFf01-D.2	f	15-41	1	1	1	3	Hypersufilidic sapric peat		
LFf01-D.3	f	41-60	1	1	1	3	Hypersufilidic heavy clay		
LFf01-D.4	f	60-90	1	1	1	3	Hypersufilidic heavy clay		

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Table 4-2 Summary of temporal and spatial variations and changes in ASS subtypes at each site (**A and D**). Note: (i) Cells shaded orange summarise data presented within this report, (ii) all other cells are based on/extrapolated from data presented in Fitzpatrick *et al.* (2010b; 2009a; 2008a; 2008b; 2009b; 2008c) and (iii) cells bordered in blue indicate subaqueous

Wallys Landing/Wetland Sites		Pre-drought Winter 2007 (h₁)	Drought Summer 2008 (h₂)	Drought Summer 2009 (h₃)	Drought End winter 2009 (a)	Drought End summer 2010 (b)	Post-drought Summer 2011 (c)	Post-drought Winter 2011 (d)	Post-drought start summer 2011/12 (e)	Post-drought start winter 2011/12 (f)	Summary
LF01-A	[1]Classification & [2]Acid hazard	**Hypersulfidic subaqueous clay (H)**	**Hypersulfidic subaqueous clay (H)**	**Sulfuric subaqueous clay (H)**	**Sulfuric* subaqueous clay (H)**	**Sulfuric* subaqueous clay (H)**	**Hypersulfidic subaqueous clay (H)**	**Hypersulfidic subaqueous clay (H)**	**Hypersulfidic subaqueous clay (H)**	**Hypersulfidic subaqueous clay (H)**	During the extreme drought (2007 to 2009) the partial drying of the wetland caused the Hypersulfidic subaqueous clays transform to Sulfuric clays. When the Sulfuric clays were rewetted after summer rainfall in 2009, acidic pools of water (pH <3.5) formed. Further inundation following winter 2009 neutralised the acidic pools and caused the formation of Sulfuric subaqueous clays. Prolonged inundation encouraged sulfate reduction and caused the formation of Hypersulfidic subaqueous clays.
	Dominant water and ASS process	**UW & Sulfide**	**LW & Sulfide**	**RF & Sulfuric**	**RW &Sulfuric**	**RW & Sulfuric**	**RW & Sulfide**	**UW & Sulfide**	**UW & Sulfide**	**UW & Sulfide**	
LF01-D	[1]Classification & [2]Acid hazard	**Hypersulfidic subaqueous clay (H)**	**Hypersulfidic subaqueous clay (H)**	**Sulfuric clay (H)**	**Sulfuric* subaqueous clay (H)**	**Sulfuric* subaqueous clay (H)**	**Hypersulfidic subaqueous clay (H)**	**Hyposulfidic subaqueous clay (M)**	**Hypersulfidic subaqueous clay (H)**	**Hypersulfidic subaqueous clay (H)**	During the extreme drought (2007 to 2009) the partial drying of the river caused the Hypersulfidic subaqueous clays to transform to Sulfuric clays. On rewetting Sulfuric subaqueous clays were formed. Prolonged inundation encouraged sulfate reduction and caused the formation of Hypersulfidic subaqueous clays.
	Dominant water and ASS process	**UW & Sulfide**	**LW & Sulfide**	**LW & Sulfuric**	**RF &Sulfuric**	**RW & Sulfuric**	**RW & Sulfide**	**UW & Sulfide**	**UW & Sulfide**	**UW & Sulfide**	

[1]**Classification** – Acid Sulfate Soil subtype classification
[2] **Acid hazard** – Acidification hazard: **H** = High; **M** = medium; **L** = Low; **VL** = Very Low
Dominant Water process
LW – Lowering water level regime to expose soil to air due to drought conditions and water evaporation
UW – Unchanged water regime, which had not yet evaporated to expose soil to air
RW – Rising water level regime to inundate and saturate soils by reflooding (e.g. due to pumping, regulator installation, river flow and groundwater)
RF – Rain fall rewetting and natural reflooding to inundate and saturate soils

Dominant ASS – process
Sulfuric – Sulfuricization - oxidation of pyrite in hypersulfidic material due to onset of aerobic conditions to form sulfuric material
Sulfuric* – As above with acidic minerals and/or salt efflorescences noted (i.e. measurable RA)
Sulfide – Sulfidization due to sulfide accumulation to form hypersulfidic material
Monosulfide – Monosulfidization due to monosulfide accumulation to form monosulfidic material
Leach – Leaching of acid from soil by winter rain fall
Sulfuric **subaqueous** with **overlying circa neutral water** pH >4: = font coloured blue or default
Sulfuric **subaqueous** soil with **overlying acid water** pH <4: = font coloured red
Where h₁ to h₃ = historical sampling; (a) – (b) sampling conducted in this project

5.   LF02 – POINT STURT NORTH

Summary

Overall, soil at Point Sturt North was considered to pose a medium acidification hazard.

Soil material sampled closest to the shoreline comprised sulfuric and hypersulfidic soil with medium and high acidification hazard ratings. These soil materials had been exposed and dry for a period of more than 2 ½ years between 2008 and 2010. Rising water levels, caused by increased inflows from the Murray River, meant that this site became inundated in September 2010. Even though the study area had been inundated for a period of 21 months, soil material closest to the shore remained sulfuric. Further into the lake (LF02-A), soil material converted from sulfuric to hypersulfidic. Neutralisation was considered to be limited and the soil material was considered to pose a high acidification hazard.

Profiles that were located furthest into the lake (LF02-B) comprised hypersulfidic and hyposulfidic soil with very low and low acidification hazard ratings. Net acidity was generally negative throughout the profiles sampled and there was little acidity, moderate levels of ANC and acidification potentials were low and very low. Inundation, in September 2010, caused soil material to convert from hypersulfidic and hyposulfidic soil to subaqueous hyposulfidic soil. Reflooding caused limited changes to occur and soil material was considered to pose a low acidification hazard.

5.1 Background

Study area LF02 was located on the north eastern side of Point Sturt on the south western side of Lake Alexandrina (Figure 1-1). As part of this study, sampling was carried out in November 2011 and June 2012 (Samplings-e/f). Previous samplings were undertaken in May and June 2011 (Sampling-d), January and February 2011 (Sampling-c), March 2010 (Sampling-b) and November 2009 (Sampling-a). Additionally, data from historic sampling (Samplings-h_1), carried out in March 2008, were reassessed as part of this study. Sampling site locations are displayed in Figure 5-1.
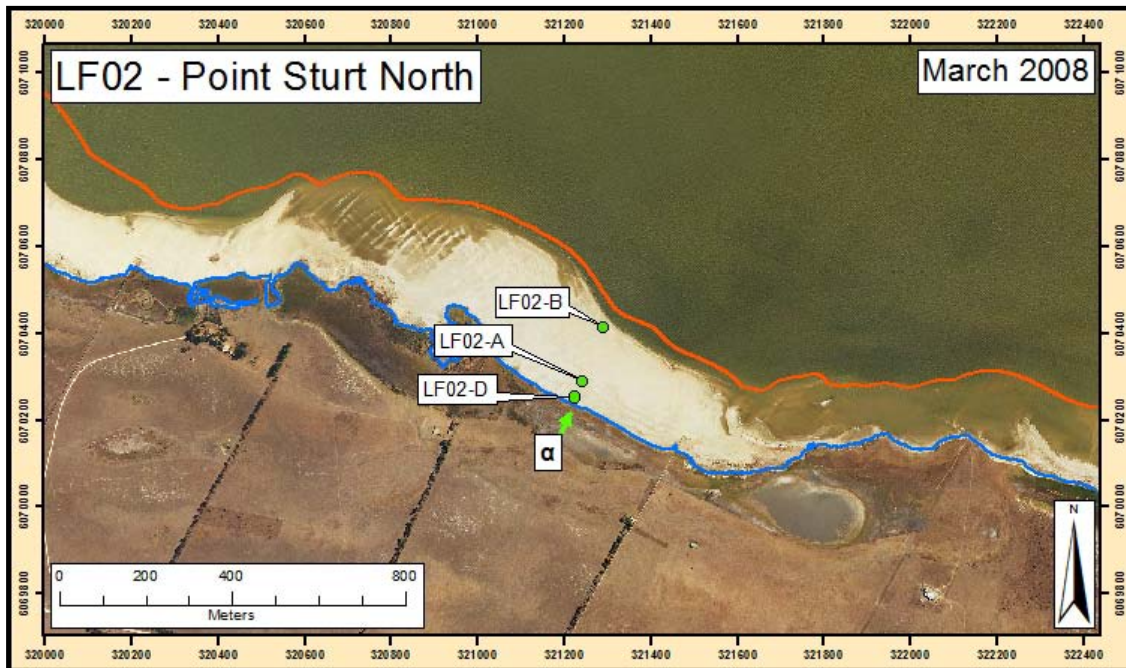
Figure 5-1 Sample location map. Aerial photograph taken in March 2008 (Orange line: sampling-a & b water level, Blue line: sampling-c, d, e & f water level)

At the time of Sampling-c/d/e/f, the lake level had risen to between 0.5 and 0.7 m AHD and the study area had been completely re-flooded (Figure 5-1: Figure 5-2). Prior to this, the study area comprised an extensive beach, which extended from the pre-drought (pre 2006) shore to the waterline, approximately 200 m north (Figure 5-1). The beach had been sparsely revegetated with grasses between Sampling-h_1 in March 2008 and when the aerial photograph was taken in March 2008 (Figure 5-1: Figure 5-2). Only minor changes were noted in the study area between Sampling-a and Sampling-b. The lake level had dropped from -0.80 m AHD in November 2009 (Sampling-a) to a low of -0.95 m AHD in January 2010. However, by March 2010 (Sampling-b) the lake level had risen back to -0.80 m AHD (MDBA 2011). In March 2010, a few small sand dunes (height < 30 cm) had formed against sparse vegetation.

Figure 5-2 Site photographs. Refer to Figure 5-1 for the location and direction that photographs were taken, indicated by α or β (photographs were selected that best depicted the environmental conditions at the study area during each sampling)

5.2 Soils

Soils at Point Sturt North generally comprised sulfuric and hypersulfidic sand at site LF02-A and hyposulfidic sand at sites LF02-B. A summary of encountered soils is provided below and site locations are presented in Figure 5-1. Detailed profile descriptions are presented in Appendix 4 and Appendix 8. Profile photographs are presented in Appendix 5.

LF02-A

During previous studies, when the study area was dry, a spade was used to collect profiles at this site on three occasions (Samplings-h_1/a/b). The investigations generally encountered 40 cm of pale grey and grey sand. During the historic sampling, diffuse yellowish and grey mottles were encountered from 10 to 15 cm. During Sampling-a and Sampling-b, distinct yellow and orange mottles were encountered between 8 and 40 cm and between 4 and 38 cm respectively. Underlying this, to the maximum depth of investigation (70 to 80 cm) was grey loamy to clayey sand. Yellow and orange mottles were noted in this material during Samplings-a/b.

When water levels rose and the study area became inundated (Samplings-c/d), a UWS was used to collect subaqueous soil profiles on two occasions. The investigations encountered 13 and 19 cm of greyish brown sand with diffuse black mottles. Black mottles increased from 5 % in Sampling-c to 30 % in Sampling-d. Underlying this, to depths of 25 and 33 cm was light brownish grey sand with yellow jarosite mottles. During Sampling-c, there were 30 % strong jarosite mottles that reduced to 10 % diffuse mottles during Sampling-d. This was underlain, to the maximum extent of investigation (60 and 78 cm), by dark grey heavy clay with minor carbonate.

As part of this study, a UWS was used to collect subaqueous soil profiles (Samplings-e/f). The investigations encountered pale brown sand to depths of between 4 and 8 cm, which was underlain by grey loamy sand with 30 % prominent black mottles to a depths of between 13 and 23 cm. During Sampling-e, this was underlain, to a depth of 25 cm, by light grey sand with few fine medium roots. Underlying this, to the maximum depth of investigation (57 cm), was greenish grey heavy clay. Sampling-f encountered greyish brown sand to a depth of 42 cm. Underlying this, to the maximum depth of investigation (67 cm), was dark grey sandy clay loam with rare jarosite mottles.

LF02-B

During previous studies, when the study area was dry, a spade was used to collect profiles at this site on three occasions (Samplings-h_1/a/b). The investigation generally encountered between 50 and 65 cm of pale grey to grey sand. During the historic sampling, this material was saturated below 5 cm. During Samplings-a/b, prominent black mottles were noted between 5 and 65 cm. Underlying this, to the maximum depth of investigation (70 to 75 cm) was black sand with grey mottles, few shell fragments and a weak sulfidic smell.

When water levels rose and the study area became inundated (Samplings-c/d), a UWS was used to collect subaqueous soil profiles on two occasions. Both investigations encountered 7 and 9 cm of pale brown sand with diffuse black mottles. This was underlain, to depths of 23 and 25 cm, by medium sand. During Sampling-c, this material was pale brown. During Sampling-d, this sand had reduced to a dark grey colour with 30 % diffuse black mottles. Underlying this, to the maximum extent of investigation (67 and 78 cm), was grey sand with shell fragments near the base.

As part of this study, a UWS was used to collect subaqueous soil profiles (Samplings-e/f). The investigations encountered grey sand with black mottles and few rootlets to a depth of 12 cm, Sampling-e encountered light olive brown sand with few shell fragments to a depth of 19 cm. This was underlain, to a depth of 25 cm, by grey clayey sand. Underlying this, to the maximum depth of investigation (38 cm), was grey clayey sand with common shell fragments and hard carbonate from 35 to 37 cm. Sampling-f encountered grey medium sand to a depth of 35 cm. This was underlain, to a depth of 47 cm, by dark grey clayey sand. Underlying this, to the maximum depth of investigation (78 cm), was grey clayey sand.

LF02-D

As part of this study, a UWS was used to collect subaqueous soil profiles (Samplings-e/f). The investigations encountered 8 to 11 cm of grey sand to loamy sand with 30 to 40 % black mottles and pale brown oxidised sand at surface. This was underlain, to depths of 19 and 25 cm, by greyish brown clayey to loamy sand. Sampling-e encountered light grey clayey sand with 10 % jarosite mottles to a depth of 31 cm. This was underlain, to a depth of 47 cm, by dark grey clayey sand with prominent root channels with orange brown cores. Underlying this, to the maximum extent of investigation (80 cm), was greenish grey heavy clay. Sampling-f encountered greyish brown loamy to clayey sand with few dark brown and black bands to a depth of 40 cm. Underlying this, to the maximum extent of investigation (72 cm), was dark grey sandy loam with few brown mottles and root channels.

5.3 Soil acidity and acid-base accounting

Acid-base accounting was carried out according to the methods described in Section 2.3. Acid-base accounting and pH data (pH_{OX}, pH_{INC} & pH_W), for each soil layer, are presented in Figure 5-3. These data were used to inform the acidification hazard assessment that is presented in Table 5-1.
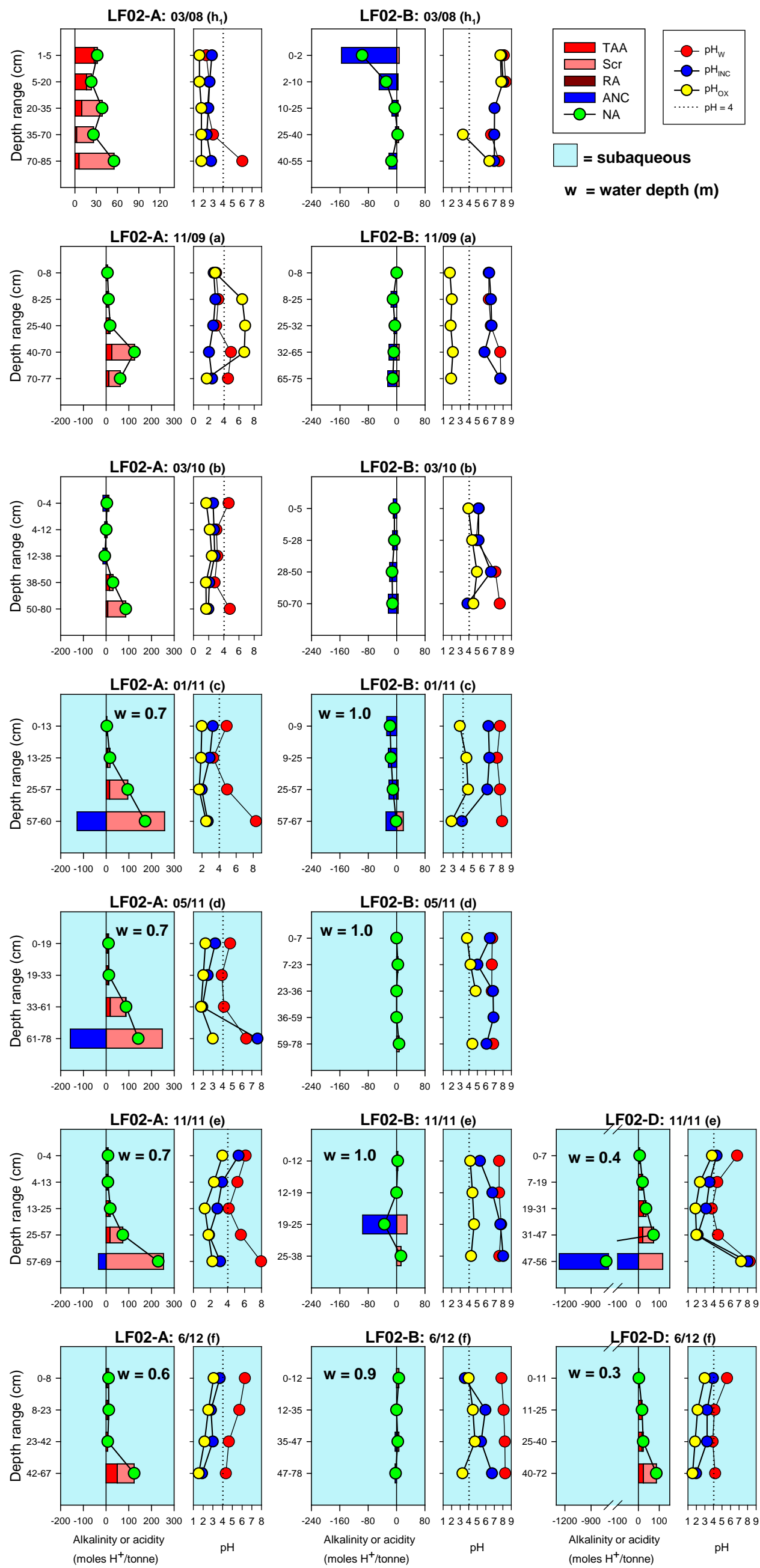
Figure 5-3 pH and acid-base accounting data plotted against depth for each profile collected

5.4 Summary and discussion

Acidification potential assessment and ASS material classification were carried out for each soil sample collected, according to the definitions and methods presented in Section 1.3 and Section 2.4 respectively. A summary of acidification potential and ASS material classification is presented in Table 5-1.

Acidification hazard assessment and ASS subtype classification were carried out for each soil profile collected. ASS subtype classification was achieved using the methods described in Appendix 2. Acidification hazard assessment was based on: (i) landscape position (Figure 5-1), (ii) soil morphology (Section 5.2), (iii) acid-base accounting (Figure 5-3), (iv) pH data (Figure 5-3), (v) acidification potential (Table 5-1) and (vi) ASS material and subtype classification (Table 5-1). Acidification hazard categories were: (i) very low, (ii) low, (iii) medium and (iv) high. A summary of ASS subtype classification and acidification hazard for each profile collected between March 2008 and June 2012 is presented in Table 5-1.

Soil profiles at Point Sturt North sampled closest to the shoreline (LF02-A and LF02-D; Figure 5-1) comprised sulfuric and hypersulfidic soil with high acidification hazard ratings (Table 5-1). These soil materials had been exposed and dry for a period of more than 2 ½ years between 2008 and 2010. Rising water levels, caused by increased inflows from the Murray River, resulted in this site becoming inundated in September 2010 (Table 5-2). In profile LF02-A, a slight increase in pH (from 3.9 to 4.2) at a depth of approximately 20 cm meant that, following reflooding, soil material at this site was classified as hypersulfidic. Profile LF02-D remained sulfuric. Even though the site had been inundated for a period of 21 months, neutralisation was limited and the soil material posed a high acidification hazard (Table 5-1).

Profiles that were located further into the lake (LF02-B; Figure 5-1) comprised hypersulfidic and hyposulfidic soil with very low and low acidification hazard ratings (Table 5-1). The net acidity was generally negative throughout the profiles sampled and there was little acidity, moderate levels of ANC (Figure 5-3) and acidification potentials were low and very low (Table 5-1). Reflooding caused limited changes to occur and soil material was considered to pose a low acidification hazard (Table 5-1).

Overall, soil at Point Sturt North was considered to pose a medium acidification hazard.

Table 5-1 Summary of acidification potential, ASS material classification, ASS subtype classification and acidification hazard (* indicates sulfuric soil material). The soil texture in brackets following the ASS subtype classification indicates the dominant texture of the profile

Sample	Sampling	Depth (cm)	pH$_{OX}$ < 2.5	pH$_{INC}$ < 4.0	NA > 0	Acidification potential	ASS material classification	ASS subtype classification	Acidification hazard
LF02-A									
AAa 29.1	h$_1$	0-1	1	1	1	3*	Sulfuric sand	Sulfuric soil (sand)	High
AAa 29.2	h$_1$	1-5	1	1	1	3*	Sulfuric sand		
AAa 29.3	h$_1$	5-20	1	1	1	3*	Sulfuric sand		
AAa 29.4	h$_1$	20-35	1	1	1	3*	Sulfuric sand		
AAa 29.5	h$_1$	35-70	1	1	1	3*	Sulfuric sand		
AAa 29.6	h$_1$	70-85	1	1	1	3	Hypersulfidic sand		
LFa02-A.1	a	0-8	0	1	1	2*	Sulfuric sand	Sulfuric soil (sand)	High
LFa02-A.2	a	8-25	0	1	1	2*	Sulfuric sand		
LFa02-A.3	a	25-40	0	1	1	2*	Sulfuric sand		
LFa02-A.4	a	40-70	0	1	1	2	Hypersulfidic loamy sand		
LFa02-A.5	a	70-77	1	1	1	3	Hypersulfidic loamy sand		
LFb02-A.1	b	0-4	1	1	1	3	Hypersulfidic sand	Sulfuric soil (sand)	High
LFb02-A.2	b	4-12	1	1	1	3*	Sulfuric sand		
LFb02-A.3	b	12-38	1	1	0	2*	Sulfuric sand		
LFb02-A.4	b	38-50	1	1	1	3*	Sulfuric loamy sand		
LFb02-A.5	b	50-80	1	1	1	3	Hypersulfidic loamy sand		
LFc02-A.1	c	0-13	1	1	1	3	Sand	Sulfuric subaqueous soil (sand)	High
LFc02-A.2	c	13-25	1	1	1	3*	Sulfuric sand		
LFc02-A.3	c	25-57	1	1	1	3	Hypersulfidic sand		
LFc02-A.4	c	57-60	1	1	1	3	Hypersulfidic clay		
LFd02-A.1	d	0-19	1	1	1	3	Sand	Sulfuric subaqueous soil (sand)	High
LFd02-A.2	d	19-33	1	1	1	3*	Sulfuric sand		
LFd02-A.3	d	33-61	1	1	1	3	Hypersulfidic loamy sand		
LFd02-A.4	d	61-78	0	0	1	1	Hyposulfidic clay		
LFe02-A.1	e	0-4	0	0	1	1	Sand	Hypersulfidic subaqueous soil (sand)	High
LFe02-A.2	e	4-13	1	1	1	3	Loamy sand		
LFe02-A.3	e	13-25	1	1	1	3	Sand		
LFe02-A.4	e	25-57	1	1	1	3	Hypersufilidic clayey sand		
LFe02-A.5	e	57-69	1	1	1	3	Hypersufilidic heavy clay		
LFf02-A.1	f	0-8	0	1	1	2	Hypersufilidic sand	Hypersulfidic subaqueous soil (sand)	High
LFf02-A.2	f	8-23	0	1	1	2	Hypersufilidic sand		
LFf02-A.3	f	23-42	1	1	1	3	Sand		
LFf02-A.4	f	42-67	1	1	1	3	Hypersufilidic sandy clay		
LF02-B									
AAa 30.1	h$_1$	0-2	0	0	0	0	Hyposulfidic sand	Hyposulfidic soil (sand)	Very Low
AAa 30.2	h$_1$	2-10	0	0	0	0	Sand		
AAa 30.3	h$_1$	10-25	0	0	0	0	Sand		
AAa 30.4	h$_1$	25-40	0	0	0	0	Sand		
AAa 30.5	h$_1$	40-55	0	0	0	0	Sand		
LFa02-B.1	a	0-8	1	0	0	1	Hyposulfidic sand	Hyposulfidic soil (sand)	Low
LFa02-B.2	a	8-25	1	0	0	1	Hyposulfidic sand		
LFa02-B.3	a	25-32	1	0	0	1	Hyposulfidic sand		
LFa02-B.4	a	32-65	1	0	0	1	Hyposulfidic sand		
LFa02-B.5	a	65-75	1	0	0	1	Hyposulfidic sand		
LFb02-B.1	b	0-5	0	0	0	0	Hyposulfidic sand	Hypersulfidic soil (sand)	Low
LFb02-B.2	b	5-28	0	0	0	0	Hyposulfidic sand		
LFb02-B.3	b	28-50	0	0	0	0	Hyposulfidic sand		
LFb02-B.4	b	50-70	0	1	0	1	Hypersulfidic sand		
LFc02-B.1	c	0-9	0	0	0	0	sand	Hypersulfidic subaqueous soil (sand)	Low
LFc02-B.2	c	9-25	0	0	0	0	sand		
LFc02-B.3	c	25-57	0	0	0	0	sand		
LFc02-B.4	c	57-67	0	1	0	1	Hypersulfidic sand		
LFd02-B.1	d	0-7	0	0	0	0	Sand	Hyposulfidic subaqueous soil (sand)	Low
LFd02-B.2	d	7-23	0	0	1	1	Sand		
LFd02-B.3	d	23-36	0	0	0	0	Sand		
LFd02-B.4	d	36-59	0	0	0	0	Sand		
LFd02-B.5	d	59-78	0	0	1	1	Hyposulfidic sand		
LFe02-B.1	e	0-12	0	0	1	1	Sand	Hyposulfidic subaqueous soil (sand)	Low
LFe02-B.2	e	12-19	0	0	0	0	Sand		
LFe02-B.3	e	19-25	0	0	0	0	Hyposulfidic clayey sand		
LFe02-B.4	e	25-38	0	0	1	1	Hyposulfidic clayey sand		
LFf02-B.1	f	0-12	0	1	1	2	Hypersufilidic sand	Hypersulfidic subaqueous soil (sand)	Low
LFf02-B.2	f	12-35	0	0	0	0	Sand		
LFf02-B.3	f	35-47	0	0	1	1	Hyposulfidic sand		
LFf02-B.4	f	47-78	0	0	0	0	Clayey sand		
LF02-D									
LFe02-D.1	e	0-7	0	0	1	1	Hyposulfidic sand	Sulfuric subaqueous soil (sand)	High
LFe02-D.2	e	7-19	1	1	1	3	Clayey sand		
LFe02-D.3	e	19-31	1	1	1	3*	Sulfuric clayey sand		
LFe02-D.4	e	31-47	1	1	1	3	Hypersufilidic clayey sand		

LFe02-D.5	e	47-56	0	0	0	0	Hyposulfidic heavy clay		
LFf02-D.1	f	0-11	0	1	1	2	Loamy sand	Sulfuric subaqueous soil (sand)	High
LFf02-D.2	f	11-25	1	1	1	3	Loamy sand		
LFf02-D.3	f	25-40	1	1	1	3*	Sulfuric loamy sand		
LFf02-D.4	f	40-72	1	1	1	3	Hypersufilidic sandy loam		

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Table 5-2 Summary of temporal and spatial variations and changes in ASS subtypes at each site (**A and B**). Note: (i) Cells shaded orange summarise data presented within this report, (ii) all other cells are based on/extrapolated from data presented in Fitzpatrick *et al.* (2008a; 2008b; 2009b; 2008c) and (iii) cells bordered in blue indicate subaqueous

Point Sturt North Sites		Drought Summer 2008 (h₁)	Drought Winter 2009 (h₂)	Drought End winter 2009 (a)	Drought End summer 2010 (b)	Post-drought Summer 2011 (c)	Post-drought Winter 2011 (d)	Post-drought start summer 2011/12 (e)	Post-drought start winter 2011/12 (f)	Summary
LF02-A	¹Classification & ²Acid hazard	Sulfuric (H)	Sulfuric (H)	Sulfuric (H)	Sulfuric* (H)	Sulfuric subaqueous (H)	Sulfuric subaqueous (H)	Hypersulfidic subaqueous (H)	Hypersulfidic subaqueous (H)	During the extreme drought period (2007 to 2009) the partial drying of the lake caused the formation of Sulfuric soils. Prolonged inundation, following winter 2010, caused the formation of Sulfuric subaqueous soil that developed into Hypersulfidic subaqueous soil.
	Dominant water and ASS process	LW & Sulfuric	LW & Sulfuric	LW & Sulfuric	LW & Sulfuric	RW & Sulfuric	UW & Sulfuric	UW & Sulfide	UW & Sulfide	
LF02-B	¹Classification & ²Acid hazard	Hyposulfidic (VL)	Hyposulfidic (VL)	Hyposulfidic (L)	Hyposulfidic (L)	Hyposulfidic subaqueous (L)	Hyposulfidic subaqueous (L)	Hyposulfidic subaqueous (L)	Hypersulfidic subaqueous (L)	During the extreme drought period (2007 to 2009) soil material remained Hyposulfidic. Inundation, following winter 2010, caused the formation of Hypersulfidic and Hyposulfidic subaqueous soil.
	Dominant water and ASS process	LW & Sulfide	LW & Sulfide	LW & Sulfide	LW & Sulfide	RW & Sulfide	UW & Sulfide	UW & Sulfide	UW & Sulfide	
LF02-D	¹Classification & ²Acid hazard	No Data	No Data	No Data	No Data	No Data	No Data	Sulfuric subaqueous (H)	Sulfuric subaqueous (H)	Following inundation in winter 2010, soil material remained Sulfuric subaqueous clay soil.
	Dominant water and ASS process	No Data	No Data	No Data	No Data	No Data	No Data	UW & Sulfuric	UW & Sulfuric	

¹Classification – Acid Sulfate Soil subtype classification
² Acid hazard – Acidification hazard: H = High; **M** = medium; **L** = Low; **VL** = Very Low
Dominant Water process
LW – Lowering water level regime to expose soil to air due to drought conditions and water evaporation
UW – Unchanged water regime, which had not yet evaporated to expose soil to air
RW – Rising water level regime to inundate and saturate soils by reflooding (e.g. due to pumping, regulator installation, river flow and groundwater)
RF – Rain fall rewetting and natural reflooding to inundate and saturate soils

Dominant ASS – process
Sulfuric – Sulfuricization - oxidation of pyrite in hypersulfidic material due to onset of aerobic conditions to form sulfuric material
Sulfuric* – As above with acidic minerals and/or salt efflorescences noted (i.e. measurable RA)
Sulfide – Sulfidization due to sulfide accumulation to form hypersulfidic material
Monosulfide – Monosulfidization due to monosulfide accumulation to form monosulfidic material
Leach – Leaching of acid from soil by winter rain fall
Sulfuric **subaqueous** with **overlying circa neutral water** pH >4: = font coloured blue or default
Sulfuric **subaqueous** soil with **overlying acid water** pH <4: = font coloured red
Where h₁ to h₃ = historical sampling; (a) – (b) sampling conducted in this project

6.   LF03 – MILANG

Summary

Overall, soil at Milang was considered to pose a medium acidification hazard.

During the extreme drought period (2007 to 2009) the partial drying of the lake caused profiles collected closest to the shoreline (LF03A) to transform from hypersulfidic subaqueous clay soil to sulfuric clay soil.   Most acidity was present below 25 cm and predominantly comprised S_{CR}, which became a combination of S_{CR} and TAA following drying.   Reflooding, in September 2010, had little impact on this soil material.   Although this site remained inundated for a period of 21 months, neutralisation was limited, soil material remained sulfuric and the acidification hazard remained high.

Profiles collected further into the lake (LF03B) were classified as hypersulfidic and sulfuric soil with medium acidification hazard ratings.   Drought conditions caused hypersulfidic subaqueous soil to transform to sulfuric soil. Acidity within the subaqueous profile predominantly comprised S_{CR}, some of which transformed to TAA following drying.   Reflooding and inundation for a period of 21 months seems to have caused some flushing of acidity (H^+) from surface sediments and encouraged reducing conditions and sulfate reduction. The acidification hazard at this site was considered to be medium.

6.1 Background

Study area LF03 was located south of the main Milang jetty (Figure 1-1). As part of this study, sampling was carried out in December 2011 and June 2012 (Samplings-e/f). Previous samplings were undertaken in May and June 2011 (Sampling-d), January and February 2011 (Sampling-c), March 2010 (Sampling-b) and November 2009 (Sampling-a). Additionally, data from historic sampling (Samplings-h_1/h_2), carried out in August 2007 and August 2009, were reassessed as part of this study. Sampling site locations are displayed in Figure 6-1.
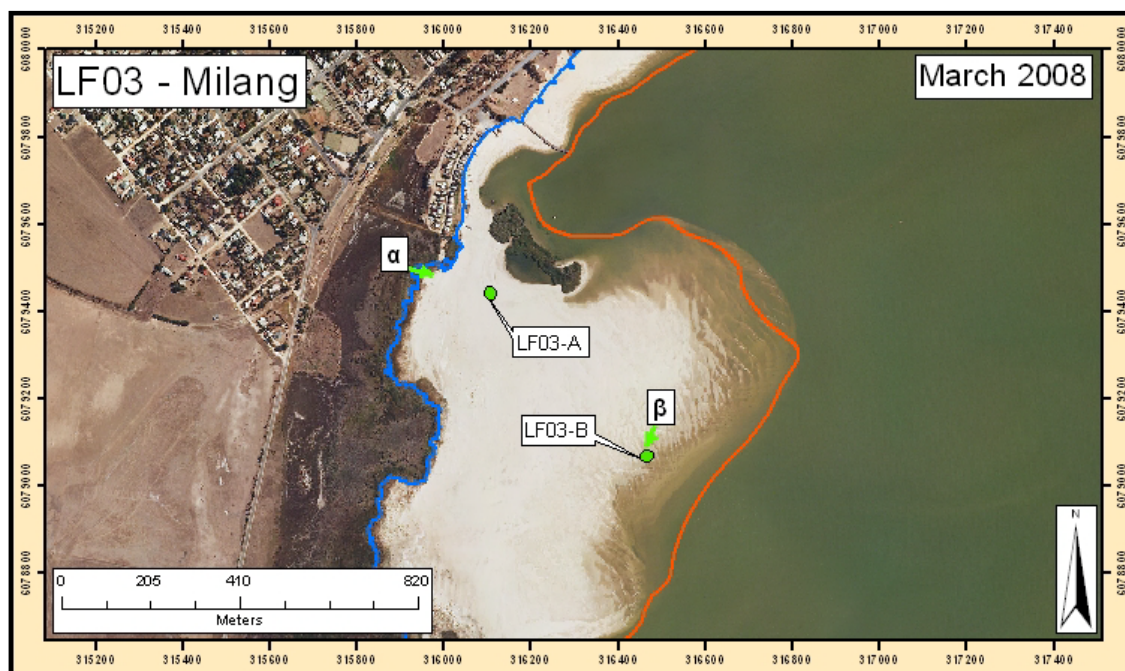
Figure 6-1 Sample location map. Aerial photograph taken in March 2008 (Orange line: sampling-a & b water level, Blue line: sampling-c, d, e & f water level)

At the time of Sampling-c/d/e/f, the lake level had risen to approximately 0.7 m AHD and the study area had been completely re-flooded (Figure 6-1: Figure 6-2). Prior to this, at the time of Samplings-a/b, the study area comprised an extensive area of beach, which extended from the pre-drought (pre 2006) shore to the waterline, approximately 750 m east (Figure 6-1). However, prior to this, in August 2007 (Sampling-h_1), only a few metres of beach were exposed (varied with seiche) (Figure 6-2). Since March 2008, the water level had dropped slightly and a large proportion of this beach area had been revegetated with grasses (Figure 6-1: Figure 6-2). Only minor changes were noted in the study area between Sampling-a and Sampling-b. The lake level had dropped from -0.80 m AHD in November 2009 (Sampling-a) to a low of -0.95 m AHD in January 2010. However, by March 2010 (Sampling-b) the lake level had risen back to -0.80 m AHD (MDBA 2011). In March 2010, small sand dunes (height < 30 cm) had formed against or had covered vegetation.
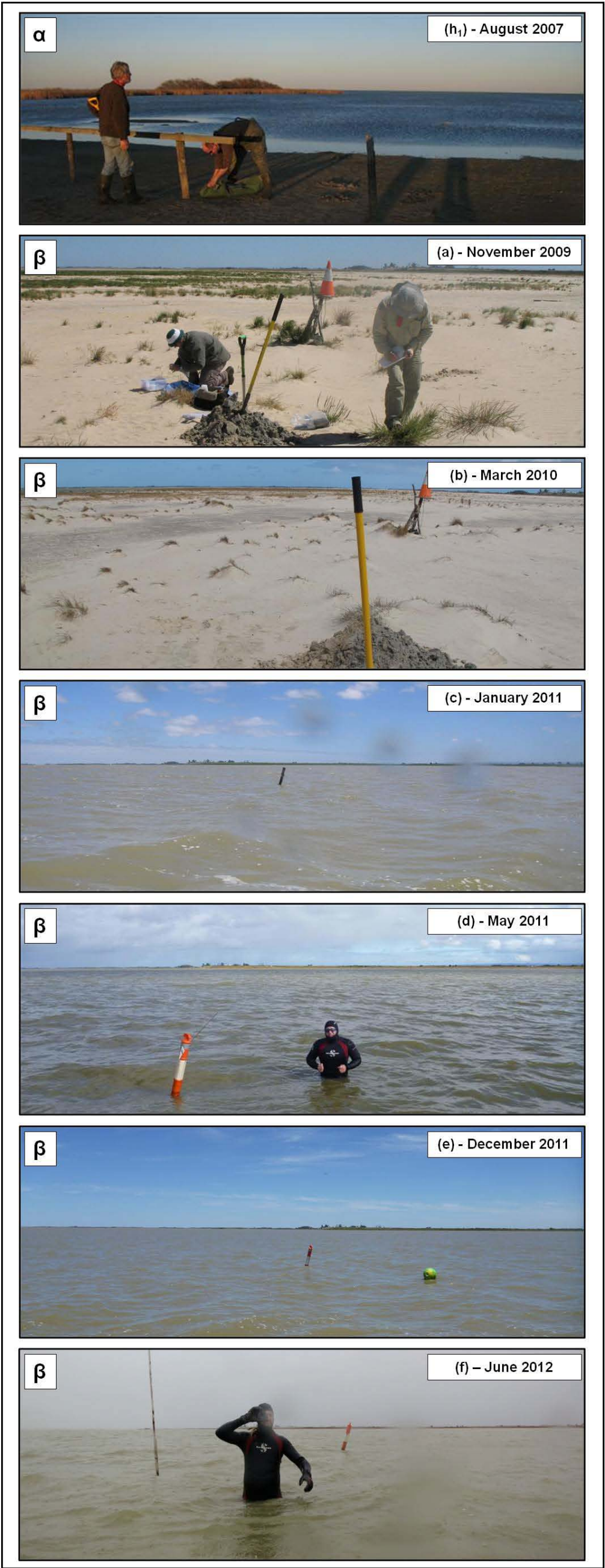
Figure 6-2 Site photographs. Refer to Figure 6-1 for the location and direction that photographs were taken, indicated by α or β (photographs were selected that best depicted the environmental conditions at the study area during each sampling)

6.2 Soils

Soils at Milang generally comprised sulfuric, hypersulfidic and hyposulfidic sand. A summary of encountered soils is provided below and site locations are presented in Figure 6-1. Detailed profile descriptions are presented in Appendix 4 and Appendix 8. Profile photographs are presented in Appendix 5.

LF03-A
During previous studies, when the study area was dry, profiles were collected at this site on three occasions (Samplings-h_1/a/b). The historic sampling was subaqueous and was carried out using a gouge auger. It encountered grey and black sand and silt to a depth of 30 cm. Underlying this was olive brown to black clay to a depth of 50 cm. This was underlain, to the maximum extent of investigation (80 cm) by grey sand. Samplings-a/b were carried out using a spade and encountered yellow brown sand and loamy sand to depths of 30 cm and 25 cm respectively. Sampling-a encountered very dark olive grey medium clay between 30 and 40 cm. From 40 to 50 cm was grey sand with orange and red mottles. Underlying this, to the maximum depth of investigation (70 cm), was dark grey sand.   Sampling-b, encountered yellow grey and grey sand and loamy sand with jarosite mottles associated with roots to a depth of 100 cm. Underlying this, to the maximum depth of investigation (110 cm), was organic rich dark olive heavy clay.

When water levels rose and the study area became inundated (Samplings-c/d), a UWS was used to collect subaqueous soil profiles on two occasions. The investigations encountered dark grey to black organic rich loamy sand to depths of 7 and 10 cm. Underlying this, to a depth of 16 cm, was greyish brown loamy sand with approximately 5 % black mottles. This was underlain, to depths of 24 and 21 cm , by olive brown clay with a few jarosite mottles associated with root channels. Underlying this, to depths of 54 and 47 cm, was grey brown loamy sand with 30 % jarosite mottles. During Sampling-c, this was underlain, to the maximum extent of investigation (63 cm) by dark grey sand with clayey bands and a few jarosite mottles. During Sampling-d, very dark brown spongy sapric peat was encountered instead, to a depth of 65 cm.

As part of this study, a UWS was used to collect subaqueous soil profiles (Samplings-e/f). The investigations encountered 10 to 15 cm of dark grey sand with 30% black mottles, which overlay grey brown loamy sand to depths of 16 to 20 cm. This was underlain, to depths of 19 to 26 cm, by very dark grey brown heavy clay with remnant roots. Underlying this, to depths of 42 to 60 cm, was grey brown loamy sand with prominent yellow jarosite mottles. During Sampling-e, this was underlain, to the maximum extent of investigation (48 cm) by very dark brown sapric peat. During Sampling-f, this was underlain, to the maximum extent of investigation (68 cm) by grey loamy sand.

LF03-B
During previous studies, when the study area was dry, profiles were collected at this site on three occasions (Samplings-h_1/a/b). The historic sampling was subaqueous and was carried out using a gouge auger. It encountered yellow sand to a depth of 5cm, which was underlain to a depth of 15 cm by very dark grey sand with black and yellow mottles. This was underlain, to the maximum extent of investigation (30 cm) by pale grey sand with minor black mottles and few shells. Samplings-a/b were carried out using a spade and encountered yellow brown sand to a depth of 30 cm. During Sampling-a, orange mottles were encountered between 15 and 30 cm. During Sampling-b, reddish brown mottles were encountered between 0 and 10 cm and jarosite mottles between 10 and 30 cm. Samplings-a and Sampling-b encountered grey medium to coarse sand between 30 cm and 50 cm and between 30 cm and 60 cm respectively. During Sampling-a, this was underlain, to the maximum extent of investigation (65 cm), by blueish grey medium clay. In contrast, Sampling-b encountered olive grey sand with shell fragments and a distinct 5 cm thick band of shell and bluish grey sandy clay at 60 cm.

When water levels rose and the study area became inundated (Samplings-c/d), a UWS was used to collect subaqueous soil profiles on two occasions. The investigations encountered 13 and 6 cm of dark grey sand with black mottles. This was underlain, to depths of 30 and 20 cm, by grey sand with a few jarosite

mottles. Underlying this was grey sand to depths of 47 and 51 cm. This was underlain, to the maximum extent of investigation (74 and 53 cm), by dark grey sand and loamy sand.

As part of this study, a UWS was used to collect subaqueous soil profiles (Samplings-e/f). The investigation encountered 8 to 9 cm of greyish brown sand, which overlay dark greyish brown sand with black mottles to a depths of 14 to 15 cm. This was underlain, to depths of 29 to 30 cm, by grey sand. During Sampling-e, this was underlain, to a depth of 37 cm, by grey clayey sand. Underlying this, to the maximum extent of investigation (48 cm) by very dark grey loamy sand. During Sampling-f, this was underlain, to a depth of 50 cm, by greyish brown sand with some sandy clay bands. Underlying this, to the maximum extent of investigation (72 cm) by greyish brown sand.

6.3 Soil acidity and acid-base accounting

Acid-base accounting was carried out according to the methods described in Section 2.3. Acid-base accounting and pH data (pH_{OX}, pH_{INC} & pH_W), for each soil layer, are presented in Figure 6-3. These data were used to inform the acidification hazard assessment that is presented in Table 6-1.
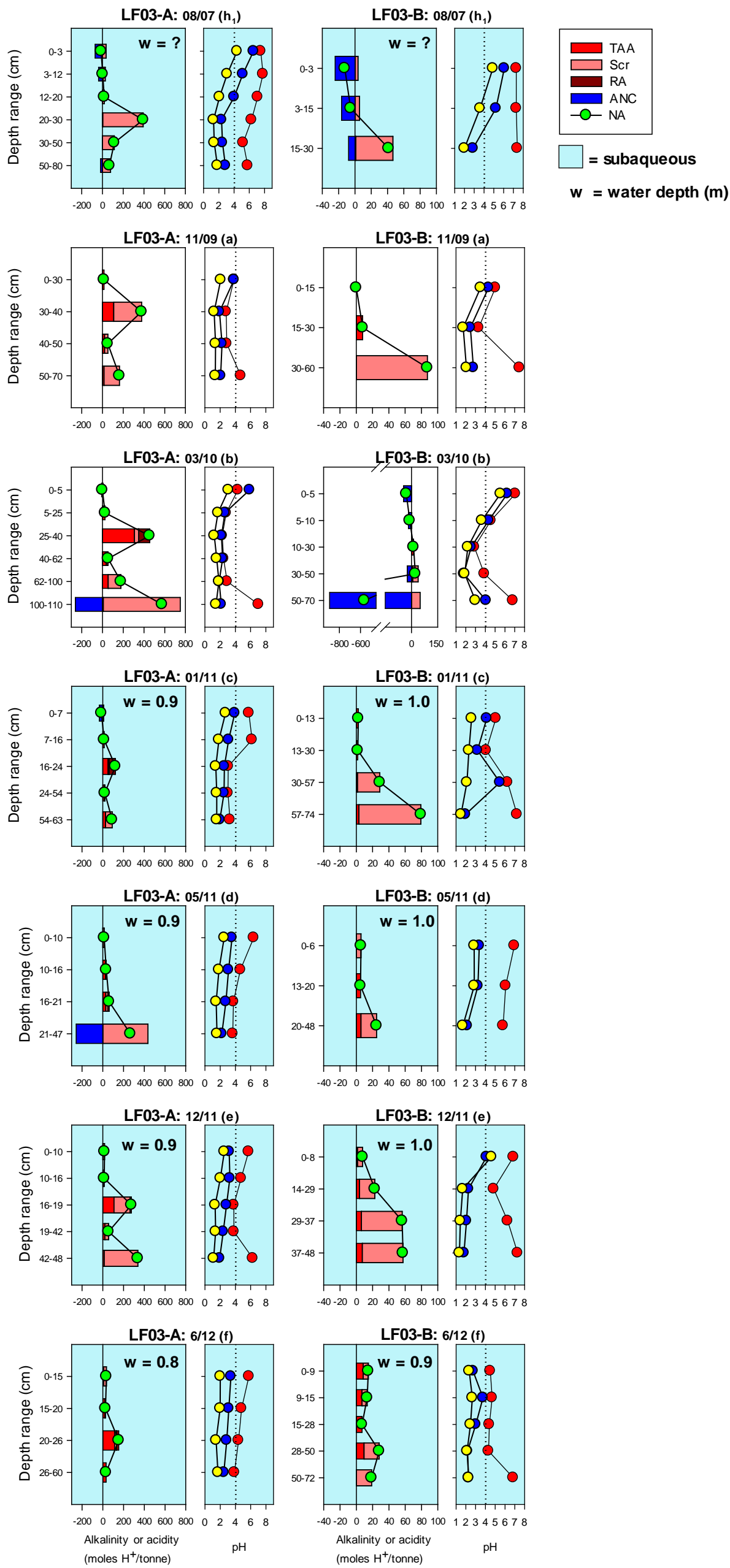
Figure 6-3 pH and acid-base accounting data plotted against depth for each profile collected

6.4 Summary and discussion

Acidification potential assessment and ASS material classification were carried out for each soil sample collected, according to the definitions and methods presented in Section 1.3 and Section 2.4 respectively. A summary of acidification potential and ASS material classification is presented in Table 6-1.

Acidification hazard assessment and ASS subtype classification were carried out for each soil profile collected. ASS subtype classification was achieved using the methods described in Appendix 2. Acidification hazard assessment was based on: (i) landscape position (Figure 6-1), (ii) soil morphology (Section 6.2), (iii) acid-base accounting (Figure 6-3), (iv) pH data (Figure 6-3), (v) acidification potential (Table 6-1) and (vi) ASS material and subtype classification (Table 6-1). Acidification hazard categories were: (i) very low, (ii) low, (iii) medium and (iv) high. A summary of ASS subtype classification and acidification hazard for each profile collected between August 2007 and June 2012 is presented in Table 6-1.

Soil profiles at Milang comprised hypersulfidic and sulfuric soil with medium and high acidification hazard ratings (Table 6-1). Profiles collected closest to the shoreline (LF03-A; Figure 6-1) were classified as hypersulfidic and sulfuric soil with high acidification hazard ratings (Table 6-1). They generally had high positive net acidity, low levels of ANC and medium and high acidification potential (Figure 6-3; Table 6-1). The historic sampling at site LF03-A was carried out under subaqueous conditions and soil materials were classified as hypersulfidic subaqueous soil, which dried to sulfuric soil (Samplings-a/b) (Table 6-1). Acidity within the subaqueous profile predominantly comprised S_{CR}, which became a combination of S_{CR} and TAA following drying (Figure 6-3). Most of the acidity in the profile was present below approximately 25 cm. Reflooding, in September 2010, had little impact on this soil material (Table 6-2). Although this site remained inundated for a period of 21 months, RA and TAA was still present at depth and soil material remained sulfuric (Figure 6-3).

Profiles collected further into the lake, at site LF03-B (Figure 6-1), were classified as hypersulfidic and sulfuric with medium acidification hazard ratings (Table 6-1). They generally had positive net acidity, little ANC and high acidification potential below 15 cm (Figure 6-3; Table 6-1). The historic sampling at this site was carried out under subaqueous conditions and soil materials were classified as hypersulfidic subaqueous, which dried to sulfuric (Samplings-a/b) (Table 6-1). Acidity within the subaqueous profile predominantly comprised S_{CR}, some of which transformed to TAA following drying (Figure 6-3). Reflooding and inundation for a period of 21 months seems to have caused some flushing of acidity (H^+) from surface sediments and encouraged reducing conditions and sulfate reduction (Table 6-2).

Overall, soil at Milang was considered to pose a medium acidification hazard.

Table 6-1 Summary of acidification potential, ASS material classification, ASS subtype classification and acidification hazard (* indicates sulfuric soil material). The soil texture in brackets following the ASS subtype classification indicates the dominant texture of the profile

Sample	Sampling	Depth (cm)	pH_{OX} < 2.5	pH_{INC} < 4.0	NA > 0	Acidification potential	ASS material classification	ASS subtype classification	Acidification hazard
LF03-A									
AA 16.1	h_1	0-3	0	0	0	0	Hyposulfidic sand		
AA 16.2	h_1	3-12	0	0	0	0	Hyposulfidic silt		
AA 16.3	h_1	12-20	1	0	1	2	Hyposulfidic silty sand	Hypersulfidic subaqueous clay soil (sand)	High
AA 16.4	h_1	20-30	1	1	1	3	Hypersulfidic clay		
AA 16.5	h_1	30-50	1	1	1	3	Hypersulfidic clay		
AA 16.6	h_1	50-80	1	1	1	3	Hypersulfidic sand		
LFa03-A.1	a	0-30	1	1	1	3*	Sulfuric fine sand		
LFa03-A.2	a	30-40	1	1	1	3*	Sulfuric clay	Sulfuric soil (sand)	High
LFa03-A.3	a	40-50	1	1	1	3*	Sulfuric coarse sand		
LFa03-A.4	a	50-70	1	1	1	3	Hypersulfidic sand		
LFb03-A.1	b	0-5	0	0	0	0	Hyposulfidic loamy sand		
LFb03-A.2	b	5-25	1	1	1	3*	Sulfuric loamy sand		
LFb03-A.3	b	25-40	1	1	1	3*	Sulfuric heavy clay	Sulfuric clay soil (sand)	High
LFb03-A.4	b	40-62	1	1	1	3*	Sulfuric loamy sand		
LFb03-A.5	b	62-100	1	1	1	3*	Sulfuric sand		
LFb03-A.6	b	100-110	1	1	1	3	Hypersulfidic heavy clay		
LFc03-A.1	c	0-7	0	1	0	1	Hypersulfidic loamy sand loamy sand		
LFc03-A.2	c	7-16	1	1	1	3	loamy sand	Sulfuric subaqueous clay soil (sand)	High
LFc03-A.3	c	16-24	1	1	1	3*	Sulfuric clay		
LFc03-A.4	c	24-54	1	1	1	3*	Sulfuric loamy sand		
LFc03-A.5	c	54-63	1	1	1	3*	Sulfuric sand		
LFd03-A.1	d	0-10	0	1	1	2	Hypersulfidic loamy sand		
LFd03-A.2	d	10-16	1	1	1	3	Loamy sand	Sulfuric subaqueous soil (sand)	High
LFd03-A.3	d	16-21	1	1	1	3*	Sulfuric clay		
LFd03-A.4	d	21-47	1	1	1	3*	Sulfuric loamy sand		
LFe03-A.1	e	0-10	0	1	1	2	Hypersufilidic loamy sand		
LFe03-A.2	e	10-16	1	1	1	3	Hypersufilidic loamy sand	Sulfuric subaqueous soil (sand)	High
LFe03-A.3	e	16-19	1	1	1	3*	Sulfuric heavy clay		
LFe03-A.4	e	19-42	1	1	1	3*	Sulfuric loamy sand		
LFe03-A.5	e	42-48	1	1	1	3	Hypersufilidic sapric peat		
LFf03-A.1	f	0-15	1	1	1	3	Hypersufilidic loamy fine sand		
LFf03-A.2	f	15-20	1	1	1	3	Hypersufilidic loamy fine sand	Sulfuric subaqueous soil (sand)	High
LFf03-A.3	f	20-26	1	1	1	3	Hypersufilidic heavy clay		
LFf03-A.4	f	26-60	1	1	1	3*	Sulfuric loamy sand		
LF03-B									
AA 15.1	h_1	0-3	0	0	0	0	Sand		
AA 15.2	h_1	3-15	0	0	0	0	Sand	Hypersulfidic subaqueous soil (sand)	Medium
AA 15.3	h_1	15-30	1	1	1	3	Hypersulfidic sand		
LFa03-B.1	a	0-15	0	0	0	0	Hyposulfidic sand		
LFa03-B.2	a	15-30	1	1	1	3*	Sulfuric sand	Sulfuric soil (sand)	Medium
LFa03-B.3	a	30-60	1	1	1	3	Hypersulfidic sand		
LFb03-B.1	b	0-5	0	0	0	0	Hyposulfidic sand		
LFb03-B.2	b	5-10	0	0	0	0	Hyposulfidic sand		
LFb03-B.3	b	10-30	1	1	1	3*	Sulfuric sand	Sulfuric soil (sand)	Medium
LFb03-B.4	b	30-50	1	1	1	3*	Sulfuric sand		
LFb03-B.5	b	50-70	0	0	0	0	Hyposulfidic sand		
LFc03-B.1	c	0-13	0	0	1	1	Sand		
LFc03-B.2	c	13-30	1	1	1	3	Sand	Hypersulfidic subaqueous soil (sand)	Medium
LFc03-B.3	c	30-57	1	0	1	2	Hyposulfidic sand		
LFc03-B.4	c	57-74	1	1	1	3	Hypersulfidic sand		
LFd03-B.1	d	0-6	0	1	1	2	Sand		
LFd03-B.2	d	13-20	0	1	1	2	Sand	Hypersulfidic subaqueous soil (sand)	Medium
LFd03-B.3	d	20-48	1	1	1	3	Hypersulfidic sand		
LFe03-B.1	e	0-8	0	0	1	1	Hyposulfidic sand		
LFe03-B.3	e	14-29	1	1	1	3	Hypersufilidic sand	Hypersulfidic subaqueous soil (sand)	Medium
LFe03-B.4	e	29-37	1	1	1	3	Hypersufilidic clayey sand		
LFe03-B.5	e	37-48	1	1	1	3	Hypersufilidic loamy sand		
LFf03-B.1	f	0-9	1	1	1	3	Hypersufilidic sand		
LFf03-B.2	f	9-15	0	1	1	2	Hypersufilidic sand	Hypersulfidic subaqueous soil (sand)	Medium
LFf03-B.3	f	15-28	1	1	1	3	Sand		
LFf03-B.4	f	28-50	1	1	1	3	Hypersufilidic sand		
LFf03-B.5	f	50-72	1	1	1	3	Hypersufilidic sand		

Table 6-2 Summary of temporal and spatial variations and changes in ASS subtypes at each site (**A and B**). Note: (i) Cells shaded orange summarise data presented within this report, (ii) all other cells are based on/extrapolated from data presented in Fitzpatrick *et al.* (2008a; 2008b; 2009b; 2008c) and (iii) cells bordered in blue indicate subaqueous

Milang Sites		Pre-drought Winter 2007 (h₁)	Drought Winter 2009 (h₂)	Drought End winter 2009 (a)	Drought End summer 2010 (b)	Post-drought Summer 2011 (c)	Post-drought Winter 2011 (d)	Post-drought start summer 2011/12 (e)	Post-drought start winter 2011/12 (f)	Summary
LF03-A	[1]Classification & [2]Acid hazard	**Hypersulfidic subaqueous clay (H)**	**Sulfuric (H)**	**Sulfuric (H)**	**Sulfuric* clay (H)**	**Sulfuric subaqueous clay (H)**	**Sulfuric subaqueous (H)**	**Sulfuric subaqueous (H)**	**Sulfuric subaqueous (H)**	During the extreme drought period (2007 to 2009) the partial drying of the lake caused Hypersulfidic subaqueous clay soil to transform to Sulfuric clay soil. Inundation, following winter 2010, caused the formation of Sulfuric subaqueous (clay) soil.
	Dominant water and ASS process	**UW & Sulfide**	**LW & Sulfuric**	**LW & Sulfuric**	**LW & Sulfuric**	**RW & Sulfuric**	**UW & Sulfuric**	**UW & Sulfuric**	**UW & Sulfuric**	
LF03-B	[1]Classification & [2]Acid hazard	**Hypersulfidic subaqueous (M)**	**Sulfuric (M)**	**Sulfuric (M)**	**Sulfuric (M)**	**Hypersulfidic subaqueous (M)**	**Hypersulfidic subaqueous (M)**	**Hypersulfidic subaqueous (M)**	**Hypersulfidic subaqueous (M)**	During the extreme drought period (2007 to 2009) the partial drying of the lake caused Hypersulfidic subaqueous soil to transform to Sulfuric soil. Inundation, following winter 2010, encouraged sulfate reduction and caused the formation of Hypersulfidic subaqueous soil.
	Dominant water and ASS process	**UW & Sulfide**	**LW & Sulfuric**	**LW & Sulfuric**	**LW & Sulfuric**	**RW & Sulfide**	**UW & Sulfide**	**UW & Sulfide**	**UW & Sulfide**	

[1] **Classification** – Acid Sulfate Soil subtype classification
[2] **Acid hazard** – Acidification hazard: **H** = High; **M** = medium; **L** = Low; **VL** = Very Low
Dominant Water process
LW – Lowering water level regime to expose soil to air due to drought conditions and water evaporation
UW – Unchanged water regime, which had not yet evaporated to expose soil to air
RW – Rising water level regime to inundate and saturate soils by reflooding (e.g. due to pumping, regulator installation, river flow and groundwater)
RF – Rain fall rewetting and natural reflooding to inundate and saturate soils

Dominant ASS – process
Sulfuric – Sulfuricization - oxidation of pyrite in hypersulfidic material due to onset of aerobic conditions to form sulfuric material
Sulfuric* – As above with acidic minerals and/or salt efflorescences noted (i.e. measurable RA)
Sulfide – Sulfidization due to sulfide accumulation to form hypersulfidic material
Monosulfide – Monosulfidization due to monosulfide accumulation to form monosulfidic material
Leach – Leaching of acid from soil by winter rain fall
Sulfuric **subaqueous** with **overlying circa neutral water** pH >4: = font coloured blue or default
Sulfuric **subaqueous** soil with **overlying acid water** pH <4: = font coloured red
Where h₁ to h₃ = historical sampling; (a) – (b) sampling conducted in this project

7. LF04 – TOLDEROL

Summary

Soil at Tolderol was considered to pose a medium acidification hazard. On drying, previously acidic soil material is likely to re-acidify rapidly and may impact upon surface waters.

Closest to the shoreline, drought caused hypersulfidic subaqueous soil to form sulfuric soil with high acidification hazard ratings. Reflooding, in September 2010, and inundation for a period of 21 months seems to have generally resulted in less acidic soil conditions and a transformation from sulfuric to hypersulfidic subaqueous soil. In Sampling-d/e there was a slight lessening of TAA and a corresponding increase in S_{CR} in the profile suggesting the onset of reducing conditions may have promoted reduction of sulfate. However, Sampling-f encountered significant concentrations of TAA between depths of 23 and 30 cm that was associated with low pHw and jarosite mottles. This was attributed to spatial variability.

Profiles collected further into the lake were classified as hypersulfidic and hyposulfidic soil with low and medium acidification hazard ratings. Following reflooding, in September 2010, there was an apparent loss of ANC from surface soil layers. Although this may have been due to chemical dissolution, it was most likely the result of physical erosion (noted at other locations around the lakes). These soil material were considered to have a medium soil acidification hazard.

7.1 Background

Study area LF04 was located approximately 16 km north east of Milang, within the Tolderol Game Reserve (Figure 1-1). As part of this study, sampling was carried out in December 2011 and June 2012 (Samplings-e/f). Previous samplings were undertaken in May and June 2011 (Sampling-d), January and February 2011 (Sampling-c), March 2010 (Sampling-b) and November 2009 (Sampling-a). Additionally, data from historic sampling (Samplings-h_1/h_2), carried out in August 2007 and August 2009, were reassessed as part of this study. Sampling site locations are displayed in Figure 7-1.
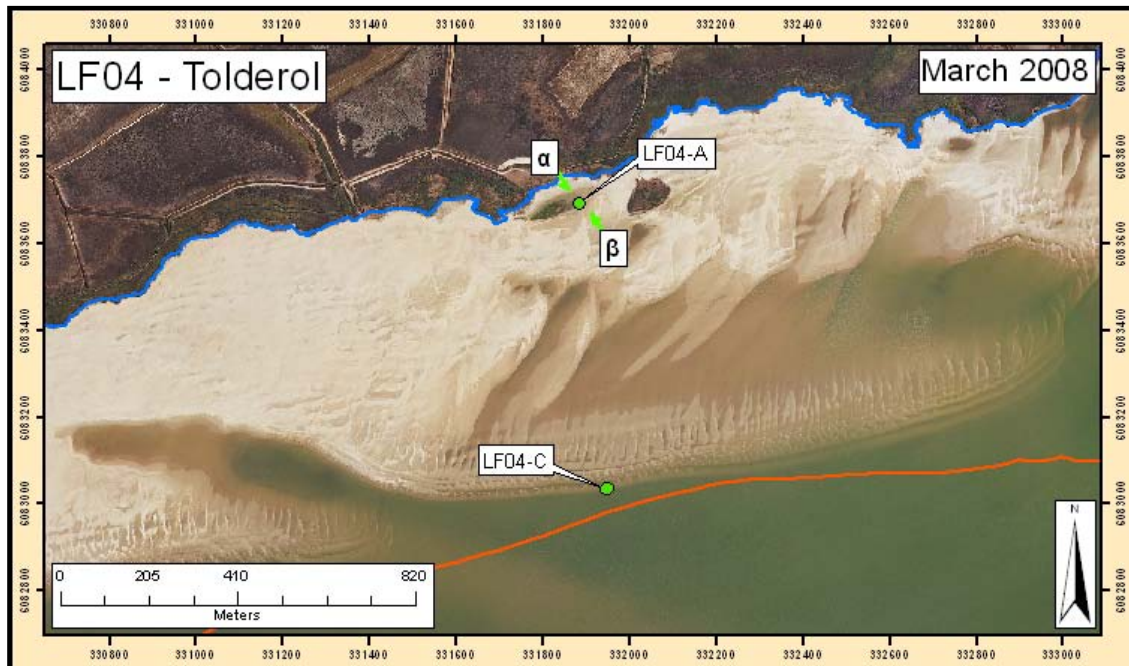
Figure 7-1 Sample location map. Aerial photograph taken in March 2008 (Orange line: sampling-a & b water level, Blue line: sampling-c, d, e & f water level)

At the time of Sampling-c/d/e, the lake level had risen to approximately 0.65 m AHD and the study area had been completely re-flooded (Figure 7-1: Figure 7-2). Prior to this, at the time of Samplings-a/b, the study area comprised an extensive area of beach, which extended from the pre-drought (pre 2006) shore to the waterline, approximately 700 m south (Figure 7-1). However, prior to this, in August 2007 (Sampling-h_1), only a few metres of beach were exposed (varied with seiche) (Figure 7-2). Since March 2008, the water level had dropped slightly and a large proportion of this beach area had been revegetated with cereal rye (Figure 7-1: Figure 7-2). Only minor changes were noted in the study area between Sampling-a and Sampling-b. The lake level had dropped from -0.80 m AHD in November 2009 (Sampling-a) to a low of -0.95 m AHD in January 2010. However, by March 2010 (Sampling-b) the lake level had risen back to -0.80 m AHD (MDBA 2011). In March 2010, the cereal rye had dropped its seeds and only the dried stems remained.

α   (h₁) - August 2007

β   (a) - November 2009

β   (b) - March 2010

β   (c) - January 2011

β   (d) - May 2011

β   (e) - December 2011

β   (f) – June 2012

Figure 7-2 Site photographs. Refer to Figure 7-1 for the location and direction that photographs were taken, indicated by α or β (photographs were selected that best depicted the environmental conditions at the study area during each sampling)

7.2 Soils

Soils at Tolderol generally comprised sulfuric, hypersulfidic and hyposulfidic sand. A summary of encountered soils is provided below and site locations are presented in Figure 7-1. Detailed profile descriptions are presented in Appendix 4 and Appendix 8. Profile photographs are presented in Appendix 5.

LF04-A
During previous studies, when the study area was dry, profiles were collected at this site on three occasions (Samplings-h_1/a/b). The historic sampling was subaqueous and was carried out using a spade. It encountered yellowish grey sand to a depth of 3 cm, which was underlain, to the maximum depth of investigation (15 cm), by grey sandy clay with black mottles. Sampling-a encountered pale grey medium to coarse sand with orange mottles to a depth of 25 cm. This was underlain, to a depth of 35 cm, by grey sand with jarosite mottles. Between 35 and 42 cm was greenish grey sandy clay with few orange mottles along root channels. This was underlain, to the maximum extent of investigation (55 cm) by grey sand with dark grey mottles. Sampling-b encountered light brown sand with yellow and orange mottles to a depth of 15 cm. This was underlain, to a depth of 40 cm by grey sand with yellow brown and jarosite mottles. Between 40 and 50 cm was dark grey sand with darker grey mottles. This was underlain, to the maximum extent of investigation (65 cm) by blue grey medium to heavy clay.

When water levels rose and the study area became inundated (Samplings-c/d), a UWS was used to collect subaqueous soil profiles on two occasions. The investigations encountered 18 and 10 cm of dark grey to black sand that was underlain, to depths of 28 and 20 cm, by grey sand with 10 to 15 % yellow jarosite mottles. These were distinct during Sampling-c and diffuse during Sampling-d. Underlying this, to depths of 38 and 58 cm was grey sand with rare shells encountered during Sampling-d. This was underlain, to the maximum extent of investigation (65 and 77 cm), by dark grey clay. Many more shells were encountered in this layer during Sampling-d.

As part of this study, a push tube and UWS were used to collect subaqueous soil profiles (Samplings-e/f). Sampling-e encountered 5 cm of very dark grey sand, which overlay light brownish grey sand with diffuse jarosite mottles to a depth of 12 cm. This was underlain, to a depth of 45 cm, by grey sand with greenish grey bands of clay. Underlying this, to the maximum extent of investigation (67 cm) was dark greenish grey clay with some sandy lenses and prominent layers of shell fragments. Sampling-f encountered 10 cm of very dark grey sand, which overlay brownish grey sand with diffuse jarosite mottles to a depth of 23 cm. This was underlain, to a depth of 30 cm, by dark greenish grey sandy clay loam with jarosite mottles. Underlying this, to a depth of 52 cm, was grey sand with few brown mottles. This was underlain, to the maximum extent of investigation (80 cm) by grey sandy clay loam with rare shell fragments at base.

LF04-C
During previous studies, when the study area was dry, profiles were collected at this site on three occasions (Samplings-h_2/a/b). The historic sampling was subaqueous and was carried out from a boat and encountered grey coarse sand to the maximum depth of investigation at 50 cm. Sampling-a encountered 3 cm of pale brown coarse sand with bright orange mottles. This was underlain, to a depth of 10 cm, by dark grey medium sand with brown orange and black mottles. Underlying this, to the maximum extent of investigation (35 cm), was very dark grey to black coarse sand. Sampling-b encountered 15 cm of brown sand with distinct red brown mottles. Between 15 and 35 cm was dark grey to black sand. This was underlain, to the maximum extent of investigation (50 cm), by olive grey gleyed sand with small amounts of fine fibric material.

When water levels rose and the study area became inundated (Samplings-c/d), a UWS was used to collect subaqueous soil profiles on two occasions. Very dark grey to black sand was encountered to depths of 15 and 23 cm, which was underlain, to depths of 40 and 47 cm, by grey sand with dark grey to black diffuse mottles. During Sampling-c, this was underlain, to the maximum extent of investigation (70 cm), by dark

grey sand. During Sampling-d, this was underlain, to the maximum extent of investigation (70 cm), by a grey shelly sandy clay band overlying dark grey sand.

As part of this study, a push tube and UWS were used to collect subaqueous soil profiles (Samplings-e/f). The investigations encountered 15 to 23 cm of very dark grey sand with some monosulfidic material, which overlay grey sand with thin bands of clay to depths of 47 to 51 cm. This was underlain, to depths of 62 to 78 cm, by grey sand with common shell fragments. Underlying this, to the maximum extent of investigation (68 and 82 cm) was dark grey medium to heavy clay with bivalves at upper boundary in Sampling-e.

7.3 Soil acidity and acid-base accounting

Acid-base accounting was carried out according to the methods described in Section 2.3. Acid-base accounting and pH data (pH_{OX}, pH_{INC} & pH_W), for each soil layer, are presented in Figure 7-3. These data were used to inform the acidification hazard assessment that is presented in Table 7-1.
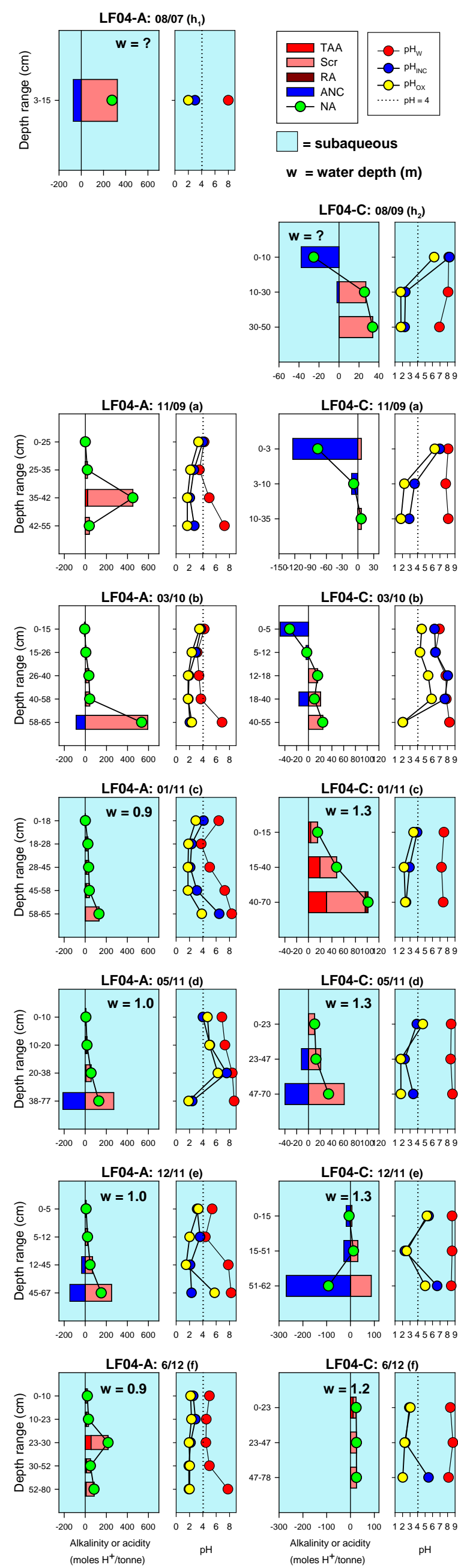
Figure 7-3 pH and acid-base accounting data plotted against depth for each profile collected

7.4 Summary and discussion

Acidification potential assessment and ASS material classification were carried out for each soil sample collected, according to the definitions and methods presented in Section 1.3 and Section 2.4 respectively. A summary of acidification potential and ASS material classification is presented in Table 7-1.

Acidification hazard assessment and ASS subtype classification were carried out for each soil profile collected. ASS subtype classification was achieved using the methods described in Appendix 2. Acidification hazard assessment was based on: (i) landscape position (Figure 7-1), (ii) soil morphology (Section 7.2), (iii) acid-base accounting (Figure 7-3), (iv) pH data (Figure 7-3), (v) acidification potential (Table 7-1) and (vi) ASS material and subtype classification (Table 7-1). Acidification hazard categories were: (i) very low, (ii) low, (iii) medium and (iv) high. A summary of ASS subtype classification and acidification hazard for each profile collected between August 2007 and June 2012 is presented in Table 7-1.

Soil profiles at Tolderol comprised hyposulfidic, hypersulfidic and sulfuric soil with low to high acidification hazard ratings (Table 7-1). Profiles collected closest to the shoreline (LF04-A; Figure 7-1) were classified as hypersulfidic and sulfuric soil with high acidification hazard ratings (Table 7-1). They generally had positive net acidity, low levels of ANC and high acidification potential (Figure 7-3; Table 7-1). The historic sampling was carried out under subaqueous conditions (Figure 7-2) and the soil material classified as hypersulfidic subaqueous soil, that dried to sulfuric soil (Sampling-b) (Table 7-1). Reflooding, in September 2010, and inundation for a period of 21 months seems to have resulted in less acidic soil conditions. The soil material at this site transformed from sulfuric to hypersulfidic subaqueous. In Sampling-d/e there was a slight lessening of TAA and a corresponding increase in S_{CR} in the profile suggesting the onset of reducing conditions may have promoted reduction of sulfate (Figure 7-3). However, Sampling-f encountered significant concentrations of TAA between depths of 23 and 30 cm that was associated with low pHw and jarosite mottles (Figure 7-3) (Section 7.2). This was attributed to spatial variability.

Profiles collected further into the lake, at site LF04-C (Figure 7-1), were classified as hyposulfidic and hypersulfidic soil with medium and low acidification hazard ratings (Table 7-1). They had both slightly positive and negative net acidity, little ANC and acidity. Acidification potential ranged from very low to high (Figure 7-3; Table 7-1). Following reflooding, in September 2010, there was an apparent loss of ANC from surface soil layers (Table 7-2). Although this may have been due to chemical dissolution, it was most likely the result of physical erosion (noted at other locations around the lakes). During drought and subsequent reflooding, soil material remained hypersulfidic with a medium acidification hazard rating (Table 7-2).

Soil at Tolderol was considered to pose a medium acidification hazard (Table 7-1). On drying, previously acidic soil material is likely to re-acidify rapidly and may impact upon surface waters.

Table 7-1 Summary of acidification potential, ASS material classification, ASS subtype classification and acidification hazard (* indicates sulfuric soil material). The soil texture in brackets following the ASS subtype classification indicates the dominant texture of the profile

Sample	Sampling	Depth (cm)	pH_{OX} < 2.5	pH_{INC} < 4.0	NA > 0	Acidification potential	ASS material classification	ASS subtype classification	Acidification hazard
LF04-A									
AA 13.2	h_1	3-15	1	1	1	3	Hypersulfidic sandy clay	Hypersulfidic subaqueous clay soil (clay)	High
LFa04-A.1	a	0-25	0	0	0	0	Hyposulfidic sand		
LFa04-A.2	a	25-35	1	1	1	3*	Sulfuric sand	Sulfuric soil	High
LFa04-A.3	a	35-42	1	1	1	3	Hypersulfidic sandy clay	(sand)	
LFa04-A.4	a	42-55	1	1	1	3	Hypersulfidic sand		
LFb04-A.1	b	0-15	0	1	0	1	Hyposulfidic sand		
LFb04-A.2	b	15-26	1	1	1	3*	Sulfuric sand		
LFb04-A.3	b	26-40	1	1	1	3*	Sulfuric sand	Sulfuric soil	High
LFb04-A.4	b	40-58	1	1	1	3*	Sulfuric sand	(sand)	
LFb04-A.5	b	58-65	1	1	1	3	Hypersulfidic heavy clay		
LFc04-A.1	c	0-18	0	0	1	1	Sand		
LFc04-A.2	c	18-28	1	1	1	3*	Sulfuric sand		
LFc04-A.3	c	28-45	1	1	1	3	Hypersulfidic sand	Sulfuric subaqueous soil	High
LFc04-A.4	c	45-58	1	1	1	3	Hypersulfidic sand	(sand)	
LFc04-A.5	c	58-65	0	0	1	1	Hyposulfidic clay		
LFd04-A.1	d	0-10	0	1	1	2	Hypersulfidic sand		
LFd04-A.2	d	10-20	1	1	1	3	Hypersulfidic sand	Hypersulfidic subaqueous soil	High
LFd04-A.3	d	20-38	1	1	1	3	Hypersulfidic sand	(sand)	
LFd04-A.4	d	38-77	1	0	1	2	Hyposulfidic sand		
LFe04-A.1	e	0-5	0	1	1	2	Hypersufilidic sand		
LFe04-A.2	e	5-12	1	1	1	3	Hypersufilidic sand	Hypersulfidic subaqueous soil	High
LFe04-A.3	e	12-45	1	1	1	3	Hypersufilidic sand	(sand)	
LFe04-A.4	e	45-67	0	1	1	2	Hypersufilidic heavy clay		
LFf04-A.1	f	0-10	1	1	1	3	Hypersufilidic sand		
LFf04-A.2	f	10-23	1	1	1	3	Hypersufilidic sand	Hypersulfidic subaqueous soil	High
LFf04-A.3	f	23-30	1	1	1	3	Hypersufilidic sandy clay	(sand)	
LFf04-A.4	f	30-52	1	1	1	3	Hypersufilidic sand		
LFf04-A.5	f	52-80	1	1	1	3	Hypersufilidic sandy clay		
LF04-C									
LL 1501	h_2	0-10	0	0	0	0	Sand	Hypersulfidic subaqueous soil	Medium
LL 1502	h_2	10-30	1	1	1	3	Hypersulfidic sand	(sand)	
LL 1503	h_2	30-50	1	1	1	3	Hypersulfidic sand		
LFa04-C.1	a	0-3	0	0	0	0	Hyposulfidic sand	Hyposulfidic soil	Low
LFa04-C.2	a	3-10	0	0	0	0	Hyposulfidic sand	(sand)	
LFa04-C.3	a	10-35	0	0	1	1	Hyposulfidic sand		
LFb04-C.1	b	0-15	0	0	0	0	Hyposulfidic sand	Hypersulfidic soil (sand)	Medium
LFb04-C.2	b	15-35	0	0	1	1	Hyposulfidic sand		
LFb04-C.3	b	35-50	1	1	1	3	Hypersulfidic sand		
LFc04-C.1	c	0-15	0	1	1	2	Hypersulfidic sand	Hypersulfidic subaqueous soil	Medium
LFc04-C.2	c	15-40	1	1	1	3	Hypersulfidic sand	(sand)	
LFc04-C.3	c	40-70	1	1	1	3	Hypersulfidic sand		
LFd04-C.1	d	0-23	0	1	1	2	Hypersulfidic sand	Hypersulfidic subaqueous soil	Medium
LFd04-C.2	d	23-47	1	1	1	3	Hypersulfidic sand	(sand)	
LFd04-C.3	d	47-70	1	1	1	3	Hypersulfidic clayey sand		
LFe04-C.1	e	0-15	0	0	0	0	Hyposulfidic sand	Hypersulfidic subaqueous soil	Medium
LFe04-C.2	e	15-51	0	1	1	2	Hypersufilidic sand	(sand)	
LFe04-C.3	e	51-62	0	0	0	0	Hyposulfidic sand		
LFf04-C.1	f	0-23	0	1	1	2	Hypersufilidic sand	Hypersulfidic subaqueous soil	Medium
LFf04-C.2	f	23-47	1	1	1	3	Hypersufilidic sand	(sand)	
LFf04-C.3	f	47-78	1	0	1	2	Hyposulfidic sand		

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Table 7-2 Summary of temporal and spatial variations and changes in ASS subtypes at each site (**A and C**). Note: (i) Cells shaded orange summarise data presented within this report, (ii) all other cells are based on/extrapolated from data presented in Fitzpatrick *et al.* (2008a; 2008b; 2009b; 2008c) and (iii) cells bordered in blue indicate subaqueous

Tolderol Sites		Pre-drought Winter 2007 (h₁)	Drought Winter 2009 (h₂)	Drought End winter 2009 (a)	Drought End summer 2010 (b)	Post-drought Summer 2011 (c)	Post-drought Winter 2011 (d)	Post-drought start summer 2011/12 (e)	Post-drought start winter 2011/12 (f)	Summary
LF04-A	¹Classification & ²Acid hazard	Hypersulfidic subaqueous clay (H)	Sulfuric (H)	Sulfuric (H)	Sulfuric (H)	Sulfuric subaqueous (H)	Hypersulfidic subaqueous (H)	Hypersulfidic subaqueous (H)	Hypersulfidic subaqueous (H)	During the extreme drought period (2007 to 2009) the partial drying of the lake caused Hypersulfidic subaqueous clay soil to transform to Sulfuric soil. Inundation, following winter 2010, caused the formation of Sulfuric subaqueous soil. Prolonged inundation encouraged sulfate reduction and caused the formation of Hypersulfidic subaqueous clays.
	Dominant water and ASS process	UW & Sulfide	LW & Sulfuric	LW & Sulfuric	LW & Sulfuric	RW & Sulfuric	UW & Sulfide	UW & Sulfide	UW & Sulfide	
LF04-C	¹Classification & ²Acid hazard	Hypersulfidic subaqueous (M)	Hypersulfidic subaqueous (M)	Hyposulfidic (L)	Hypersulfidic (M)	Hypersulfidic subaqueous (M)	Hypersulfidic subaqueous (M)	Hypersulfidic subaqueous (M)	Hypersulfidic subaqueous (M)	During the extreme drought period (2007 to 2009) the partial drying of the lake caused Hypersulfidic subaqueous soil to transform to Hypersulfidic soil. Inundation, following winter 2010, caused the formation of Hypersulfidic subaqueous soil
	Dominant water and ASS process	UW & Sulfide	UW & Sulfide	LW & Sulfide	LW & Sulfide	RW & Sulfide	UW & Sulfide	UW & Sulfide	UW & Sulfide	

¹ **Classification – Acid Sulfate Soil subtype classification**
² **Acid hazard – Acidification hazard: H = High; M = medium; L = Low; VL = Very Low**
Dominant Water process
LW – Lowering water level regime to expose soil to air due to drought conditions and water evaporation
UW – Unchanged water regime, which had not yet evaporated to expose soil to air
RW – Rising water level regime to inundate and saturate soils by reflooding (e.g. due to pumping, regulator installation, river flow and groundwater)
RF – Rain fall rewetting and natural reflooding to inundate and saturate soils

Dominant ASS – process
Sulfuric – Sulfuricization - oxidation of pyrite in hypersulfidic material due to onset of aerobic conditions to form sulfuric material
Sulfuric* – As above with acidic minerals and/or salt efflorescences noted (i.e. measurable RA)
Sulfide – Sulfidization due to sulfide accumulation to form hypersulfidic material
Monosulfide – Monosulfidization due to monosulfide accumulation to form monosulfidic material
Leach – Leaching of acid from soil by winter rain fall
Sulfuric **subaqueous** with **overlying circa neutral water** pH >4: = font coloured blue or default
Sulfuric **subaqueous** soil with **overlying acid water** pH <4: = font coloured red
Where h₁ to h₃ = historical sampling; (a) – (b) sampling conducted in this project

8.   LF06 – POLTALLOCH

Summary

Overall, soil at Poltalloch was considered to pose a low acidification hazard.

Profiles collected at Poltalloch were classified as hyposulfidic and hypersulfidic soil with very low and low acidification hazard ratings. They generally had low or negative net acidity, moderate levels of ANC, low acidity and very low and low acidification potential. Reflooding, in September 2010, had no discernible impact upon this soil material, which remained hypersulfidic and hyposulfidic with negative net acidity near the surface and positive net acidity at depth (dominated by S_{CR}).

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

8.1 Background

Study area LF06 was located approximately 4 km north east of The Narrows, on the Poltalloch Station (Figure 1-1). As part of this study, sampling was carried out in December 2011 and June 2012 (Samplings-e/f). Previous samplings were undertaken in May and June 2011 (Sampling-d), January and February 2011 (Sampling-c), March 2010 (Sampling-b) and November 2009 (Sampling-a). Additionally, data from historic sampling (Sampling-h_1), carried out in March 2008, were reassessed as part of this study. Sampling site locations are displayed in Figure 8-1.
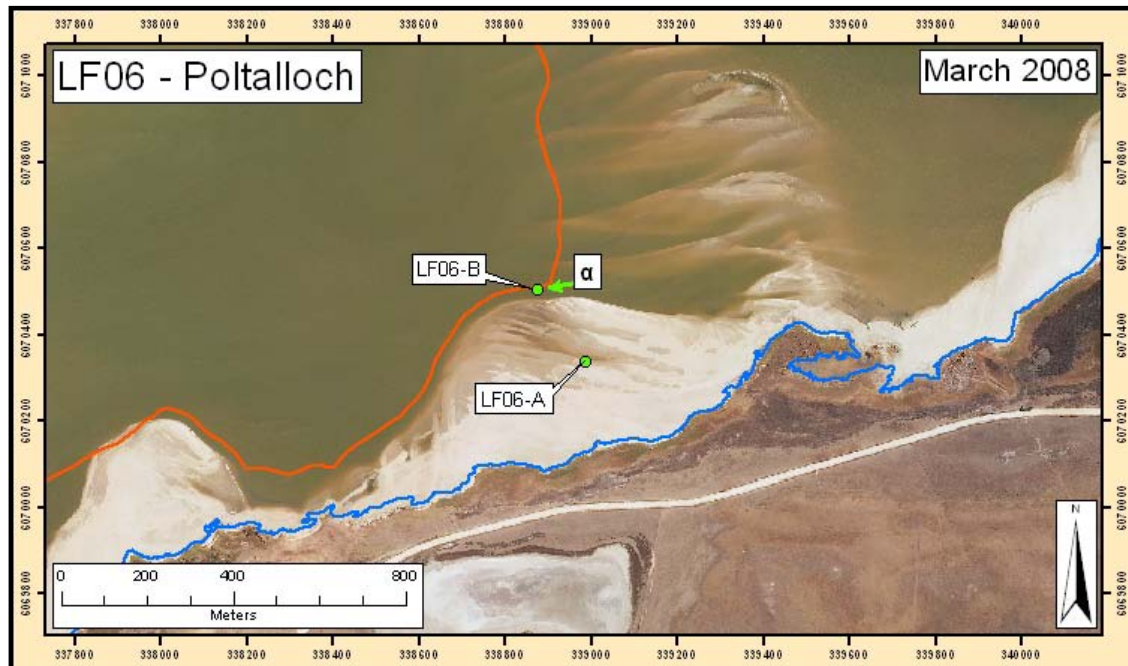
Figure 8-1 Sample location map. Aerial photograph taken in March 2008 (Orange line: sampling-a & b water level, Blue line: sampling-c, d, e & f water level)

At the time of Sampling-c/d/e, the lake level had risen to approximately 0.6 m AHD and the study area had been completely re-flooded (Figure 8-1: Figure 8-2). Prior to this, at the time of all samplings (h_1, a and b), the study area comprised an extensive area of beach, which extended from the pre-drought (pre 2006) shore to the waterline, approximately 400 m north (Figure 8-1). Since March 2008, water level had dropped slightly and a large proportion of the beach had been revegetated with grasses (Figure 8-1: Figure 8-2). Only minor changes were noted in the study area between Sampling-a and Sampling-b. The lake level had dropped from -0.80 m AHD in November 2009 (Sampling-a) to a low of -0.95 m AHD in January 2010. However, by March 2010 (Sampling-b) the lake level had risen back to -0.80 m AHD (MDBA 2011). In March 2010, the vegetation on the beach appeared slightly greener, healthier and more widespread than it had in November 2009.
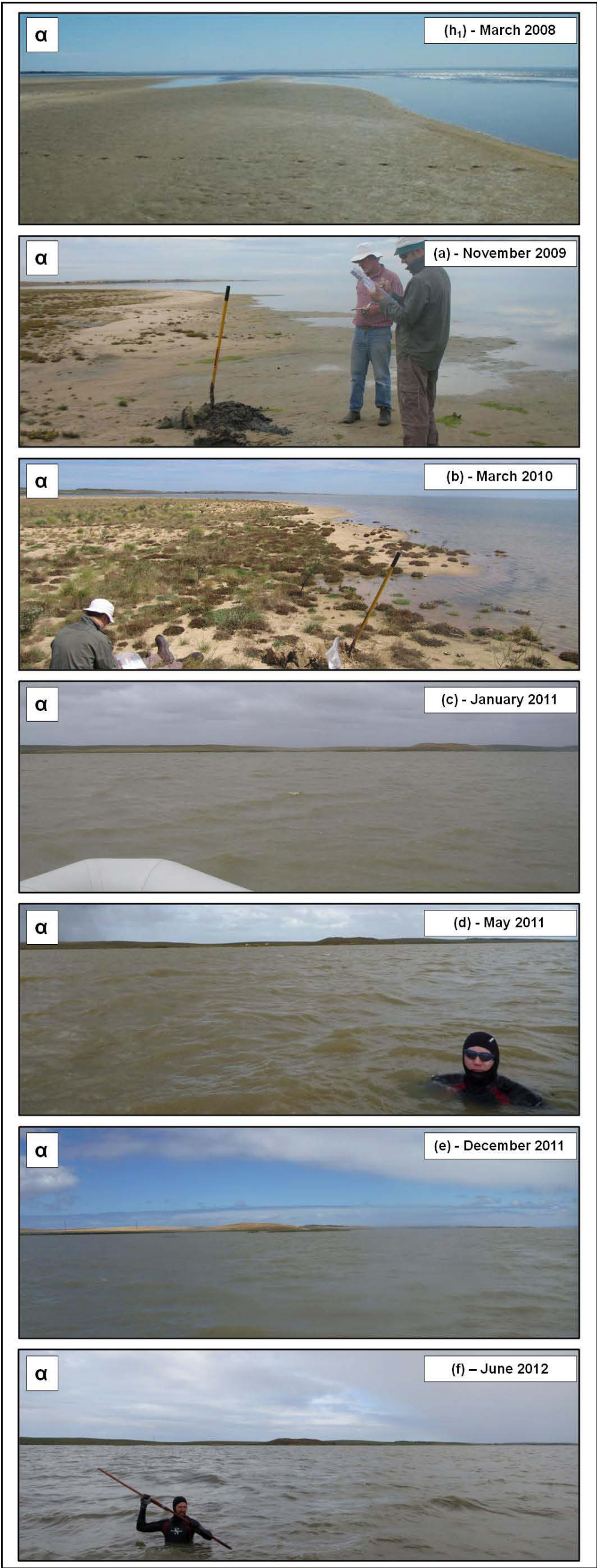
Figure 8-2 Site photographs. Refer to Figure 8-1 for the location and direction that photographs were taken, indicated by α (photographs were selected that best depicted the environmental conditions at the study area during each sampling)

8.2 Soils

Soils at Poltalloch generally comprised hyposulfidic and hypersulfidic sand. A summary of encountered soils is provided below and site locations are presented in Figure 8-1. During earlier inspections of the Poltalloch site, a section (approximately 50 m wide) of beach showed strong surface development of sideronatrite, indicating acid production (Fitzpatrick *et al.* 2008b). No acidic conditions had developed landward of this position. During Samplings-a/b, no sideronatrite was observed, probably having been dissolved by rainfall, so a decision was made to concentrate on monitoring the more representative soils towards Lake Alexandrina. Detailed profile descriptions are presented in Appendix 4 and Appendix 8. Profile photographs are presented in Appendix 5.

LF06-A
During previous studies, when the study area was dry, profiles were collected at this site on three occasions (Samplings-h$_1$/a/b). The historic sampling encountered 8 cm of yellowish brown medium sand covered by a thin greenish algal crust. This was underlain, to a depth of 15 cm, by dark grey sand with few orange root channels. Between 15 and 20 cm was grey sand with diffuse black mottles and shell fragments near base. This was underlain, to the maximum extent of investigation (32 cm) by grey sand with diffuse black mottles and shell fragments. Sampling-a encountered 20 cm of loose pale brown sand with few orange mottles associated with plant roots. Underlying this, to a depth of 45 cm, was pale yellow grey sand with brown mottles associated with root channels and few small shell fragments. This was underlain, to the maximum extent of investigation (80 cm) by grey sand with diffuse black mottles in upper 10 cm and few shell fragments throughout. Sampling-b encountered 28 cm of pale brown sand with diffuse pale reddish brown mottles associated with roots. Whole shells were noted on the surface and shell fragments were present throughout the layer. Between 28 and 55 cm was pale brownish grey sand with diffuse brown mottles and whole shells and shell fragments. This was underlain, to the maximum extent of investigation (80 cm), by olive grey medium to coarse sand with light grey and brown mottles. Many shell fragments and whole shells were present in the upper half of the layer.

When water levels rose and the study area became inundated (Samplings-c/d), a UWS was used to collect subaqueous soil profiles on two occasions. The investigations encountered 18 cm of dark grey sand with 20 to 30 % black mottles associated with roots and few shell fragments. Underlying this, to a depth of 35 cm, light olive brown sand some shell fragments throughout. This was underlain, to depths of 49 and 48 cm, by greyish brown sand with 5 % diffuse black mottles and common shell fragments. Underlying this, to the maximum extent of investigation (61 and 83 cm), was grey sand becoming dark grey loamy sand with depth. No shells were noted in these layers.

As part of this study, a push tube and UWS were used to collect subaqueous soil profiles (Samplings-e/f). Sampling-e encountered 9 cm of dark greyish brown sand with diffuse black mottles and a few bivalve shells. This was underlain, to a depth of 22 cm, by greyish brown sand with a few shell fragments. Underlying this, to a depth of 35 cm, was dark grey sand with diffuse black mottles and some bivalves. This was underlain, to a depth of 55 cm, by grey sand with darker banding. Underlying this, to the maximum extent of investigation (66 cm) was dark grey loamy sand. Sampling-f encountered 29 cm of dark grey loamy sand with few fine shell fragments. This was underlain, to a depth of 45 cm, by greyish brown sand with a few shell fragments. Underlying this, to a depth of 65 cm, was dark grey sand with whole bivalves. Underlying this, to the maximum extent of investigation (83 cm) was dark grey loamy sand with bivalves and shell fragments.

LF06-B
During previous studies, profiles were collected at this site on two separate sampling occasions (Samplings-a/b). Sampling-a encountered 5 cm of black to grey layered sand, which was underlain, to a depth of 25 cm, by brownish grey medium to coarse sand. From 25 to 45 cm was black clayey sand with grey sandy mottles. Underlying this, to the maximum extent of investigation (60 cm) was grey sand with few diffuse dark grey mottles and many small bivalves. Sampling-b encountered 10 cm of pale brown

sand with some reddish brown layering. Between 10 and 35 cm was pale greyish brown sand with distinct reddish brown mottles. This was underlain, to the maximum extent of investigation (50 cm), by black sand with few small bivalves.

When water levels rose and the study area became inundated (Samplings-c/d), a UWS was used to collect subaqueous soil profiles on two occasions. The investigations encountered 14 and 12 cm of grey brown sand with no shells. This was underlain, to depths of 25 and 19 cm, by black clayey sand with rare whole shells. Underlying this, to depths of 60 and 47 cm, was grey loamy sand with common shell fragments and whole bivalves. This was underlain, to the maximum extent of investigation (75 and 70 cm), by dark grey heavy clay. A few shells were noted during Sampling-c but none were noted during Sampling-d.

As part of this study, a push tube and UWS were used to collect subaqueous soil profiles (Samplings-e/f). The investigation encountered 9 to 10 cm of dark grey sand with a few shell fragments. This was underlain, to depths of 35 to 37 cm, by dark grey to olive grey sandy loam with common shell fragments. Underlying this, to the maximum extent of investigation (41 and 47 cm) was dark greenish grey heavy clay.

8.3 Soil acidity and acid-base accounting

Acid-base accounting was carried out according to the methods described in Section 2.3. Acid-base accounting and pH data (pH_{OX}, pH_{INC} & pH_W), for each soil layer, are presented in Figure 8-3. These data were used to inform the acidification hazard assessment that is presented in Table 8-1.
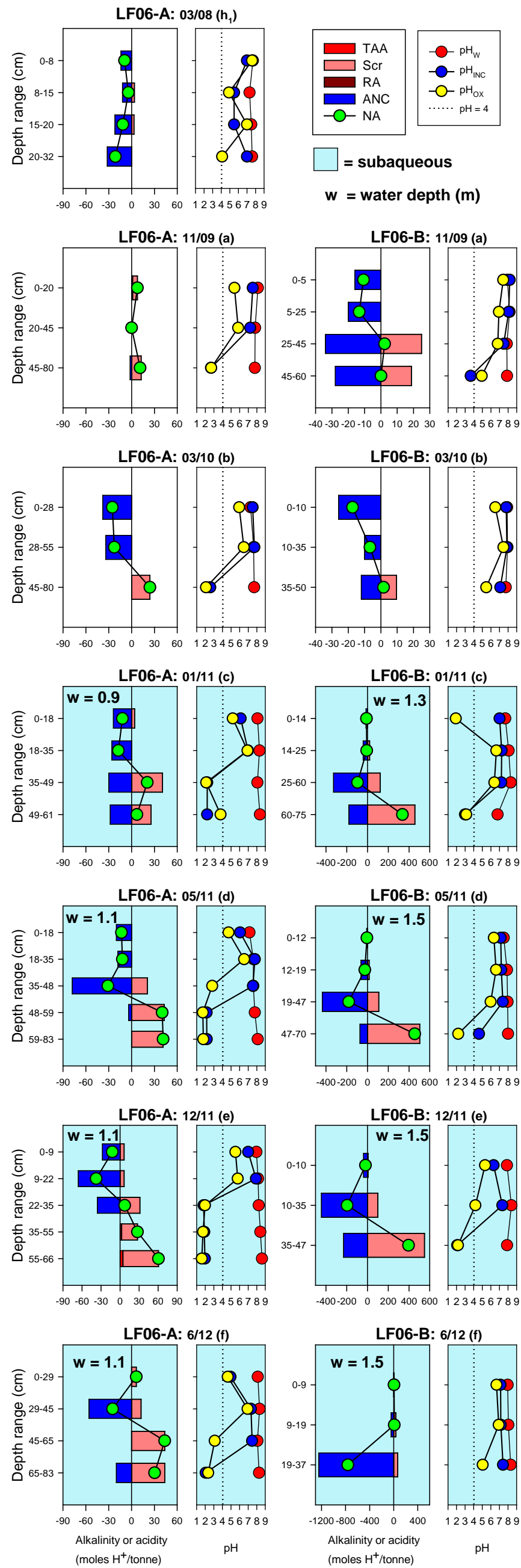
Figure 8-3 pH and acid-base accounting data plotted against depth for each profile collected

8.4 Summary and discussion

Acidification potential assessment and ASS material classification were carried out for each soil sample collected, according to the definitions and methods presented in Section 1.3 and Section 2.4 respectively. A summary of acidification potential and ASS material classification is presented in Table 8-1.

Acidification hazard assessment and ASS subtype classification were carried out for each soil profile collected. ASS subtype classification was achieved using the methods described in Appendix 2. Acidification hazard assessment was based on: (i) landscape position (Figure 8-1), (ii) soil morphology (Section 8.2), (iii) acid-base accounting (Figure 8-3), (iv) pH data (Figure 8-3), (v) acidification potential (Table 8-1) and (vi) ASS material and subtype classification (Table 8-1). Acidification hazard categories were: (i) very low, (ii) low, (iii) medium and (iv) high. A summary of ASS subtype classification and acidification hazard for each profile collected between March 2008 and June 2012 is presented in Table 8-1.

Soil profiles at Poltalloch comprised hyposulfidic and hypersulfidic soil with low and very low acidification hazard ratings (Table 8-1). Profiles collected nearest the shoreline (LF06-A; Figure 8-1) were classified as hypersulfidic soil with very low and low acidification hazard ratings (Table 8-1). They generally had low or negative net acidity and low to moderate levels of ANC. Above 45 cm, they had very low and low acidification potential. Below 45 cm, they had medium to high acidification potential (Figure 8-3; Table 8-1). ANC varied between samplings at site LF06-A because of the spatial variability of shells and shell grit in the soil (Figure 8-3; Section 8.2). Reflooding, in September 2010, had no discernible impact upon this soil material, which remained hypersulfidic with negative net acidity near the surface and positive net acidity at depth (dominated by S_{CR}) (Table 8-2).

Profiles collected further into the lake (LF06-B; Figure 8-1) were classified as hyposulfidic and hypersulfidic soil with low acidification hazard ratings (Table 8-1). They generally had low or negative net acidity, moderate levels of ANC, low acidity and very low and low acidification potential (Figure 8-3; Table 8-1). Once again, reflooding had no discernible impact upon this soil material, which remained hypersulfidic and hyposulfidic with negative net acidity near the surface and positive net acidity at depth (dominated by S_{CR}) (Table 8-2).

It should be noted that earlier inspections of the soil at Poltalloch found a section (approximately 50 m wide) of beach with strong surface development of sideronatrite, indicating acid production (Fitzpatrick *et al.* 2008b). This was not present during Samplings-a/b, probably having been dissolved by rainfall. Hence, a decision was made to concentrate on monitoring the more representative soils towards Lake Alexandrina. It was believed that the profiles sampled and the acidification hazard assessment carried out were generally representative of the majority of the study area.

Overall, soil at Poltalloch was considered to pose a low acidification hazard.

Table 8-1 Summary of acidification potential, ASS material classification, ASS subtype classification and acidification hazard (* indicates sulfuric soil material). The soil texture in brackets following the ASS subtype classification indicates the dominant texture of the profile

Sample	Sampling	Depth (cm)	pH$_{OX}$ < 2.5	pH$_{INC}$ < 4.0	NA > 0	Acidification potential	ASS material classification	ASS subtype classification	Acidification hazard
LF06-A									
PO 4.1	h$_1$	0-8	0	0	0	0	Sand		
PO 4.2	h$_1$	8-15	0	0	0	0	Sand		
PO 4.3	h$_1$	15-20	0	0	0	0	Sand	Soil (sand)	**Very Low**
PO 4.4	h$_1$	20-32	0	0	0	0	Sand		
LFa06-A.1	a	0-20	0	0	1	1	Hyposulfidic sand		
LFa06-A.2	a	20-45	0	0	0	0	Hyposulfidic sand	Hypersulfidic soil (sand)	Low
LFa06-A.3	a	45-80	0	1	1	2	Hypersulfidic sand		
LFb06-A.1	b	0-28	0	0	0	0	Hyposulfidic sand		
LFb06-A.2	b	28-55	0	0	0	0	Hyposulfidic sand	Hypersulfidic soil (sand)	Low
LFb06-A.3	b	45-80	1	1	1	3	Hypersulfidic sand		
LFc06-A.1	c	0-18	0	0	0	0	sand		
LFc06-A.2	c	18-35	0	0	0	0	sand	Hypersulfidic subaqueous soil (sand)	Low
LFc06-A.3	c	35-49	1	1	1	3	Hypersulfidic sand		
LFc06-A.4	c	49-61	0	1	1	2	Hypersulfidic sand		
LFd06-A.1	d	0-18	0	0	0	0	Sand		
LFd06-A.2	d	18-35	0	0	0	0	Sand		
LFd06-A.3	d	35-48	0	0	0	0	Hyposulfidic sand	Hypersulfidic subaqueous soil (sand)	Low
LFd06-A.4	d	48-59	1	1	1	3	Hypersulfidic sand		
LFd06-A.5	d	59-83	1	1	1	3	Hypersulfidic loamy sand		
LFe06-A.1	e	0-9	0	0	0	0	Hyposulfidic sand		
LFe06-A.2	e	9-22	0	0	0	0	Hyposulfidic sand		
LFe06-A.3	e	22-35	1	1	1	3	Hypersufilidic sand	Hypersulfidic subaqueous soil (sand)	**Medium**
LFe06-A.4	e	35-55	1	1	1	3	Hypersufidic sand		
LFe06-A.5	e	55-66	1	1	1	3	Hypersufilidic loamy sand		
LFf06-A.1	f	0-29	0	0	1	1	Hyposulfidic loamy sand		
LFf06-A.2	f	29-45	0	0	0	0	Hyposulfidic sand	Hypersulfidic subaqueous soil (sand)	Low
LFf06-A.3	f	45-65	0	0	1	1	Hyposulfidic sand		
LFf06-A.4	f	65-83	1	1	1	3	Hypersufilidic loamy sand		
LF06-B									
LFa06-B.1	a	0-5	0	0	0	0	Hyposulfidic sand		
LFa06-B.2	a	5-25	0	0	0	0	Hyposulfidic sand	Hypersulfidic soil (sand)	Low
LFa06-B.3	a	25-45	0	0	1	1	Hyposulfidic sand		
LFa06-B.4	a	45-60	0	1	0	1	Hypersulfidic sand		
LFb06-B.1	b	0-10	0	0	0	0	Hyposulfidic sand		
LFb06-B.2	b	10-35	0	0	0	0	Hyposulfidic sand	Hyposulfidic soil (sand)	Low
LFb06-B.3	b	35-50	0	0	1	1	Hyposulfidic sand		
LFc06-B.1	c	0-14	1	0	0	1	sand		
LFc06-B.2	c	14-25	0	0	0	0	Hyposulfidic clayey sand	Hyposulfidic subaqueous soil (sand)	Low
LFc06-B.3	c	25-60	0	0	0	0	Hyposulfidic loamy sand		
LFc06-B.4	c	60-75	0	1	1	2	Hypersulfidic clay		
LFd06-B.1	d	0-12	0	0	0	0	Sand		
LFd06-B.2	d	12-19	0	0	0	0	Hyposulfidic loamy sand	Hyposulfidic subaqueous soil (sand)	Low
LFd06-B.3	d	19-47	0	0	0	0	Hyposulfidic sandy loam		
LFd06-B.4	d	47-70	1	0	1	2	Hyposulfidic clay		
LFe06-B.1	e	0-10	0	0	0	0	Hyposulfidic sand		
LFe06-B.2	e	10-35	0	0	0	0	Hyposulfidic sandy loam	Hypersulfidic subaqueous soil (sand)	Low
LFe06-B.3	e	35-47	1	1	1	3	Hypersufilidic heavy clay		
LFf06-B.1	f	0-9	0	0	1	1	Hyposulfidic sand		
LFf06-B.2	f	9-19	0	0	1	1	Hyposulfidic loamy sand	Hyposulfidic subaqueous soil (sand)	Low
LFf06-B.3	f	19-37	0	0	0	0	Hyposulfidic sandy loam		

Table 8-2 Summary of temporal and spatial variations and changes in ASS subtypes at each site (**A and B**). Note: (i) Cells shaded orange summarise data presented within this report, (ii) all other cells are based on/extrapolated from data presented in Fitzpatrick *et al.* (2008a; 2008b; 2009b; 2008c) and (iii) cells bordered in blue indicate subaqueous

Poltalloch Sites		Drought End summer 2008 (h₁)	Drought End winter 2009 (a)	Drought End summer 2010 (b)	Post-drought Summer 2011 (c)	Post-drought Winter 2011 (d)	Post-drought start summer 2011/12 (e)	Post-drought start winter 2011/12 (f)	Summary
LF06-A	[1]Classification & [2]Acid hazard	**Soil (VL)**	**Hypersulfidic (L)**	**Hypersulfidic (L)**	**Hypersulfidic subaqueous (L)**	**Hypersulfidic subaqueous (L)**	**Hypersulfidic subaqueous (M)**	**Hypersulfidic subaqueous (M)**	During the extreme drought period (2007 to 2009) and partial drying of the lake soil material generally remained Hypersulfidic. Inundation, following winter 2010, caused the formation of Hypersulfidic subaqueous soil
	Dominant water and ASS process	**LW**	**LW & Sulfide**	**LW & Sulfide**	**RW & Sulfide**	**UW & Sulfide**	**UW & Sulfide**	**UW & Sulfide**	
LF06-B	[1]Classification & [2]Acid hazard	**Hyposulfidic subaqueous (L)**	**Hypersulfidic (L)**	**Hyposulfidic (L)**	**Hyposulfidic subaqueous (L)**	**Hyposulfidic subaqueous (L)**	**Hypersulfidic subaqueous (L)**	**Hypersulfidic subaqueous (L)**	During the extreme drought period (2007 to 2009) the partial drying of the lake caused Hyposulfidic subaqueous soil to transform to Hyposulfidic / Hypersulfidic soil. Inundation, following winter 2010, caused the formation of Hyposulfidic and Hypersulfidic subaqueous soil
	Dominant water and ASS process	**UW & Sulfide**	**LW & Sulfide**	**LW & Sulfide**	**RW & Sulfide**	**UW & Sulfide**	**UW & Sulfide**	**UW & Sulfide**	

[1]**Classification** – Acid Sulfate Soil subtype classification
[2]**Acid hazard – Acidification hazard: H = High; M = medium; L = Low; VL = Very Low**
Dominant Water process
LW – Lowering water level regime to expose soil to air due to drought conditions and water evaporation
UW – Unchanged water regime, which had not yet evaporated to expose soil to air
RW – Rising water level regime to inundate and saturate soils by reflooding (e.g. due to pumping, regulator installation, river flow and groundwater)
RF – Rain fall rewetting and natural reflooding to inundate and saturate soils

Dominant ASS – process
Sulfuric – Sulfuricization - oxidation of pyrite in hypersulfidic material due to onset of aerobic conditions to form sulfuric material
Sulfuric* – As above with acidic minerals and/or salt efflorescences noted (i.e. measurable RA)
Sulfide – Sulfidization due to sulfide accumulation to form hypersulfidic material
Monosulfide – Monosulfidization due to monosulfide accumulation to form monosulfidic material
Leach – Leaching of acid from soil by winter rain fall
Sulfuric **subaqueous** soil with **overlying circa neutral water** pH >4: = font coloured blue or default
Sulfuric **subaqueous** soil with **overlying acid water** pH <4: = font coloured red
Where h₁ to h₃ = historical sampling; (a) – (b) sampling conducted in this project

9.   LF07 – WALTOWA

Summary

Overall, soil at Waltowa was considered to pose a medium acidification hazard.

During drought conditions, profiles collected closest to the shoreline were classified as sulfuric soil with high acidification hazard ratings. Following reflooding, in October 2010, These profiles transformed from sulfuric to hypersulfidic subaqueous soils. Although acidity was low in surface sands, they still posed a medium to high acidification hazard because of very limited buffering capacity. The change in soil chemistry was restricted to the top 20 cm of overlying sand, where inundation had promoted reducing conditions and bacterial reduction of sulfate. Relatively low levels of acidity in the upper 20 cm had transformed from TAA to S_{CR}. The underlying soil material remained relatively unchanged with high levels of S_{CR} dominating the profile.

Profiles collected further into the lake were generally classified as hyposulfidic soil with very low acidification hazard ratings. Reflooding had no discernible impact upon this site, with soil material remaining predominantly hyposulfidic and acidity being dominated by S_{CR} .

9.1 Background

Study area LF07 was located at the north eastern extent of Lake Albert, on Waltowa Beach (Figure 1-1). As part of this study, sampling was carried out in December 2011 and June 2012 (Samplings-e/f). Previous samplings were undertaken in May and June 2011 (Sampling-d), January and February 2011 (Sampling-c), March 2010 (Sampling-b) and November 2009 (Sampling-a). Additionally, data from historic sampling (Samplings-h_1/h_2), carried out in February and October 2008, were reassessed as part of this study. Sampling site locations are displayed in Figure 9-1.
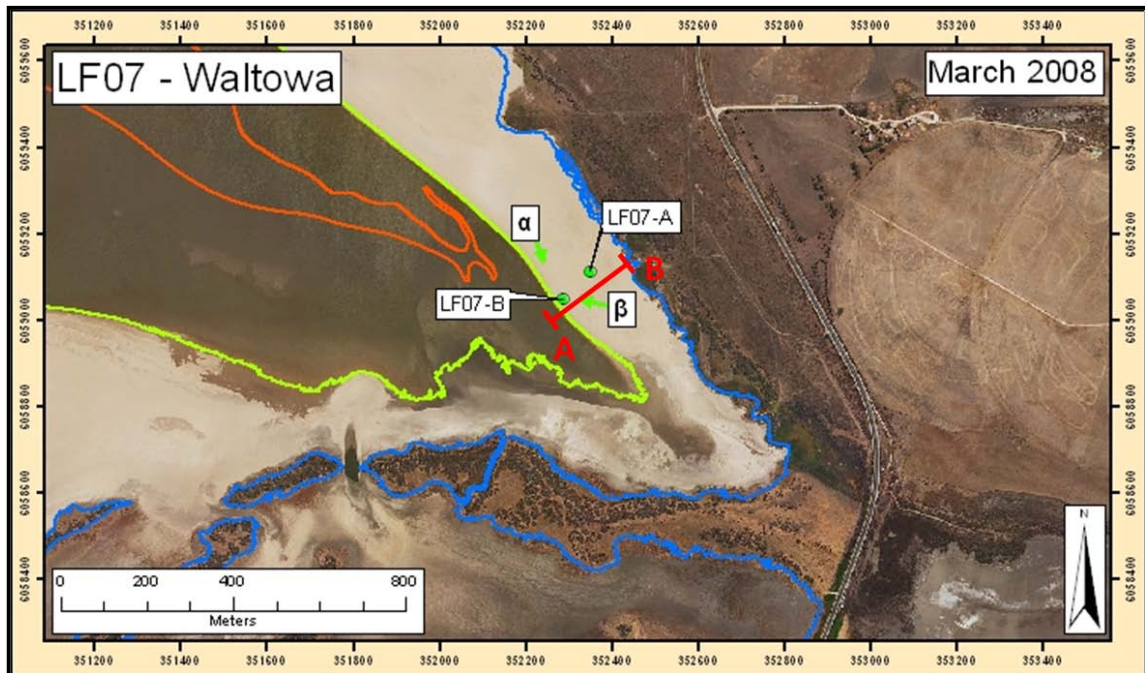
Figure 9-1 Sample location map. Aerial photograph taken in March 2008 (Orange line: sampling-a water level, Yellow line: sampling-b, Blue line: sampling-c, d, e & f water level). Red line indicates cross section presented in Section 22.6

At the time of Sampling-c/d/e, the lake level had risen to approximately 0.6 m AHD and the study area had been completely re-flooded (Figure 9-1: Figure 9-2). In March and October 2008, the study area comprised an extensive area of unvegetated beach, which extended from the pre-drought (pre 2006) shore to the waterline, approximately 200 m south west (Figure 9-1) (Figure 9-2). Since October 2008, a large proportion of the beach had been revegetated with grasses (Figure 9-1: Figure 9-2). The lake level had dropped from -0.45 m AHD in November 2009 (Sampling-a) to a low of -0.78 m AHD in March 2010 (Sampling-b) (MDBA 2011), which exposed a large area of soft, muddy lake bed (Figure 9-2). Vegetation on the beach appeared stressed, presumably due to heat and a lack of water.
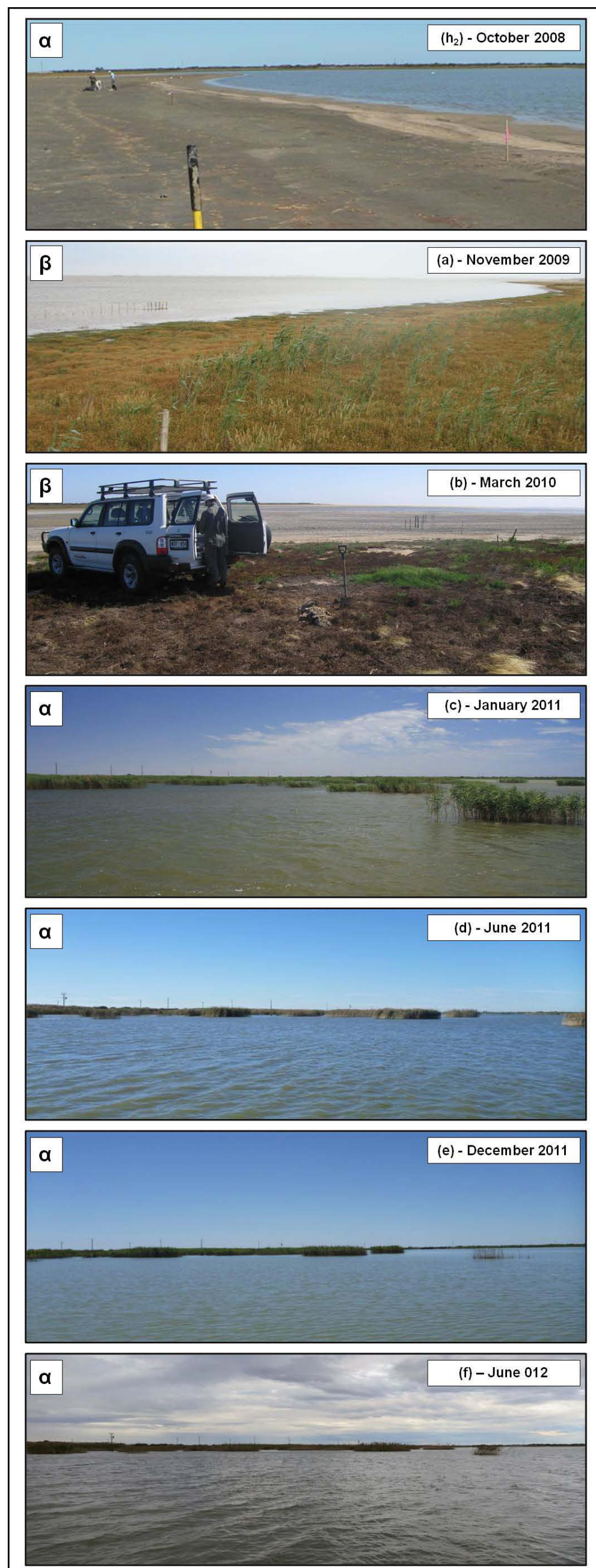
Figure 9-2 Site photographs. Refer to Figure 9-1 for the location and direction that photographs were taken, indicated by α or β (photographs were selected that best depicted the environmental conditions at the study area during each sampling)

9.2 Soils

Soils at Waltowa generally comprised sulfuric and hypersulfidic sands and clays at site LF07-A and hypersulfidic and hyposulfidic sand and clay at site LF07-B. A summary of encountered soils is provided below and site locations are presented in Figure 9-1. Detailed profile descriptions are presented in Appendix 4 and Appendix 8. Profile photographs are presented in Appendix 5.

LF07-A
During previous studies, when the study area was dry, profiles were collected at this site on three occasions (Samplings-h_1/a/b). The historic sampling encountered 5 cm of yellowish brown loose sand, which overlay pale grey sand that was present to a depth of 25 cm. From 25 to 40 cm was grey loamy sand. Samplings-a/b both encountered 2 cm of brown medium clay, which overlay pale grey sand with few orange mottles that was present to a depth of 35 cm. This was underlain, to a depth of 50 cm, by dark grey fine sandy clay loam with light brown mottles around roots. Between 50 and 70 cm was dark grey light medium clay with sapric bands and few fine shells. This was underlain, to the maximum extent of investigation (80 cm), by olive grey light medium clay.

When water levels rose and the study area became inundated (Samplings-c/d), a UWS was used to collect subaqueous soil profiles on two occasions. The investigations encountered 3 and 5 cm of black fibric sand, that was underlain, to depths of 25 and 18 cm, by grey banded sand and sandy loam. This was underlain, to depths of 40 and 50 cm, by grey sandy clay with lenses of black fibric material and few shells. Underlying this, to depths of 55 and 69 cm, was greenish grey loamy clay. Sampling-c encountered dark grey clay with lenses of sand to a depth of 70 cm. Sampling-d encountered greenish grey heavy clay with common fine calcareous nodules to a depth of 76 cm.

As part of this study, a push tube and UWS were used to collect subaqueous soil profiles (Samplings-e/f). The investigation encountered 8 to 12 cm of organic clay overlying loamy fine sand. This was underlain, to depths of 18 and 22 cm, by grey loamy fine sand with black mottles and fine roots. Underlying this, to depths of 38 and 48 cm, was very dark grey fine loamy sand to sandy clay. This was underlain, to depths of 62 to 66 cm, by dark grey to olive grey heavy clay. Underlying this, to the maximum extent of investigation (68 to 84 cm), was dark greenish grey heavy clay with carbonate mottles.

LF07-B
During previous studies, when the study area was dry, profiles were collected at this site on three occasions (Samplings-h_2/a/b). The historic sampling encountered 3 cm of yellowish sand with orange and black mottles, which overlay light grey sandy clay with few black mottles that was present to a depth of 40 cm. This was underlain, to the maximum extent of investigation (50 cm), by very dark grey sandy clay. Samplings-a/b both encountered 1 cm of brown medium clay, which overlay yellowish grey to grey sand with orange brown mottles that was present to a depth of 35 cm. This was underlain, to a depth of 45 cm, by grey to dark grey sand with few brown mottles associated with root channels. This was underlain, to the maximum extent of investigation (60 cm), by saturated dark grey to bluish grey sapric sandy clay.

When water levels rose and the study area became inundated (Samplings-c/d), a UWS was used to collect subaqueous soil profiles on two occasions. The investigations encountered 3 and 10 cm of black fibric sand, that was underlain, to a depth of 30 cm, by grey to olive grey banded sand and sandy loam. Underlying this, to a depth of 40 cm, Sampling-c encountered very dark bluish grey clayey sand. This was underlain, to the maximum extent of investigation (57 cm), by dark greenish grey clay with sandy grey lenses. Sampling-d encountered dark grey light clay between 37 and 53 cm. This was underlain, to a depth of 62 cm, by greenish grey heavy clay. This was underlain, to the maximum extent of investigation (70 cm), by greenish grey heavy clay with common calcareous grit.

As part of this study, a push tube and UWS were used to collect subaqueous soil profiles (Samplings-e/f). The investigations encountered 32 to 36 cm of oxidised sand (1 cm) over black and greyish brown sand with root channels. This was underlain, to depths of 50 to 59 cm, by dark grey medium to heavy clay

with organic material near base. Underlying this, to the maximum extent of investigation (61 to 76 cm), was grey heavy clay and carbonate gravel in Sampling-f.

9.3 Soil acidity and acid-base accounting

Acid-base accounting was carried out according to the methods described in Section 2.3. Acid-base accounting and pH data (pH_{OX}, pH_{INC} & pH_W), for each soil layer, are presented in Figure 9-3. These data were used to inform the acidification hazard assessment that is presented in Table 9-1.
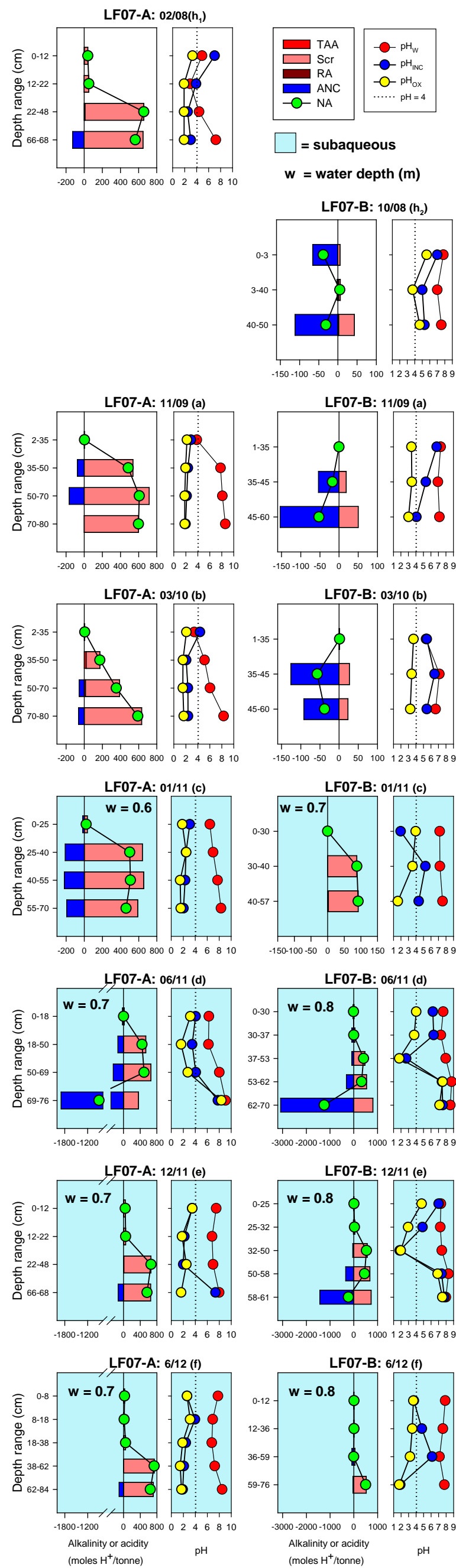
Figure 9-3 pH and acid-base accounting data plotted against depth for each profile collected

9.4 Summary and discussion

Acidification potential assessment and ASS material classification were carried out for each soil sample collected, according to the definitions and methods presented in Section 1.3 and Section 2.4 respectively. A summary of acidification potential and ASS material classification is presented in Table 9-1.

Acidification hazard assessment and ASS subtype classification were carried out for each soil profile collected. ASS subtype classification was achieved using the methods described in Appendix 2. Acidification hazard assessment was based on: (i) landscape position (Figure 9-1), (ii) soil morphology (Section 9.2), (iii) acid-base accounting (Figure 9-3), (iv) pH data (Figure 9-3), (v) acidification potential (Table 9-1) and (vi) ASS material and subtype classification (Table 9-1). Acidification hazard categories were: (i) very low, (ii) low, (iii) medium and (iv) high. A summary of ASS subtype classification and acidification hazard for each profile collected between February 2008 and June 2012 is presented in Table 9-1.

Soil profiles at Waltowa comprised sulfuric, hypersulfidic and hyposulfidic soil with very low to high acidification hazard ratings (Table 9-1). During drought conditions, profiles collected closest to the shoreline (LF07-A; Figure 9-1) were classified as sulfuric soil with high acidification hazard ratings (Table 9-1). Following reflooding, in October 2010, these profiles transformed from sulfuric to hypersulfidic subaqueous soils (Table 9-2). Although acidity was low in surface sands, they still posed a medium to high acidification hazard because of very limited buffering capacity. The change in soil chemistry was restricted to the top 20 cm of overlying sand, where inundation had promoted reducing conditions and bacterial reduction of sulfate. Following reflooding, the relatively low levels of acidity in the upper 20 cm had transformed from TAA to S_{CR} (Figure 9-3). The underlying soil material remained relatively unchanged with high levels of S_{CR} dominating the profile (Figure 9-3).

Profiles collected further into the lake (LF07-B; Figure 9-1) were generally classified as hyposulfidic soil with very low to low acidification hazard ratings (Table 9-1). They generally had negative net acidity, high levels of ANC, low acidity and very low and low acidification potential (Figure 9-3; Table 9-1). During Samplings-d & e, hypersulfidic dark grey clay was encountered between 32 and 53 cm. Additionally, no ANC was encountered within the profile during Sampling-C. These differences relate to the spatial variability of the sediments at this site, as discussed in Section 9.2. With these exceptions, there were no significant temporal variations noted at this site (Table 9-2). Reflooding had no discernible impact upon this site, with soil material remaining predominantly hyposulfidic and acidity being dominated by S_{CR} (Figure 9-3).

Overall, soil at Waltowa was considered to pose a medium acidification hazard.

Table 9-1 Summary of acidification potential, ASS material classification, ASS subtype classification and acidification hazard (* indicates sulfuric soil material). The soil texture in brackets following the ASS subtype classification indicates the dominant texture of the profile

Sample	Sampling	Depth (cm)	pH$_{OX}$ < 2.5	pH$_{INC}$ < 4.0	NA > 0	Acidification potential	ASS material classification	ASS subtype classification	Acidification hazard
LF07-A									
AT 12.1	h$_1$	0-5	0	0	0	0	Sand		
AT 12.2	h$_1$	5-25	1	1	0	2*	Sulfuric sand	Sulfuric soil	
AT 12.3	h$_1$	25-40	1	1	1	3	Hypersulfidic loamy sand	(sand)	High
AT 12.4	h$_1$	40-70	1	1	1	3	Hypersulfidic sand		
LFa07-A.2	a	2-35	1	1	1	3*	Sulfuric sand		
LFa07-A.3	a	35-50	1	1	1	3	Hypersulfidic sandy clay loam	Sulfuric clay	
LFa07-A.4	a	50-70	1	1	1	3	Hypersulfidic medium clay	soil (clay)	High
LFa07-A.5	a	70-80	1	1	1	3	Hypersulfidic medium clay		
LFb07-A.2	b	2-35	1	0	1	2*	Sulfuric sand		
LFb07-A.3	b	35-50	1	1	1	3	Hypersulfidic sandy clay loam	Sulfuric clay	
LFb07-A.4	b	50-70	1	1	1	3	Hypersulfidic medium clay	soil (clay)	High
LFb07-A.5	b	70-80	1	1	1	3	Hypersulfidic medium clay		
LFc07-A.1	c	0-25	1	1	1	3	Hypersulfidic sand		
LFc07-A.2	c	25-40	0	1	1	2	Hypersulfidic sandy clay loam	Hypersulfidic subaqueous	
LFc07-A.3	c	40-55	1	1	1	3	Hypersulfidic silty clay	clay soil (clay)	High
LFc07-A.4	c	55-70	1	1	1	3	Hypersulfidic silty clay		
LFd07-A.1	d	0-18	0	0	1	1	Hyposulfidic sandy loam		
LFd07-A.2	d	18-50	1	1	1	3	Hyposulfidic loamy clay	Hypersulfidic subaqueous	
LFd07-A.3	d	50-69	0	0	1	1	Hyposulfidic loamy clay	clay soil (clay)	Medium
LFd07-A.4	d	69-76	0	0	0	0	Hyposulfidic calcareous clay		
LFe07-A.1	e	0-12	0	1	1	2	Hypersulfilidic organic clay		
LFe07-A.2	e	12-22	1	1	1	3	Hypersulfilidic loamy sand	Hypersulfidic subaqueous	
LFe07-A.3	e	22-48	0	1	1	2	Hypersulfilidic sandy clay	clay soil (clay)	Medium
LFe07-A.5	e	66-68	1	0	1	2	Hyposulfidic heavy clay		
LFf07-A.1	f	0-8	0	1	1	2	Hypersulfilidic loamy sand		
LFf07-A.2	f	8-18	0	1	1	2	Hypersulfilidic loamy sand	Hypersulfidic	
LFf07-A.3	f	18-38	1	1	1	3	Hypersulfilidic loamy sand	subaqueous	
LFf07-A.4	f	38-62	1	1	1	3	Hypersulfilidic heavy clay	clay soil (clay)	Medium
LFf07-A.5	f	62-84	1	1	1	3	Hypersulfilidic heavy clay		
LF07-B									
W1S 1.1	h$_2$	0-3	0	0	0	0	Sand		
W1S 1.2	h$_2$	3-40	0	0	0	0	Sandy clay	Hyposulfidic clay soil (clay)	Very Low
W1S 1.3	h$_2$	40-50	0	0	0	0	Hyposulfidic medium clay		
LFa07-B.2	a	1-35	0	0	0	0	Hyposulfidic sand		
LFa07-B.3	a	35-45	0	0	0	0	Hyposulfidic sand	Hyposulfidic clay soil (sand)	Very Low
LFa07-B.4	a	45-60	0	0	0	0	Hyposulfidic sandy clay		
LFb07-B.2	b	1-35	0	0	1	1	Hyposulfidic sand		
LFb07-B.3	b	35-45	0	0	0	0	Hyposulfidic sand	Hyposulfidic clay soil (sand)	Very Low
LFb07-B.4	b	45-60	0	0	0	0	Hyposulfidic sandy clay		
LFc07-B.1	c	0-30	0	1	0	1	sand		
LFc07-B.2	c	30-40	0	0	1	1	Hyposulfidic clayey sand	Hyposulfidic subaqueous	Very Low
LFc07-B.3	c	40-57	1	0	1	2	Hyposulfidic clay	soil (sand)	
LFd07-B.1	d	0-30	0	0	0	0	Hyposulfidic loamy sand		
LFd07-B.2	d	30-37	0	0	0	0	Hyposulfidic loam	Hypersulfidic	
LFd07-B.3	d	37-53	1	1	1	3	Hypersulfidic clay	subaqueous	Low
LFd07-B.4	d	53-62	0	0	1	1	Hyposulfidic clay	clay soil (clay)	
LFd07-B.5	d	62-70	0	0	0	0	Hyposulfidic clay		
LFe07-B.1	e	0-25	0	0	1	1	Hyposulfidic sand		
LFe07-B.2	e	25-32	0	0	1	1	Hyposulfidic sandy loam	Hypersulfidic	
LFe07-B.3	e	32-50	1	1	1	3	Hypersulfilidic heavy clay	subaqueous	Low
LFe07-B.4	e	50-58	0	0	1	1	Hyposulfidic heavy clay	clay soil (clay)	
LFe07-B.5	e	58-61	0	0	0	0	Hyposulfidic heavy clay		
LFf07-B.1	f	0-12	0	1	1	2	Hypersulfilidic sand		
LFf07-B.2	f	12-36	0	0	1	1	Hyposulfidic loamy sand	Hypersulfidic subaqueous	
LFf07-B.3	f	36-59	0	0	0	0	Hyposulfidic loamy clay	clay soil (clay)	Low
LFf07-B.4	f	59-76	1	1	1	3	Hypersulfilidic heavy clay		

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Table 9-2 Summary of temporal and spatial variations and changes in ASS subtypes at each site (**A and B**). Note: (i) Cells shaded orange summarise data presented within this report, (ii) all other cells are based on/extrapolated from data presented in Fitzpatrick *et al.* (2008a; 2008b; 2009b; 2008c) and (iii) cells bordered in blue indicate subaqueous

Waltowa Sites		Drought Summer 2008 (h₁)	Drought End winter 2008 (h₂)	Drought End winter 2009 (a)	Drought End summer 2010 (b)	Post drought Summer 2011 (c)	Post drought Winter 2011 (d)	Post-drought start summer 2011/12 (e)	Post-drought start winter 2011/12 (f)	Summary
LF07-A	[1]Classification & [2]Acid hazard	Sulfuric (H)	Sulfuric (H)	Sulfuric clay (H)	Sulfuric clay (H)	Hypersulfidic subaqueous clay (H)	Hypersulfidic subaqueous clay (M)	Hypersulfidic subaqueous clay (M)	Hypersulfidic subaqueous clay (M)	During the extreme drought period (2007 to 2009) the partial drying of the lake caused Sulfuric subaqueous soil to transform to Sulfuric (clay) soil. Inundation, following winter 2010, caused the formation of Hypersulfidic subaqueous soil.
	Dominant water and ASS process	UW & Sulfide	LW & Sulfide	LW & Sulfide	LW & Sulfide	RW & Sulfide	UW & Sulfide	UW & Sulfide	UW & Sulfide	
LF07-B	[1]Classification & [2]Acid hazard	Hyposulfidic clay (VL)	Hyposulfidic clay (VL)	Hyposulfidic clay (VL)	Hyposulfidic clay (VL)	Hyposulfidic subaqueous (VL)	Hypersulfidic subaqueous clay (L)	Hypersulfidic subaqueous clay (L)	Hypersulfidic subaqueous clay (L)	During the extreme drought period (2007 to 2009) the partial drying of the lake caused Hyposulfidic subaqueous clay soil to transform to Hyposulfidic clay soil. Inundation, following winter 2010, caused the formation of Hypersulfidic and Hyposulfidic subaqueous soil.
	Dominant water and ASS process	UW & Sulfide	LW & Sulfide	LW & Sulfide	LW & Sulfide	RW & Sulfide	UW & Sulfide	UW & Sulfide	UW & Sulfide	

[1] **Classification** – Acid Sulfate Soil subtype classification
[2] **Acid hazard** – Acidification hazard: **H** = High; **M** = medium; **L** = Low; **VL** = Very Low
Dominant Water process
LW – Lowering water level regime to expose soil to air due to drought conditions and water evaporation
UW – Unchanged water regime, which had not yet evaporated to expose soil to air
RW – Rising water level regime to inundate and saturate soils by reflooding (e.g. due to pumping, regulator installation, river flow and groundwater)
RF – Rain fall rewetting and natural reflooding to inundate and saturate soils

Dominant ASS – process
Sulfuric – Sulfuricization - oxidation of pyrite in hypersulfidic material due to onset of aerobic conditions to form sulfuric material
Sulfuric* – As above with acidic minerals and/or salt efflorescences noted (i.e. measurable RA)
Sulfide – Sulfidization due to sulfide accumulation to form hypersulfidic material
Monosulfide – Monosulfidization due to monosulfide accumulation to form monosulfidic material
Leach – Leaching of acid from soil by winter rain fall
Sulfuric **subaqueous** with **overlying circa neutral water** pH >4: = font coloured blue or default
Sulfuric **subaqueous** soil with **overlying acid water** pH <4: = font coloured red
Where h₁ to h₃ = historical sampling; (a) – (b) sampling conducted in this project

10. LF08 – MENINGIE

Summary

Overall, soil at Meningie was considered to pose a medium acidification hazard.

Soil profiles at Meningie generally comprised hypersulfidic soil with medium acidification hazard ratings. During the extreme drought period (2007 to 2009), partial drying of the lake caused hypersulfidic subaqueous soil to transform to hypersulfidic clay soil. Inundation, following winter 2010, caused the formation of hypersulfidic subaqueous clay soil. Reflooding had no significant impact upon this site, acidity was dominated by S_{CR} and soil material remained hyposulfidic and hypersulfidic with medium acidification hazard ratings.

10.1 Background

Study area LF08 was located west of the Meningie jetty in Lake Albert (Figure 1-1). As part of this study, sampling was carried out in December 2011 and June 2012 (Samplings-e/f). Previous samplings were undertaken in May and June 2011 (Sampling-d), January and February 2011 (Sampling-c), March 2010 (Sampling-b) and November 2009 (Sampling-a). Additionally, data from historic sampling (Samplings-h_1/h_2), carried out in July 2007 and February 2008, were reassessed as part of this study. Sampling site locations are displayed in Figure 10-1.
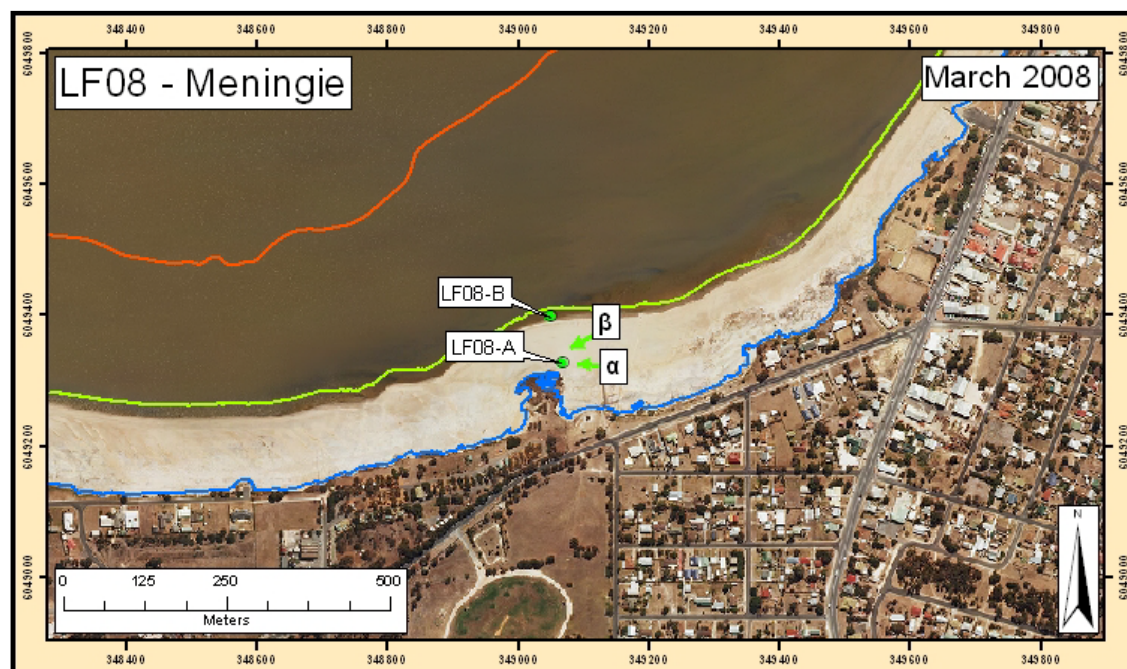
Figure 10-1 Sample location map. Aerial photograph taken in March 2008 (Orange line: sampling-a water level, Yellow line: sampling-b, Blue line: sampling-c, d, e & f water level)

At the time of Sampling-c/d/e, the lake level had risen to approximately 0.6 m AHD and the study area had been completely re-flooded (Figure 10-1: Figure 10-2). Prior to this, at the time of the first historic sampling in January 2007 (Sampling-h_1), the lake level was at pre-drought levels and the study area was subaqueous (Figure 10-2). By the time of the second historic sampling (Sampling-h_2) in February 2008, lake levels had dropped and the study area comprised a beach, which extended from the pre-drought (pre 2006) shore to the waterline, approximately 150 m north (Figure 10-1: Figure 10-2). By November 2009 (Sampling-a), the beach had been partially revegetated (Figure 10-2). Subsequently, the lake level dropped further from -0.45 m AHD in November 2009 (Sampling-a) to a low of -0.78 m AHD in March 2010 (Sampling-b) (MDBA 2011), which exposed a large area of lake bed (Figure 10-2). Vegetation on the beach appeared stressed and in some areas had been buried by windblown sand.

Figure 10-2 Site photographs. Refer to Figure 10-1 for the location and direction that photographs were taken, indicated by α or β (photographs were selected that best depicted the environmental conditions at the study area during each sampling)

10.2 Soils

Soils at Meningie generally comprised a mixture of hyposulfidic and hypersulfidic sands and clay. A summary of encountered soils is provided below and site locations are presented in Figure 10-1. Detailed profile descriptions are presented in Appendix 4 and Appendix 8. Profile photographs are presented in Appendix 5.

LF08-A

During previous studies, when the study area was dry, profiles were collected at this site on three occasions (Samplings-h_1/a/b). The historic sampling was subaqueous and was achieved with a gouge auger. It encountered 5 cm of yellowish grey sand. This was underlain, to a depth of 10 cm, by greyish yellow sand with diffuse orange mottles. Between 10 and 30 cm was pale brownish grey sand. Underlying this, to a depth of 60 cm, was grey clayey sand with common small shells. This was underlain, to the maximum extent of investigation (70 cm), by very dark grey to black heavy clay with few small shells. Sampling-a encountered 8 cm of pale yellow brown sand with grey and orange mottles. Underlying this, to a depth of 18 cm, was grey to pale brownish grey sand with dark grey and orange mottles. Between 18 and 25 cm was grey sand with black mottles and shell fragments. Underlying this, to a depth of 50 cm, was dark grey medium clay with many phragmites roots and small gastropods. This was underlain, to the maximum extent of investigation (60 cm), by greenish grey medium clay with coarse phragmites roots. Sampling-b encountered 18 cm of light brown sand with common brown and red mottles and few diffuse grey mottles. This was underlain, to a depth of 28 cm, by grey sand with few red brown mottles associated with roots. Between 28 and 45 cm was dark olive grey light medium clay with common coarse plant fragments and shell grit below 40 cm. This was underlain, to the maximum extent of investigation (60 cm), by dark green grey heavy clay with few fine relic roots.

When water levels rose and the study area became inundated (Samplings-c/d), a UWS was used to collect subaqueous soil profiles on two occasions. The investigations encountered 12 cm of olive brown to grey brown sand with few diffuse brown mottles. Underlying this, to depths of 28 and 21 cm, was grey loamy sand with darker grey clayey bands and a few shells noted in Sampling-c. This was underlain, to depths of 60 and 33 cm, by very dark grey and olive grey organic clay with common shells and shell fragments and remnant roots. Underlying this, to the maximum extent of investigation (78 and 60 cm), was dark green grey heavy clay.

As part of this study, a UWS and push tube were used to collect subaqueous soil profiles (Samplings-e/f). The investigations encountered 8 cm of black sand to loamy sand, which overlay dark grey sand to loamy sand to depths of 26 and 32 cm. This was underlain, to depths of 43 to 52 cm, by very dark grey heavy clay with common fine shells and decomposing organic matter. Sampling-e encountered dark greenish grey heavy clay a depth of 58 cm. This was underlain, to the maximum extent of investigation (60 cm), by dark grey sand. Sampling-f encountered dark grey heavy clay to the maximum extent of investigation (86 cm).

LF08-B

During previous studies, when the study area was dry, profiles were collected at this site on three occasions (Sampling-h_2/a/b). The historic sampling encountered 1 cm of loose yellow grey sand overlying brownish grey sand to a depth of 10 cm. Between 10 and 20 cm dark grey sandy clay was encountered. This was underlain, to the maximum extent of investigation (30 cm), by blueish grey heavy clay. Sampling-a encountered 10 cm of grey sand with black mottles with a brown algal surface crust (< 5 mm). Underlying this, to a depth of 20 cm, was yellow grey sand with orange mottles. Between 20 and 35 cm were grey and dark grey sand bands. This was underlain, to the maximum extent of investigation (55 cm), by greenish olive grey medium clay with sand filling planar cracks or voids. Sampling-b encountered 25 cm of light brown sand with few small red brown mottles. This was underlain, to a depth of 32 cm, by very dark grey sand with large black mottles. Between 32 and 45 cm was dark grey light sandy clay. This was underlain, to the maximum extent of investigation (55 cm), by greenish olive grey light medium clay.

When water levels rose and the study area became inundated (Samplings-c/d), a UWS was used to collect subaqueous soil profiles on two occasions. The investigations encountered 20 and 16 cm of black to greyish brown sand with few small shells. This was underlain, to depths of 33 and 23 cm, by black sandy clay and loamy sand. This was underlain, to the maximum extent of investigation (65 and 56 cm), by dark greenish grey light medium clay.

As part of this study, a UWS and push tube were used to collect subaqueous soil profiles (Samplings-e/f). The investigations encountered 20 to 23 cm of very dark grey sand to loamy sand. This was underlain, to a depth of 30 cm, by black loamy sand. Underlying this, to depths of 35 to 37 cm, was very dark grey heavy clay. This was underlain, to the maximum extent of investigation (70 to 77 cm), by dark grey heavy clay.

10.3 Soil acidity and acid-base accounting

Acid-base accounting was carried out according to the methods described in Section 2.3. Acid-base accounting and pH data (pH_{OX}, pH_{INC} & pH_W), for each soil layer, are presented in Figure 10-3. These data were used to inform the acidification hazard assessment that is presented in Table 10-1.

Figure 10-3 pH and acid-base accounting data plotted against depth for each profile collected

10.4 Summary and discussion

Acidification potential assessment and ASS material classification were carried out for each soil sample collected, according to the definitions and methods presented in Section 1.3 and Section 2.4 respectively. A summary of acidification potential and ASS material classification is presented in Table 10-1.

Acidification hazard assessment and ASS subtype classification were carried out for each soil profile collected. ASS subtype classification was achieved using the methods described in Appendix 2. Acidification hazard assessment was based on: (i) landscape position (Figure 10-1), (ii) soil morphology (Section 10.2), (iii) acid-base accounting (Figure 10-3), (iv) pH data (Figure 10-3), (v) acidification potential (Table 10-1) and (vi) ASS material and subtype classification (Table 10-1). Acidification hazard categories were: (i) very low, (ii) low, (iii) medium and (iv) high. A summary of ASS subtype classification and acidification hazard for each profile collected between July 2007 and June 2012 is presented in Table 10-1.

Soil profiles at Meningie generally comprised hypersulfidic soil with medium acidification hazard ratings (Table 10-1). During the extreme drought period (2007 to 2009), partial drying of the lake caused hypersulfidic subaqueous soil to transform to hypersulfidic clay soil. Inundation, following winter 2010, caused the formation of hypersulfidic subaqueous clay soil.

Profiles collected closest to the shoreline (LF08-A; Figure 10-1) were classified as hypersulfidic soil with medium acidification hazard ratings (Table 10-1). Above 30 cm, they generally had slightly positive net acidity, little ANC and S_{CR} and very low to medium acidification potential (Figure 10-3; Table 10-1). Below 30 cm, profiles had higher net acidity, high ANC and S_{CR} and low to high acidification potential (Figure 10-3; Table 10-1). Reflooding had no significant impact upon this site, acidity was dominated by S_{CR} and soil material remained hyposulfidic and hypersulfidic with medium acidification hazard ratings (Table 10-2).

Profiles collected further into the lake (LF08-B; Figure 10-1) were classified as hyposulfidic and hypersulfidic soil with low and medium acidification hazard ratings (Table 10-1). Above 35 to 45 cm, they generally had negative net acidity, moderate ANC, low S_{CR} and very low to low acidification potential (Figure 10-3; Table 10-1). Below 35 to 45 cm, profiles had high net acidity, low ANC, high S_{CR} and medium to high acidification potential (Figure 10-3; Table 10-1). Reflooding had no discernible impact upon this site, acidity was dominated by S_{CR} and soil material remained hyposulfidic and hypersulfidic with medium acidification hazard ratings (Table 10-2).

Overall, soil at Meningie was considered to pose a medium acidification hazard.

Table 10-1 Summary of acidification potential, ASS material classification, ASS subtype classification and acidification hazard (* indicates sulfuric soil material). The soil texture in brackets following the ASS subtype classification indicates the dominant texture of the profile

Sample	Sampling	Depth (cm)	pH$_{OX}$ < 2.5	pH$_{INC}$ < 4.0	NA > 0	Acidification potential	ASS material classification	ASS subtype classification	Acidification hazard
LF08-A									
AT 4.1	h$_1$	0-5	0	0	0	0	Sand	Hypersulfidic subaqueous soil (sand)	Medium
AT 4.2	h$_1$	5-10	0	0	1	1	Hyposulfidic sand		
AT 4.3	h$_1$	10-30	1	1	0	2	Hypersulfidic sand		
AT 4.4	h$_1$	30-60	1	0	1	2	Hyposulfidic clayey sand		
AT 4.5	h$_1$	60-70	1	0	1	2	Hyposulfidic heavy clay		
LFa08-A.1	a	0-8	0	0	0	0	Hyposulfidic sand	Hypersulfidic clay soil (clay)	Medium
LFa08-A.2	a	8-18	0	1	1	2	Hypersulfidic sand		
LFa08-A.3	a	18-25	0	1	1	2	Hypersulfidic sand		
LFa08-A.4	a	25-50	0	0	1	1	Hyposulfidic medium clay		
LFa08-A.5	a	50-60	1	1	1	3	Hypersulfidic medium clay		
LFb08-A.1	b	0-18	0	0	1	1	Hyposulfidic sand	Hypersulfidic clay soil (clay)	Medium
LFb08-A.2	b	18-28	0	1	1	2	Hypersulfidic sand		
LFb08-A.3	b	28-45	0	0	1	1	Hyposulfidic medium clay		
LFb08-A.4	b	45-60	0	0	1	1	Hyposulfidic heavy clay		
LFc08-A.1	c	0-12	0	0	0	0	sand	Hypersulfidic subaqueous clay soil (clay)	Medium
LFc08-A.2	c	12-28	1	0	1	2	Hyposulfidic sand		
LFc08-A.3	c	28-60	0	0	1	1	Hyposulfidic clay		
LFc08-A.4	c	60-78	0	1	1	2	Hypersulfidic clay		
LFd08-A.1	d	0-12	0	0	0	0	Hyposulfidic sand	Hypersulfidic subaqueous clay soil (clay)	Medium
LFd08-A.2	d	12-21	0	1	1	2	Hypersulfidic loamy sand		
LFd08-A.3	d	21-33	1	0	1	2	Hyposulfidic clay		
LFd08-A.4	d	33-60	1	1	1	3	Hypersulfidic clay		
LFe08-A.1	e	0-8	0	1	0	1	Hypersufilidic sand	Hypersulfidic subaqueous clay soil (clay)	Medium
LFe08-A.2	e	8-26	0	0	0	0	Hyposulfidic sand		
LFe08-A.3	e	26-45	1	1	1	3	Hypersufilidic heavy clay		
LFe08-A.4	e	45-58	1	1	1	3	Hypersufilidic heavy clay		
LFf08-A.1	f	0-8	0	1	1	2	Hypersufilidic loamy sand	Hypersulfidic subaqueous clay soil (clay)	Medium
LFf08-A.2	f	8-32	0	1	1	2	Hypersufilidic loamy sand		
LFf08-A.3	f	32-52	1	1	1	3	Hypersufilidic heavy clay		
LFf08-A.4	f	52-86	1	1	1	3	Hypersufilidic heavy clay		
LF08-B									
AT 17.1	h$_2$	0-1	0	0	0	0	Sand	Hyposulfidic subaqueous clay soil (clay)	Low
AT 17.2	h$_2$	1-10	0	0	0	0	Hyposulfidic sand		
AT 17.3	h$_2$	10-20	0	0	0	0	Hyposulfidic sandy clay		
LFa08-B.1	a	0-10	0	0	0	0	Hyposulfidic sand	Hypersulfidic clay soil (sand)	Medium
LFa08-B.2	a	10-20	0	0	0	0	Hyposulfidic sand		
LFa08-B.3	a	20-35	0	0	0	0	Hyposulfidic sand		
LFa08-B.4	a	35-55	1	1	1	3	Hypersulfidic medium clay		
LFb08-B.1	b	0-25	0	0	0	0	Hyposulfidic sand	Hypersulfidic clay soil (clay)	Medium
LFb08-B.2	b	25-32	0	0	0	0	Hyposulfidic sand		
LFb08-B.3	b	32-45	0	0	1	1	Hyposulfidic sandy clay		
LFb08-B.4	b	45-65	0	1	1	2	Hypersulfidic light clay		
LFc08-B.1	c	0-20	0	0	0	0	Hyposulfidic sand	Hypersulfidic subaqueous clay soil (clay)	Medium
LFc08-B.2	c	20-33	0	0	0	0	Hyposulfidic sandy clay		
LFc08-B.3	c	33-45	0	1	1	2	Hypersulfidic sandy clay		
LFc08-B.4	c	45-65	1	1	1	3	Hypersulfidic clay		
LFd08-B.1	d	0-16	0	0	0	0	Hyposulfidic sand	Hypersulfidic subaqueous clay soil (clay)	Medium
LFd08-B.2	d	16-23	0	0	0	0	Hyposulfidic loamy sand		
LFd08-B.3	d	23-56	1	1	1	3	Hypersulfidic clay		
LFe08-B.1	e	0-20	0	0	0	0	Hyposulfidic sand	Hypersulfidic subaqueous clay soil (clay)	Medium
LFe08-B.2	e	20-30	0	0	0	0	Hyposulfidic loamy sand		
LFe08-B.3	e	30-37	0	0	0	0	Hyposulfidic heavy clay		
LFe08-B.4	e	37-70	1	1	1	3	Hypersufilidic heavy clay		
LFf08-B.1	f	0-23	0	0	0	0	Hyposulfidic loamy sand	Hypersulfidic subaqueous clay soil (clay)	Medium
LFf08-B.2	f	23-30	0	0	0	0	Hyposulfidic loamy sand		
LFf08-B.3	f	30-35	0	0	1	1	Hyposulfidic heavy clay		
LFf08-B.4	f	35-77	1	1	1	3	Hypersufilidic heavy clay		

Table 10-2 Summary of temporal and spatial variations and changes in ASS subtypes at each site (**A and B**). Note: (i) Cells shaded orange summarise data presented within this report, (ii) all other cells are based on/extrapolated from data presented in Fitzpatrick *et al.* (2008a; 2008b; 2009b; 2008c) and (iii) cells bordered in blue indicate subaqueous

Meningie Sites		Pre-drought Winter 2007 (h₁)	Drought Summer 2008 (h₂)	Drought End winter 2009 (a)	Drought End summer 2010 (b)	Post drought Summer 2011 (c)	Post drought Winter 2011 (d)	Post-drought start summer 2011/12 (e)	Post-drought start winter 2011/12 (f)	Summary
LF08-A	¹Classification & ²Acid hazard	Hypersulfidic subaqueous (M)	Hypersulfidic clay (M)	Hypersulfidic clay (M)	Hypersulfidic clay (M)	Hypersulfidic subaqueous clay (M)	Hypersulfidic subaqueous clay (M)	Hypersulfidic subaqueous clay (M)	Hypersulfidic subaqueous clay (M)	During the extreme drought period (2007 to 2009) the partial drying of the lake caused Hypersulfidic subaqueous soil to transform to Hypersulfidic clay soil. Inundation, following winter 2010, caused the formation of Hypersulfidic subaqueous clay soil.
	Dominant water and ASS process	UW & Sulfide	LW & Sulfide	LW & Sulfide	LW & Sulfide	RW & Sulfide	UW & Sulfide	UW & Sulfide	UW & Sulfide	
LF08-B	¹Classification & ²Acid hazard	Hyposulfidic subaqueous clay (L)	Hyposulfidic subaqueous clay (L)	Hypersulfidic clay (M)	Hypersulfidic clay (M)	Hypersulfidic subaqueous clay (M)	Hypersulfidic subaqueous clay (M)	Hypersulfidic subaqueous clay (M)	Hypersulfidic subaqueous clay (M)	During the extreme drought period (2007 to 2009) the partial drying of the lake caused Hyposulfidic subaqueous clay soil to transform to Hypersulfidic clay soil. Inundation, following winter 2010, caused the formation of Hypersulfidic subaqueous clay soil.
	Dominant water and ASS process	UW & Sulfide	UW & Sulfide	LW & Sulfide	LW & Sulfide	RW & Sulfide	UW & Sulfide	UW & Sulfide	UW & Sulfide	

¹ **Classification** – Acid Sulfate Soil subtype classification
² **Acid hazard – Acidification hazard: H = High; M = medium; L = Low; VL = Very Low**
Dominant Water process
LW – Lowering water level regime to expose soil to air due to drought conditions and water evaporation
UW – Unchanged water regime, which had not yet evaporated to expose soil to air
RW – Rising water level regime to inundate and saturate soils by reflooding (e.g. due to pumping, regulator installation, river flow and groundwater)
RF – Rain fall rewetting and natural reflooding to inundate and saturate soils

Dominant ASS – process
Sulfuric – Sulfuricization - oxidation of pyrite in hypersulfidic material due to onset of aerobic conditions to form sulfuric material
Sulfuric* – As above with acidic minerals and/or salt efflorescences noted (i.e. measurable RA)
Sulfide – Sulfidization due to sulfide accumulation to form hypersulfidic material
Monosulfide – Monosulfidization due to monosulfide accumulation to form monosulfidic material
Leach – Leaching of acid from soil by winter rain fall
Sulfuric **subaqueous** with **overlying circa neutral water** pH >4: = font coloured blue or default
Sulfuric **subaqueous** soil with **overlying acid water** pH <4: = font coloured red
Where h₁ to h₃ = historical sampling; (a) – (b) sampling conducted in this project

11. LF10 – CAMPBELL PARK

Summary

Soil at Campbell Park comprised hyposulfidic, hypersulfidic and sulfuric soil and overall was considered to pose a high acidification hazard.

During drought conditions, profiles collected at the shoreline, in a reed bed were classified as sulfuric and hyposulfidic organic soil with medium and high acidification hazard ratings. Following reflooding in October 2010, the distribution of acidity within the soil profile changed. The net acidity decreased in the upper 30 to 40 cm and increased in the underlying sediments. This may be the result of the extreme heterogeneity of the reed bed (i.e. distribution of organic matter) or a downward migration of acidity caused by rainfall and reflooding.

Profiles collected 150 m into the lake were generally classified as sulfuric and hypersulfidic soil with high acidification hazard ratings. During Samplings-h_1/h_2, surface soils were well buffered against acidity and classified as hyposulfidic. However, by the time of Sampling-a, surface soils had strongly acidified and contained high concentrations of TAA and RA. This was most likely due to upward migration of acidic solutions by capillary action during formation of mineral efflorescences (as indicated by elevated RA). At the time of Sampling-d, having been inundated for more than nine months, soil profiles remained sulfuric. At the time of Samplings-e/f, having been inundated for 15 to 21 months, increases in soil pH and reduced RA, meant that these profiles were classified as hypersulfidic. Regardless, these profiles were considered to pose high acidification hazards.

Profiles collected 300 m into the lake were classified as hyposulfidic, hypersulfidic and sulfuric soil with medium and low acidification hazard ratings. Profiles collected following reflooding were dominated by ANC, in the form of carbonate (calcrete) rubble. This was attributed to the spatial variability of calcrete around Campbell Park.

11.1 Background

Study area LF10 was located in Lake Albert on the northern side of Campbell Park Peninsula (Figure 1-1). As part of this study, sampling was carried out in December 2011 and June 2012 (Samplings-e/f). Previous samplings were undertaken in May and June 2011 (Sampling-d), January and February 2011 (Sampling-c), March 2010 (Sampling-b) and November 2009 (Sampling-a). Additionally, data from historic sampling (Samplings-h_1/h_2), carried out in July 2007 and February 2008, were reassessed as part of this study. Sampling site locations are displayed in Figure 11-1.
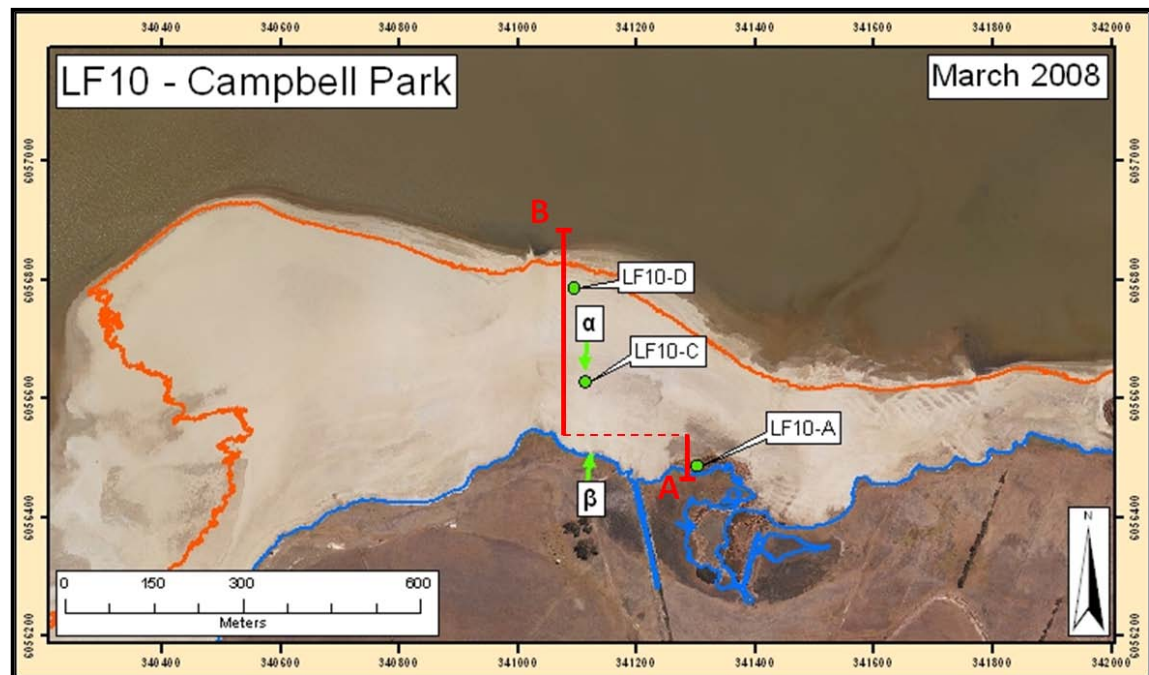
Figure 11-1 Sample location map. Aerial photograph taken in March 2008 (Orange line: sampling-a water level, Blue line: sampling-c, d, e & f water level). Red line indicates cross section presented in Section 22.2

At the time of Sampling-c/d/e, the lake level had risen to approximately 0.6 m AHD and the study area had been completely re-flooded (Figure 11-1: Figure 11-2). Prior to this, at the time of the first historic sampling in July 2007 (Sampling-h_1), the lake level was at pre-drought levels and no beach was exposed (Figure 11-2). By the time of the second historic sampling (Sampling-h_2) in February 2008, lake levels had dropped and the study area comprised a beach, which extended from the pre-drought (pre 2006) shore to the waterline, approximately 300 m north (Figure 11-1: Figure 11-2). The lake level dropped further from -0.45 m AHD in November 2009 (Sampling-a) to a low of -0.78 m AHD in March 2010 (Sampling-b) (MDBA 2011), which exposed a large area of lake bed (Figure 11-2).
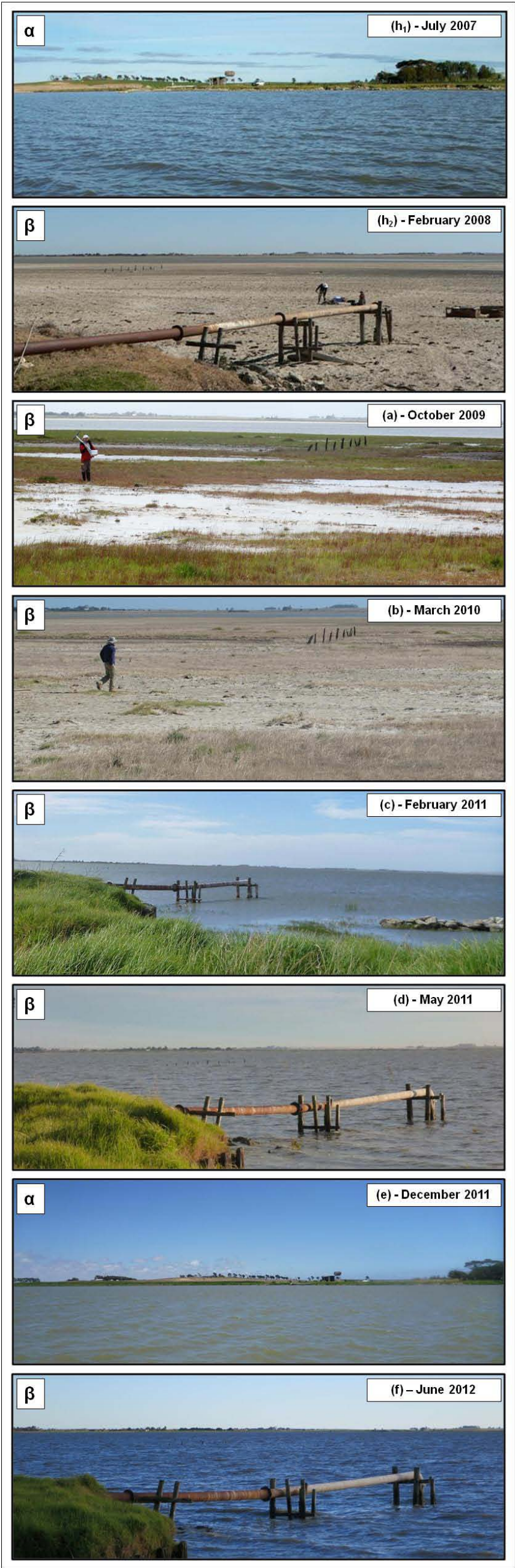
Figure 11-2 Site photographs. Refer to Figure 11-1 for the location and direction that photographs were taken, indicated by α or β (photographs were selected that best depicted the environmental conditions at the study area during each sampling)

11.2 Soils

Soils at Campbell Park generally comprised: (i) LF10-A: sulfuric peat and clay, (ii) LF10-B: sulfuric sand, (iii) LF10-C: hypersulfidic and sulfuric sand and clay, (iv) LF10-D: hypersulfidic and hyposulfidic sand and clay and (v) LF10-E: hyposulfidic sand and clay. A summary of encountered soils is provided below and site locations are presented in Figure 11-1. Detailed profile descriptions are presented in Appendix 4 and Appendix 8. Profile photographs are presented in Appendix 5.

LF10-A
During previous studies, when the study area was dry, profiles were collected at this site on three occasions (Samplings-h_1/a/b). The site was dry during all samplings and was located in a reed bed on the pre-drought shore. The historic sampling encountered 5 cm of dense root mat with clay. This overlay grey and dark grey heavy clay to the maximum extent of investigation at 100 cm. Samplings-a/b both encountered 50 cm of brown orange fibric peat and clay loam. This was underlain, to a depth of 75 cm, by grey sand and loamy sand with much brown organic material. From 75 to 80 cm was brown sand and loamy sand. This was underlain, to the maximum extent of investigation (100 cm), by grey to olive grey heavy clay. During Sampling-b, shells were noted below 80 cm, which had not been observed during Sampling-a.

When water levels rose and the study area became inundated (Samplings-c/d), a UWS was used to collect subaqueous soil profiles on two occasions. The investigations encountered 18 and 12 cm of black (Sampling-c) to very dark brown (Sampling-d) sandy clay loam with abundant hemic material (hemic peat). This was underlain, to depths of 36 and 19 cm, by grey light clay and clayey sand. Underlying this, to depths of 66 and 63 cm (63 cm was the maximum extent of investigation for Sampling-d), was grey heavy clay with large yellow jarosite mottles. Underlying this, to the maximum extent of investigation (80 cm), Sampling-c encountered very dark grey medium heavy clay with yellow mottles and few fine roots.

As part of this study, a UWS was used to collect subaqueous soil profiles (Samplings-e/f). The investigation encountered 10 to 12 cm of very dark brown hemic peat with a few cm of MBO at surface. This was underlain, to depths of 20 to 21 cm, by dark grey clayey sand with common fine roots. Underlying this, to depths of 53 to 57 cm, was grey heavy clay with prominent jarosite mottles associated with root channels. This was underlain, to the maximum extent of investigation (65 and 86 cm), by dark grey heavy clay.

LF10-C
During previous studies, profiles were collected at this site on four separate sampling occasions (Samplings-h_1/h_2/a/b). The first historic sampling was undertaken when the lake levels were high and was carried out under subaqueous conditions (all subsequent samplings were undertaken in dry conditions). Samples were collected with a gouge auger, which encountered 5 cm of yellowish grey sand. This was underlain, to a depth of 40 cm, by grey heavy clay with decomposing roots. From 40 to 50 cm was grey to pale grey sand, which was underlain, to the maximum extent of investigation (75 cm), by brownish grey sand. The second historic sampling encountered 8 cm of greenish yellow sand, which was underlain, to a depth of 28 cm, by grey sandy clay with orange and yellow mottles associated with root channels. This was underlain, to the maximum extent of investigation (50 cm), by pale grey sand with some grey clay lenses. Sampling-a encountered 0.5 cm of pale yellow brown crust. This was underlain, to a depth of 5 cm, by dark red brown fibric silty clay with many relic phragmites roots. From 5 to 20 cm was light brown coarse sand with yellow brown mottles. Underlying this, to a depth of 50 cm, was grey clayey sand with yellow mottles that had orange hallows. This was underlain, to the maximum extent of investigation (80 cm), by grey medium clay. Sampling-b, encountered 0.5 cm of white and pale yellow crust. This was underlain, to a depth of 5 cm, by very dark brown sapric clay loam peat. From 5 to 20 cm was grey light clay with strong jarosite mottles and brown sapric peat. Underlying this, to a depth of 35 cm, was brownish grey sand with dark grey, yellow and reddish brown mottles. From 35 to 50 cm was very dark grey loamy sand light grey, reddish and pale yellow mottles. This was underlain, to the maximum extent of investigation (80 cm), by moist grey sand with reddish brown mottles.

When water levels rose and the study area became inundated (Samplings-c/d), a UWS was used to collect subaqueous soil profiles on two occasions. The investigations encountered 7 and 10 cm of greyish brown clay with decomposing organic matter at the surface. Yellow jarosite (5 %) we noted near the base of this layer during Sampling-d. Underlying this, to a depth of 29 cm, was light olive brown loamy sand with 25 % jarosite mottles noted during Sampling-c and 15 % jarosite mottles during Sampling-d. This was underlain, to a depth of 70 cm by grey to greyish brown loamy sand with 10 % diffuse darker grey mottles.

As part of this study, a UWS and push tube were used to collect subaqueous soil profiles (Samplings-e/f). Sampling-e encountered 5 cm of very dark grey heavy clay with brown organic matter at surface. This was underlain, to a depth of 18 cm, by light olive brown loamy sand. Underlying this, to a depth of 30 cm, was grey loamy sand. This was underlain, to the maximum extent of investigation (45 cm), by grey loamy sand with few old roots. Sampling-f encountered 18 cm of very dark grey sand to loamy sand with 30 % black decomposing organic matter. This was underlain, to a depth of 18 cm, by light olive brown loamy sand. Underlying this, to a depth of 30 cm, was grey loamy sand. This was underlain, to the maximum extent of investigation (45 cm), by grey loamy sand with few old roots.

LF10-D

During previous studies, profiles were collected at this site on two separate sampling occasions (Samplings-a/b). Sampling-a was carried out directly at the edge of the water. The lake level had dropped by Sampling-b. Sampling-a encountered 2 cm of grey light clay overlying 3 cm of monosulfidic black light clay gel. Underlying this, to a depth of 20 cm, was light brown sand with orange mottles. This was underlain, to the maximum extent of investigation (50 cm), by wet dark grey to grey clayey sand. Sampling-b encountered 0.5 cm of dry layered brownish grey heavy clay with some organic matter. Underlying this, to a depth of 15 cm, was pale brownish yellow sand with diffuse brownish red mottles. From 15 to 35 cm was grey loamy sand with distinct grey, brownish red, yellow and black mottles. This was underlain, to the maximum extent of investigation (55 cm), by grey sandy loam with diffuse black mottles and few relic roots.

When water levels rose and the study area became inundated (Samplings-c/d), a UWS was used to collect subaqueous soil profiles on two occasions. The investigations encountered 16 and 12 cm of grey to grey brown and black loamy sand with many fine roots and a few fine shell fragments. This was underlain, to depths of 28 and 30 cm (30 cm was the maximum depth of investigation during Sampling-d), by greenish grey clay and sandy loam with soft and hard carbonate nodules. Between 28 and 47 cm, Sampling-c encountered calcareous rubble. This was underlain, to the maximum extent of investigation (56 cm), by greenish grey sandy loam.

As part of this study, a UWS and push tube were used to collect subaqueous soil profiles (Samplings-e/f). Sampling-e encountered 5 cm of black to dark grey loamy sand. This was underlain, to a depth of 17 cm, by olive brown loamy sand. Underlying this, to the maximum extent of investigation (35 cm), was grey sandy loam with both soft and hard carbonate nodules. Sampling-f encountered 4 cm of dark grey sand with few fine rootlets. This was underlain, to a depth of 12 cm, by dark grey loamy sand. Underlying this, to a depth of 20 cm, was olive grey loamy sand with clayey lenses. This was underlain, to a depth of 33 cm, by olive grey clay or sandy clay with 50 % coarse carbonate nodules. Underlying this, to the maximum extent of investigation (88 cm), was dark grey sandy clay loam with few fine shell fragments and carbonate nodules.

11.3 Soil acidity and acid-base accounting

Acid-base accounting was carried out according to the methods described in Section 2.3. Acid-base accounting and pH data (pH_{OX}, pH_{INC} & pH_W), for each soil layer, are presented in Figure 11-3. These data were used to inform the acidification hazard assessment that is presented in Table 11-1.

Figure 11-3 pH and acid-base accounting data plotted against depth for each profile collected

11.4 Summary and discussion

Acidification potential assessment and ASS material classification were carried out for each soil sample collected, according to the definitions and methods presented in Section 1.3 and Section 2.4 respectively. A summary of acidification potential and ASS material classification is presented in Table 11-1.

Acidification hazard assessment and ASS subtype classification were carried out for each soil profile collected. ASS subtype classification was achieved using the methods described in Appendix 2. Acidification hazard assessment was based on: (i) landscape position (Figure 11-1), (ii) soil morphology (Section 11.2), (iii) acid-base accounting (Figure 11-3), (iv) pH data (Figure 11-3), (v) acidification potential (Table 11-1) and (vi) ASS material and subtype classification (Table 11-1). Acidification hazard categories were: (i) very low, (ii) low, (iii) medium and (iv) high. A summary of ASS subtype classification and acidification hazard for each profile collected between July 2007 and June 2012 is presented in Table 11-1.

Soil profiles at Campbell Park generally comprised hyposulfidic, hypersulfidic and sulfuric soil with low to high acidification hazard ratings (Table 11-1). During drought conditions, profiles collected at the shoreline, in a reed bed (LF10-A; Figure 11-1), were classified as sulfuric and hyposulfidic (pH_W and pH_{INC} < 5) organic soil with medium and high acidification hazard ratings (Table 11-1). The upper portion of the profiles (above 50 to 75 cm) had relatively high net acidity, little or no ANC, high TAA, minor S_{CR} and high acidification potential (Figure 11-3; Table 11-1). The lower half of the profiles (below 50 to 75 cm) had relatively low or negative net acidity, little or moderate ANC, little or no TAA and S_{CR} and very low acidification potential (Figure 11-3; Table 11-1). Following reflooding, in October 2010, the distribution of acidity within the soil profile changed. The net acidity decreased in the upper 30 to 40 cm and increased in the underlying sediments. This may be the result of the extreme heterogeneity of the reed bed (i.e. distribution of organic matter) or a downward migration of acidity caused by rainfall and reflooding.

Profiles collected approximately 150 m into the lake (LF10-C; Figure 11-1) were classified as sulfuric and hypersulfidic soil with high acidification hazard ratings (Table 11-1). They had relatively high net acidity, little or no ANC, high TAA, S_{CR} and moderate levels of RA and high acidification potential (Figure 11-3; Table 11-1). During Samplings-h_1/h_2, surface soils were well buffered against acidity and classified as hyposulfidic. However, by the time of Sampling-a, surface soils had strongly acidified and contained high concentrations of TAA and RA (Figure 11-3). This was most likely due to upward migration of acidic solutions by capillary action during formation of mineral efflorescences (as indicated by elevated RA). At the time of Sampling-d, having been inundated for more than nine months, soil profiles remained sulfuric (Table 11-2). At the time of Samplings-e/f, having been inundated for 15 to 21 months, increases in soil pH and reduced RA, meant that these profiles were classified as hypersulfidic. Regardless, these profiles were considered to pose high acidification hazards.

Profiles collected 300 m into the lake (LF10-D; Figure 11-1) were classified as hyposulfidic, hypersulfidic and sulfuric soil with medium and low acidification hazard ratings (Table 11-1). During drought conditions, the upper portion of the profiles (above 15 to 20 cm) had negative net acidity, moderate to high ANC, moderate S_{CR} and very low acidification potential (Figure 11-3;). The lower half of the profiles (below 15 to 20 cm) had positive net acidity, little or no ANC, moderate S_{CR} and high acidification potential (Figure 11-3;). Profiles collected following reflooding were dominated by ANC, in the form of carbonate (calcrete) rubble. This was attributed to the spatial variability of the underlying calcrete around Campbell Park (Section 11.2).

Overall, soil at Campbell Park was considered to pose a high acidification hazard.

Table 11-1 Summary of acidification potential, ASS material classification, ASS subtype classification and acidification hazard (* indicates sulfuric soil material). The soil texture in brackets following the ASS subtype classification indicates the dominant texture of the profile

Sample	Sampling	Depth (cm)	pH$_{OX}$ < 2.5	pH$_{INC}$ < 4.0	NA > 0	Acidification potential	ASS material classification	ASS subtype classification	Acidification hazard
LF10-A									
AT 9.2	h$_1$	5-30	1	1	1	3*	Sulfuric heavy clay peat	Sulfuric organic soil (clay)	High
AT 9.3	h$_1$	30-50	0	0	1	1	Hyposulfidic heavy clay		
AT 9.4	h$_1$	50-100	0	0	0	0	Hyposulfidic heavy clay		
LFa10-A.1	a	0-50	1	0	1	2*	Sulfuric peat	Sulfuric organic soil (organic)	High
LFa10-A.2	a	50-75	1	1	1	3	Hyposulfidic sand		
LFa10-A.3	a	75-80	0	0	1	1	Hyposulfidic sand		
LFa10-A.4	a	80-100	0	0	0	0	Hyposulfidic heavy clay		
LFb10-A.1	b	0-50	1	0	1	2	Hyposulfidic peat	Hyposulfidic organic soil (organic)	Medium
LFb10-A.2	b	50-75	0	0	1	1	Hyposulfidic loamy sand		
LFb10-A.3	b	75-80	0	0	0	0	Hyposulfidic loamy sand		
LFb10-A.4	b	80-100	0	0	0	0	Hyposulfidic heavy clay		
LFc10-A.1	c	0-18	1	0	1	2	Hyposulfidic sandy organic clay	Sulfuric subaqueous organic soil (clay)	High
LFc10-A.2	c	18-36	0	0	1	1	Hyposulfidic clay		
LFc10-A.3	c	36-66	1	1	1	3*	Sulfuric clay		
LFc10-A.4	c	66-80	1	1	1	3*	Sulfuric clay		
LFd10-A.1	d	0-12	1	0	1	2	Hyposulfidic hemic peat	Sulfuric subaqueous organic soil (clay)	High
LFd10-A.2	d	12-19	0	0	1	1	Hyposulfidic sand		
LFd10-A.3	d	19-63	1	1	1	3*	Sulfuric clay		
LFe10-A.1	e	0-10	1	0	1	2	Hyposulfidic hemic peat	Sulfuric subaqueous organic soil (clay)	High
LFe10-A.2	e	10-20	1	1	1	3	Sulfuric clayey sand		
LFe10-A.3	e	20-57	1	1	1	3	Sulfuric heavy clay		
LFe10-A.4	e	57-65	1	1	1	3	Sulfuric heavy clay		
LFf10-A.1	f	0-12	1	0	1	2	Hyposulfidic hemic peat	Hypersulfidic subaqueous organic soil (clay)	High
LFf10-A.2	f	12-21	0	0	0	0	Hyposulfidic hemic peat		
LFf10-A.3	f	21-53	1	1	1	3	Hypersufilidic heavy clay		
LFf10-A.4	f	53-86	1	1	1	3	Hypersufilidic heavy clay		
LF10-C									
AT 7.1	h$_1$	0-5	0	0	0	0	Sand	Hypersulfidic subaqueous clay soil (sand)	High
AT 7.2	h$_1$	5-20	1	1	1	3	Hypersulfidic heavy clay		
AT 7.3	h$_1$	20-40	1	1	1	3	Hypersulfidic heavy clay		
AT 7.4	h$_1$	40-50	1	1	1	3	Hypersulfidic sand		
AT 7.5	h$_1$	50-75	1	1	1	3	Hypersulfidic sand		
AT 19.1	h$_2$	0-8	0	0	0	0	Sand	Sulfuric soil (sand)	High
AT 19.2	h$_2$	8-18	1	1	1	3*	Sulfuric sand		
AT 19.3	h$_2$	18-28	1	1	1	3*	Sulfuric sandy clay		
AT 19.4	h$_2$	28-50	1	1	1	3*	Sulfuric sand		
LFa10-C.1	a	0-0.5	1	1	1	3*	Sulfuric crust	Sulfuric clay soil (sand)	High
LFa10-C.2	a	0.5-5	1	1	1	3*	Sulfuric silty clay		
LFa10-C.3	a	5-20	1	1	1	3*	Sulfuric sand		
LFa10-C.4	a	20-50	1	1	1	3*	Sulfuric clayey sand		
LFa10-C.5	a	50-80	1	1	1	3*	Sulfuric medium clay		
LFb10-C.1	b	0-0.5	1	1	1	3*	Sulfuric sand	Sulfuric clay soil (sand)	High
LFb10-C.2	b	0.5-5	1	1	1	3*	Sulfuric clay loam		
LFb10-C.3	b	5-20	1	1	1	3*	Sulfuric light clay		
LFb10-C.4	b	20-35	1	1	1	3*	Sulfuric sand		
LFb10-C.5	b	35-50	1	1	1	3*	Sulfuric loamy sand		
LFb10-C.6	b	50-80	1	1	1	3*	Sulfuric sand		
LFc10-C.1	c	0-7	1	1	1	3	Hypersulfidic sandy clay loam	Sulfuric subaqueous soil (sand)	High
LFc10-C.2	c	7-29	1	1	1	3	Hypersulfidic sandy clay loam		
LFc10-C.3	c	29-45	1	1	1	3*	Sulfuric loamy sand		
LFc10-C.4	c	45-70	1	1	1	3*	Sulfuric loamy sand		
LFd10-C.1	d	0-10	1	1	1	3	Hypersulfidic clay	Sulfuric subaqueous soil (sand)	High
LFd10-C.2	d	10-29	1	1	1	3	Hypersulfidic loamy sand		
LFd10-C.3	d	29-50	1	1	1	3*	Sulfuric loamy sand		
LFd10-C.4	d	50-70	1	1	1	3	Hypersulfidic loamy sand		
LFe10-C.1	e	0-5	1	0	1	2	Hyposulfidic heavy clay	Hypersulfidic subaqueous soil (sand)	High
LFe10-C.2	e	5-18	1	1	1	3	Hypersufilidic loamy sand		
LFe10-C.3	e	18-30	1	1	1	3	Hypersufilidic loamy sand		
LFe10-C.4	e	30-45	1	1	1	3	Hypersufilidic loamy sand		
LFf10-C.1	f	0-18	0	1	1	2	Hypersufilidic loamy sand	Hypersulfidic subaqueous soil (sand)	High
LFf10-C.2	f	18-23	1	1	1	3	Hypersufilidic organic clay		
LFf10-C.3	f	23-40	1	1	1	3	Hypersufilidic loamy sand		
LFf10-C.4	f	40-70	1	1	1	3*	Sulfuric sand		
LF10-D									
LFa10-D.1	a	0-5	0	0	0	0	Hyposulfidic light clay	Hypersulfidic soil (sand)	Medium
LFa10-D.2	a	5-20	0	0	0	0	Hyposulfidic sand		
LFa10-D.3	a	20-50	1	1	1	3	Hypersulfidic clayey sand		

Sample	Sampling	Depth (cm)	pH$_{OX}$ < 2.5	pH$_{INC}$ < 4.0	NA > 0	Acidification potential	ASS material classification	ASS subtype classification	Acidification hazard
LFb10-D.1	b	0-0.5	0	0	0	0	Hyposulfidic heavy clay		
LFb10-D.2	b	0.5-15	0	0	0	0	Hyposulfidic sand	Sulfuric soil	Medium
LFb10-D.3	b	15-35	1	1	1	3*	Sulfuric loamy sand	(sand)	
LFb10-D.4	b	35-55	1	0	1	2	Hyposulfidic sandy loam		
LFc10-D.1	c	0-16	0	0	1	1	Hyposulfidic loamy sand		
LFc10-D.2	c	16-28	0	0	0	0	Hyposulfidic carbonate/sand	Hypersulfidic	
LFc10-D.3	c	28-47	0	0	0	0	Hyposulfidic carbonate rubble	subaqueous	Low
LFc10-D.4	c	47-56	0	1	1	2	Hypersulfidic sandy loam	soil (sand)	
LFd10-D.1	d	0-5	0	0	0	0	Hyposulfidic loamy sand		
LFd10-D.2	d	5-12	0	0	0	0	Hyposulfidic loamy sand	Hyposulfidic	
LFd10-D.3	d	12-30	0	0	0	0	Hyposulfidic carbonate nodules	subaqueous soil (sand)	Very Low
LFe10-D.1	e	0-5	0	0	1	1	Loamy sand	Hyposulfidic	
LFe10-D.2	e	5-17	0	0	0	0	Hyposulfidic loamy sand	subaqueous	Low
LFe10-D.3	e	17-35	0	0	0	0	Hyposulfidic carbonate sand	soil (sand)	
LFf10-D.1	f	0-4	1	0	1	2	Hyposulfidic sand		
LFf10-D.2	f	4-12	0	0	1	1	Hyposulfidic loamy sand	Hypersulfidic	
LFf10-D.3	f	12-20	1	0	1	2	Hyposulfidic loamy sand	subaqueous	Low
LFf10-D.4	f	20-33	0	0	0	0	Hyposulfidic sandy clay	soil (sand)	
LFf10-D.5	f	45-88	0	1	1	2	Hypersufilidic sandy clay loam		

Table 11-2 Summary of temporal and spatial variations and changes in ASS subtypes at each site (**A, C and D**). Note: (i) Cells shaded orange summarise data presented within this report, (ii) all other cells are based on/extrapolated from data presented in Fitzpatrick *et al.* (2010a; 2008a; 2008b; 2009b; 2008c) and (iii) cells bordered in blue indicate subaqueous conditions

Campbell Park Sites		Pre-drought Winter 2007 (h₁)	Drought Summer 2008 (h₂)	Pumping Summer 2009 (h₃)	No pumping End winter 2009 (a)	No pumping End summer 2010 (b)	Post drought Summer 2011 (c)	Post drought Winter 2011 (d)	Post-drought start summer 2011/12 (e)	Post-drought start winter 2011/12 (f)	Summary
LF10-A	¹Classification & ²Acid hazard	Sulfuric organic (H)	Sulfuric organic (H)	Sulfuric organic (H)	Sulfuric* organic (H)	Hyposulfidic organic (M)	Sulfuric subaqueous organic (H)	Sulfuric subaqueous organic (H)	Sulfuric subaqueous organic (H)	Hypersulfidic subaqueous organic (H)	During the entire extreme drought period (2007 to 2009) this site remained a Sulfuric organic soil. Spatial variability meant that this material classified as Hyposulfidic organic soil in 2010. Inundation, following winter 2010, caused the formation of Sulfuric subaqueous organic soil. Prolonged inundation, for > 21 months resulted in the formation of Hypersulfidic subaqueous soil
	Dominant water and ASS process	2 m high live Phragmites LW & Sulfuric	2 m high live Phragmites LW & Sulfuric	1 m high dead *Phragmites* LW & Sulfuric	1 m high dead *Phragmites* LW & Sulfuric	1 m high dead *Phragmites* LW & Leach	2 m high live *Phragmites* RW & Sulfuric	2 m high live *Phragmites* UW & Sulfuric	2 m high live *Phragmites* UW & Sulfuric	2 m high live *Phragmites* UW & Sulfide	
LF10-C	¹Classification & ²Acid hazard	Hypersulfidic subaqueous clay (H)	Sulfuric (H)	Sulfuric (H)	Sulfuric* clay (H)	Sulfuric* clay (H)	Sulfuric subaqueous (H)	Sulfuric subaqueous (H)	Hypersulfidic subaqueous (H)	Hypersulfidic subaqueous (H)	During the extreme drought period (2007 to 2009) the partial drying of the lake caused the Hypersulfidic subaqueous soils to transform to Sulfuric soils. Inundation, following winter 2010, caused the formation of Hypersulfidic subaqueous soil
	Dominant water and ASS process	UW & Sulfide	LW & Sulfuric	LW & Sulfuric	RF & Sulfuric	LW & Sulfuric	RW & Sulfuric	UW & Sulfuric	UW & Sulfide	UW & Sulfide	
LF10-D	¹Classification & ²Acid hazard	Hypersulfidic subaqueous (M)	Sulfuric (M)	Hypersulfidic Soil (M)	Hypersulfidic Soil (M)	Sulfuric (M)	Hypersulfidic subaqueous (L)	Hyposulfidic subaqueous (VL)	Hyposulfidic subaqueous (L)	Hyposulfidic subaqueous (L)	During the extreme drought period (2007 to 2008) the partial drying of the lake caused the Hypersulfidic subaqueous soils to transform to Sulfuric soils. However, pumping of water into Lake Albert from Lake Alexandrina caused these Sulfuric soils to be re-submerged under water and transform to a Hypersulfidic Soil. When pumping was discontinued and the water levels dropped again the Hypersulfidic soil transformed back to a Sulfuric soil. Inundation, following winter 2010, caused the formation of Hypersulfidic and Hyposulfidic subaqueous soil.
	Dominant water and ASS process	UW & Sulfide	LW & Sulfuric	RW & Sulfide Monosulfide	RW & Sulfide Monosulfide	LW & Sulfuric	RW & Sulfide	UW & Sulfide	UW & Sulfide	UW & Sulfide	

¹**Classification – Acid Sulfate Soil subtype classification**
²**Acid hazard – Acidification hazard: H = High; M = medium; L = Low; VL = Very Low**
Dominant Water process
LW – Lowering water level regime to expose soil to air due to drought conditions and water evaporation
UW – Unchanged water regime, which had not yet evaporated to expose soil to air
RW – Rising water level regime to inundate and saturate soils by reflooding (e.g. due to pumping, regulator installation, river flow and groundwater)
RF – Rain fall rewetting and natural reflooding to inundate and saturate soils

Dominant ASS – process
Sulfuric – Sulfuricization - oxidation of pyrite in hypersulfidic material due to onset of aerobic conditions to form sulfuric material
Sulfuric* – As above with acidic minerals and/or salt efflorescences noted (i.e. measurable RA)
Sulfide – Sulfidization due to sulfide accumulation to form hypersulfidic material
Monosulfide – Monosulfidization due to monosulfide accumulation to form monosulfidic material
Leach – Leaching of acid from soil by winter rain fall
Sulfuric **subaqueous** with **overlying circa neutral water** pH >4: = font coloured blue or default
Sulfuric **subaqueous** soil with **overlying acid water** pH <4: = font coloured red
Where h₁ to h₃ = historical sampling; (a) – (b) sampling conducted in this project

12. LF12 – LOVEDAY BAY

Summary

Overall, soil at Loveday Bay was considered to pose a high acidification hazard.

Soil profiles at Loveday Bay generally comprised hypersulfidic and sulfuric soil with medium and high acidification hazard ratings. Drought and the subsequent drying of Loveday Bay (postulated to have occurred between summer 2007 and summer 2009) caused hypersulfidic subaqueous soil to transform to sulfuric soil. Subsequent rewetting resulted in this sulfuric soil transforming to sulfuric subaqueous soil overlain by acidic water. A second period of drying resulted in this material transforming back to sulfuric soil. Inundation, following winter 2010, promoted the formation of hypersulfidic subaqueous soil.

During drought conditions, acidity within surface sediments (i.e. < 25 cm deep) was dominated by TAA. Following reflooding, acidity within the profile was dominated by S_{CR}. This indicates that reflooding may have caused some flushing of acidity (H^+) from surface sediments and encouraged reducing conditions and sulfate reduction, resulting in the formation of hypersulfidic subaqueous soils.

12.1 Background

Study area LF12 was located at the south eastern extent of Lake Alexandrina, on the north eastern side of Loveday Bay (Figure 1-1). As part of this study, sampling was carried out in December 2011 and June 2012 (Samplings-e/f). Previous samplings were undertaken in May and June 2011 (Sampling-d), January and February 2011 (Sampling-c), March 2010 (Sampling-b) and November 2009 (Sampling-a). Additionally, data from historic sampling (Sampling-h_2), carried out in August 2009, were reassessed as part of this study. Sampling site locations are displayed in Figure 12-1.
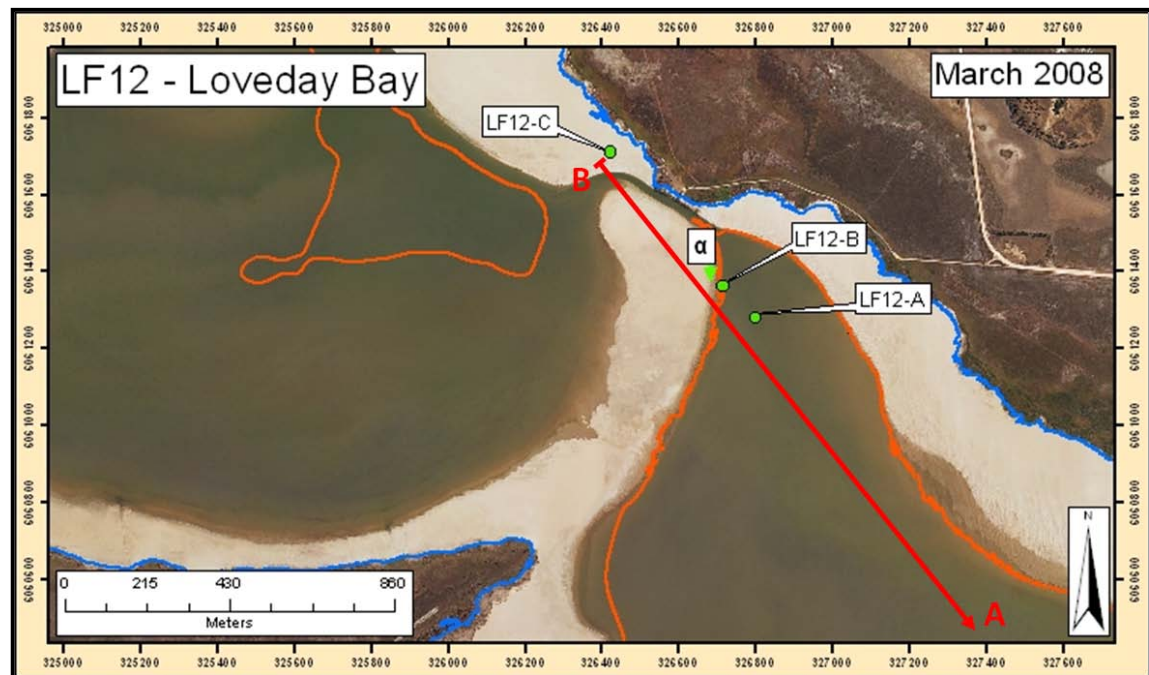
Figure 12-1 Sample location map. Aerial photograph taken in March 2008 (Orange line: sampling-a water level, Blue line: sampling-c, d, e & f water level). Red line indicates cross section presented in Section 22.4

At the time of Sampling-c/d/e, the lake level had risen to approximately 0.65 m AHD and the study area had been completely re-flooded (Figure 12-1: Figure 12-2). Prior to this, in August and October 2009 (Samplings-h_2/a), the study area comprised a partially revegetated sandy spit, which separated a large (approximately 220 hectares) pond of water from the main body of Lake Alexandrina (Figure 12-1: Figure 12-2). Since the aerial photograph was taken in March 2008, the water level had dropped slightly and there was no channel between the pond of water in the east and Lake Alexandrina to the west. By March 2010 (Sampling-b), the pond of water had completely dried and the main body of Lake Alexandrina had receded further from Loveday Bay (Figure 12-2).
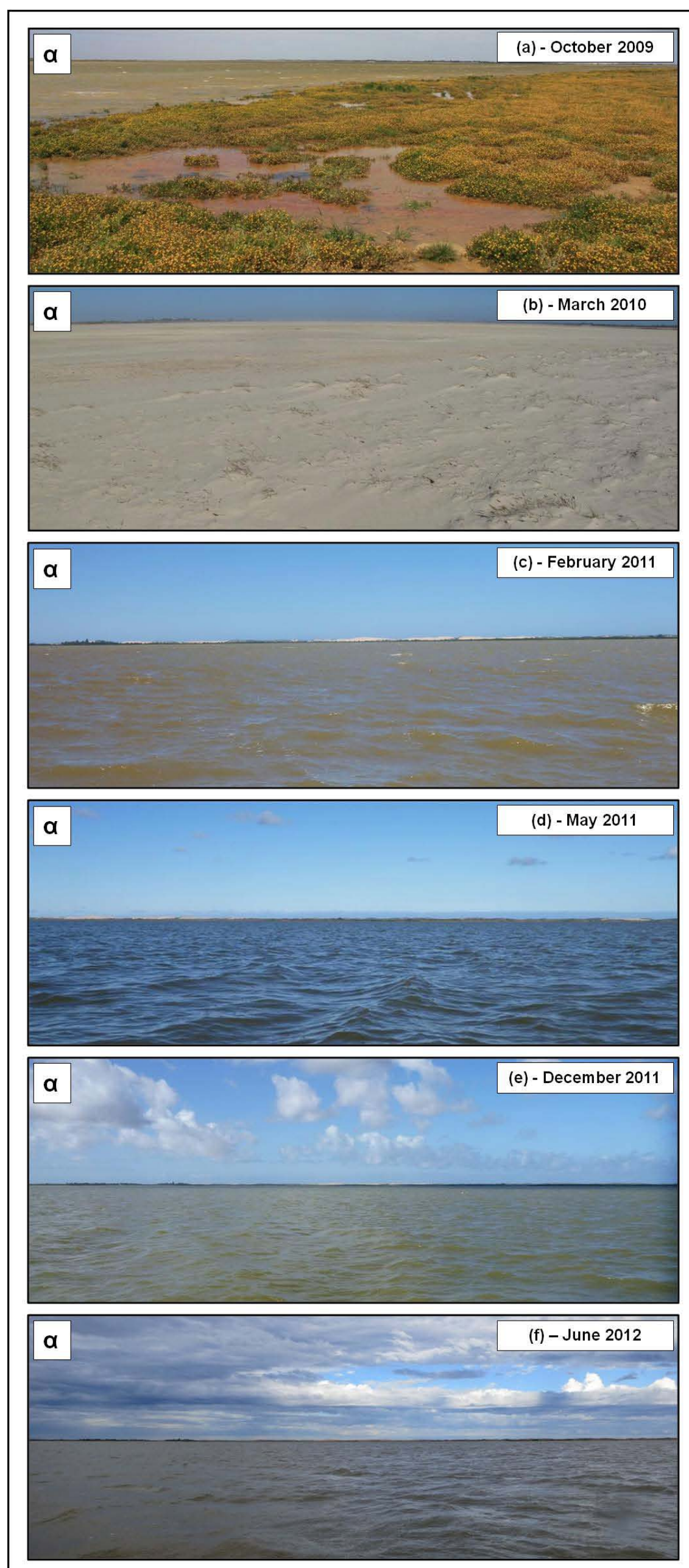
Figure 12-2 Site photographs. Refer to Figure 12-1 for the location and direction that photographs were taken, indicated by α (photographs were selected that best depicted the environmental conditions at the study area during each sampling)

12.2 Soils

Soils at Loveday Bay generally comprised: (i) LF12-A: sulfuric and hypersulfidic sand and clay, (ii) LF12-B: hypersulfidic and hyposulfidic sand and clay and (iii) LF12-C: sulfuric and hypersulfidic sand. A summary of encountered soils is provided below and site locations are presented in Figure 12-1. Detailed profile descriptions are presented in Appendix 4 and Appendix 8. Profile photographs are presented in Appendix 5.

LF12-A
During previous studies, profiles were collected at this site on two separate sampling occasions (Samplings-a/b). Sampling-a was carried out under subaqueous conditions (the subsequent sampling was undertaken in dry conditions). It encountered a 1 cm thick light yellow algal mat. This was underlain, to a depth of 15 cm, by grey sand. From 15 to 40 cm was grey sandy clay. Underlying this, to a depth of 100 cm, was dark grey light medium clay. This was underlain, to the maximum extent of investigation (130 cm), by grey heavy clay. Sampling-b encountered a 0.5 cm thick crust of light yellow grey sand cemented with salt. From 0.5 to 1.5 cm was yellow sand, which was underlain, to a depth of 7 cm, was moist grey loamy sand. Underlying this, to a depth of 23 cm, was brownish grey loamy sand with reddish brown mottles, few relic roots with associated jarosite mottles and clay lenses and organic matter near lower boundary. Between 23 and 50 cm was olive grey sandy clay with reddish brown mottles associated with roots. Underlying this, to the maximum extent of investigation (100 cm), was olive grey sandy clay.

When water levels rose and the study area became inundated (Samplings-c/d), a UWS was used to collect subaqueous soil profiles on two occasions. The investigations encountered 9 and 10 cm of greyish brown loamy sand, which was underlain, to depths of 17 and 18 cm, by grey sandy loam. Approximately 10 % jarosite mottles were noted during Sampling-c and only remnant jarosite mottles were present during Sampling-d. Underlying this, to depths of 58 and 47 cm, was dark grey sandy clay. This was underlain, to depths of 74 and 76 cm (74 cm was the maximum extent of investigation during Sampling-c), by dark greenish grey heavy clay. During Sampling-d, this was underlain, to the maximum extent of investigation (80 cm), by dark greyish brown sand.

As part of this study, a push tube was used to collect subaqueous soil profiles (Samplings-e/f). The investigations encountered 8 cm of olive grey and black loamy clay with weak jarosite mottles in Sampling-e. This was underlain, to depths of 15 to 21 cm, by grey clayey to loamy sand with a few fine roots and diffuse jarosite mottles. Underlying this, to a depth of 33 cm, was grey sandy clay with dark yellowish brown mottles in Sampling-e. This was underlain, to depths of 49 to 50 cm, by grey sandy clay. Underlying this, to depths of 71 to 72 cm (72 cm was the maximum extent of investigation during Sampling-e), was dark grey fine sandy clay. During Sampling-f, this was underlain, to the maximum extent of investigation (84 cm), by dark grey to dark greenish grey heavy clay.

LF12-B
During previous studies, profiles were collected at this site on two separate sampling occasions (Samplings-a/b). Sampling-a encountered 2 cm of cracked red orange and black medium clay. This was underlain, to a depth of 16 cm, by black sand, which was underlain, to the maximum extent of investigation (25 cm), by light grey sand with brown mottles. Sampling-b encountered 10 cm of windblown, loose pale yellow brown sand. Underlying this, to a depth of 35 cm, was pale brown loamy sand with distinct brown and grey mottles. From 35 to 40 cm was black sand with rare reddish mottles along root channels. This was underlain, to the maximum extent of investigation (60 cm), by grey sandy clay.

When water levels rose and the study area became inundated (Samplings-c/d), a UWS was used to collect subaqueous soil profiles on two occasions. The investigations encountered 12 and 10 cm of very dark grey to grey loamy sand. This was underlain, to depths of 32 and 26 cm, by black grading to grey loamy sand with black mottles and layering. Between 32 and 63 cm, Sampling-c encountered dark grey sandy clay loam with clay lenses and few shell fragments. This was underlain, to the maximum extent of investigation (76 cm), by dark grey heavy clay with some shell fragments. Between 26 and 32 cm,

Sampling-d encountered dark grey loamy sand with few black mottles. This was underlain, to the maximum extent of investigation (70 cm), by olive grey heavy clay. No shells were noted during Sampling-d.

As part of this study, a push tube was used to collect subaqueous soil profiles (Samplings-e). The investigation encountered 10 cm of black sand. This was underlain, to a depth of 12 cm, by a compressed layer of black medium clay. Underlying this, to a depth of 38 cm, was black and very dark grey loamy sand. This was underlain, to a depth of 60 cm, by dark grey to grey loamy sand. Underlying this, to the maximum extent of investigation (72 cm), was olive grey sandy clay loam.

LF12-C

During previous studies, profiles were collected at this site on two separate sampling occasions (Samplings-a/b). Sampling-a encountered a 0.5 cm thick crust of yellow salt, which overlay 9.5 cm of light brown medium sand with many orange brown stained roots. From 10 to 60 cm was light brown sand. This was underlain, to the maximum extent of investigation (80 cm), by grey sand. Sampling-b encountered 10 cm of loose pale brown fine sand with reddish brown mottles. This was underlain, to a depth of 23 cm, by pale brownish grey sand with strong reddish brown mottles. From 23 to 36 cm was light brownish grey sand with yellow jarosite mottles associated with reddish brown root channels. Underlying this, to a depth of 48 cm, was olive grey sand and loamy sand with yellow jarosite mottles. This was underlain, to the maximum extent of investigation (80 cm), by grey to dark grey loamy sand with strong brown and yellow brown mottles associated with root channels.

When water levels rose and the study area became inundated (Samplings-c/d), a UWS was used to collect subaqueous soil profiles on two occasions. The investigations encountered 11 and 12 cm of black grading to dark grey loamy sand with few fine roots. This was underlain, to depths of 36 and 34 cm, by light brownish grey loamy sand with diffuse jarosite mottles. Underlying this, to a depth of 50 cm, was grey loamy sand with few yellowish brown mottles associated with root channels. This was underlain, to the maximum extent of investigation (66 and 64 cm), by grey loamy sand.

As part of this study, a push tube was used to collect subaqueous soil profiles (Samplings-e/f). Sampling-e encountered 9 cm of black loamy sand with fine rootlets. This was underlain, to a depth of 32 cm, by light brownish grey loamy sand with diffuse jarosite mottles. Underlying this, to the maximum extent of investigation (45 cm), was grey loamy sand. Sampling-f encountered 13 cm of black loamy sand with fine rootlets. This was underlain, to a depth of 15 cm, by black organic loamy sand with clay lenses and sapric peat. Underlying this, to a depth of 30 cm, was very dark grey loamy sand. this was underlain, to a depth of 67 cm, by grey loamy sand with black and reddish mottles and few shell fragments near the base. Underlying this, to the maximum extent of investigation (84 cm), was grey sandy clay loam with clayey lenses, shell fragments and very fine roots.

12.3 Soil acidity and acid-base accounting

Acid-base accounting was carried out according to the methods described in Section 2.3. Acid-base accounting and pH data (pH_{OX}, pH_{INC} & pH_W), for each soil layer, are presented in Figure 12-1. These data were used to inform the acidification hazard assessment that is presented in Table 12-1.
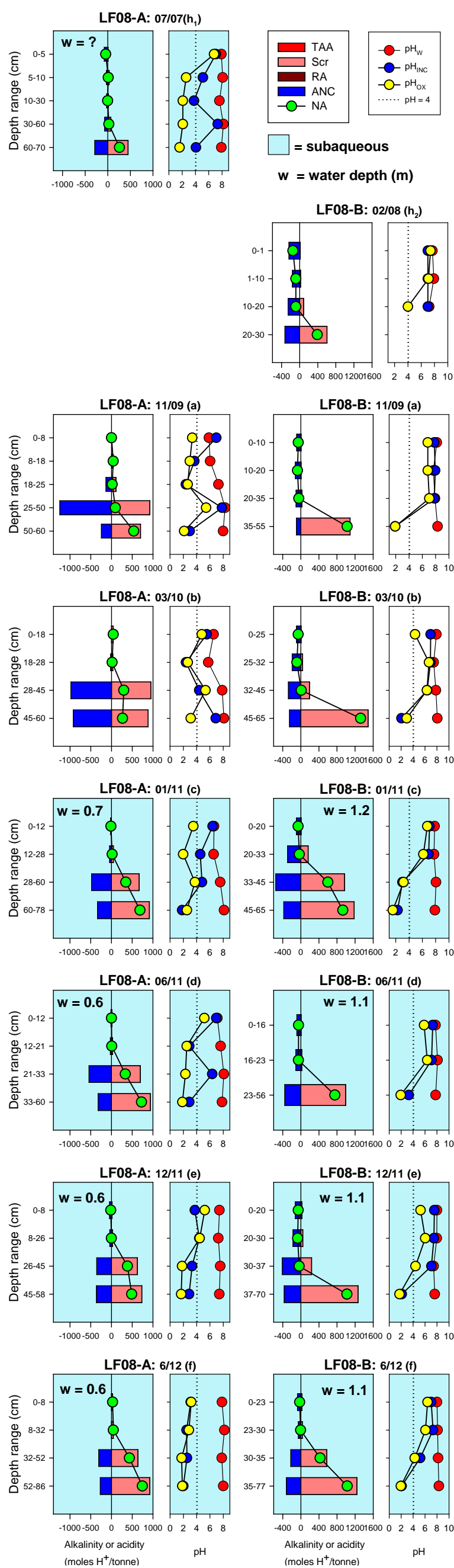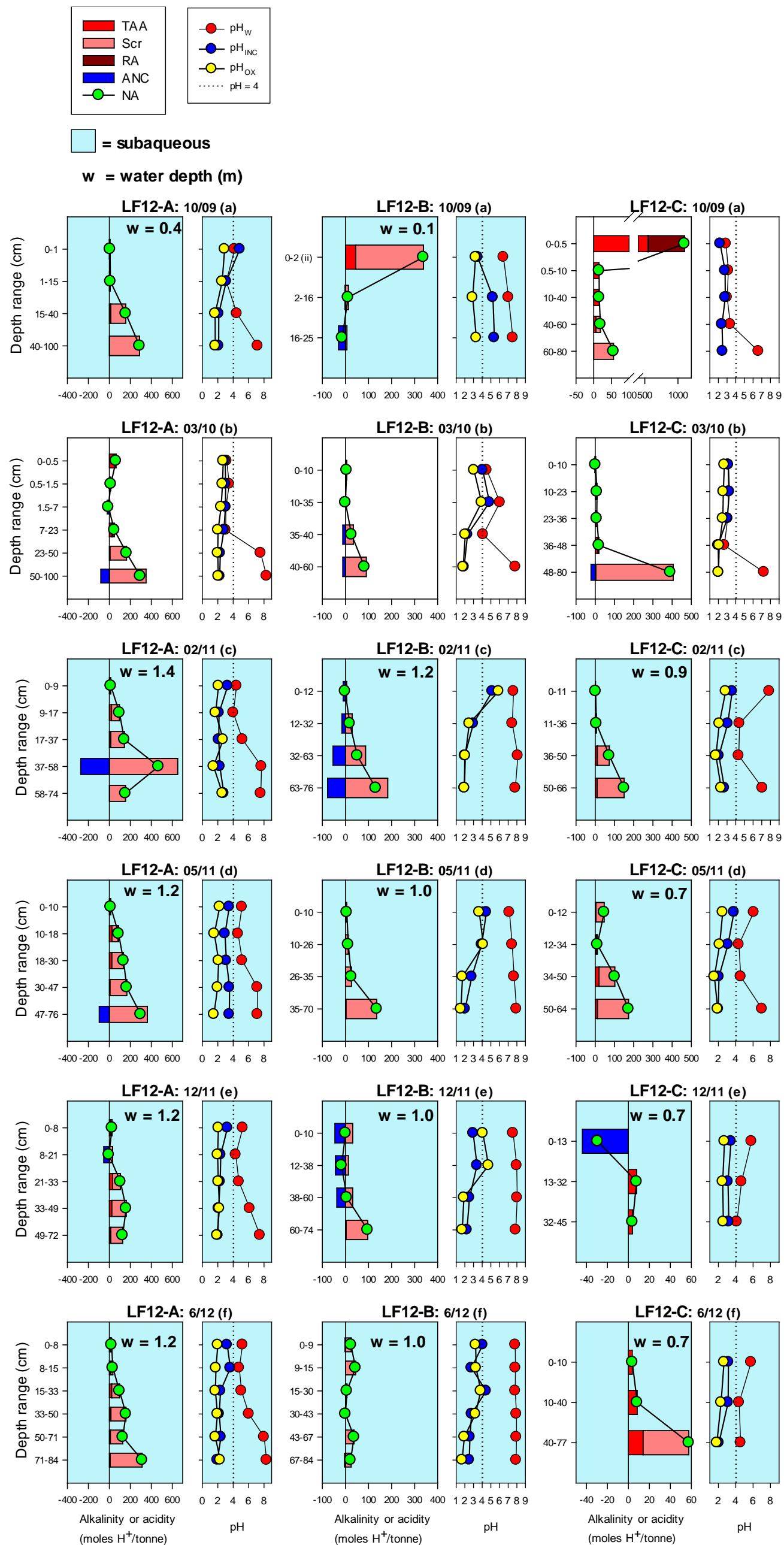
Figure 12-3 pH and acid-base accounting data plotted against depth for each profile collected

12.4 Summary and discussion

Acidification potential assessment and ASS material classification were carried out for each soil sample collected, according to the definitions and methods presented in Section 1.3 and Section 2.4 respectively. A summary of acidification potential and ASS material classification is presented in Table 12-1.

Acidification hazard assessment and ASS subtype classification were carried out for each soil profile collected. ASS subtype classification was achieved using the methods described in Appendix 2. Acidification hazard assessment was based on: (i) landscape position (Figure 12-1), (ii) soil morphology (Section 12.2), (iii) acid-base accounting (Figure 12-3), (iv) pH data (Figure 12-3), (v) acidification potential (Table 12-1) and (vi) ASS material and subtype classification (Table 12-1). Acidification hazard categories were: (i) very low, (ii) low, (iii) medium and (iv) high. A summary of ASS subtype classification and acidification hazard for each profile collected between October 2010 and June 2012 is presented in Table 12-1.

Soil profiles at Loveday Bay generally comprised hypersulfidic and sulfuric soil with medium and high acidification hazard ratings (Table 12-1). Drought (2007 to 2009) and the subsequent drying of Loveday Bay (postulated to have occurred between summer 2007 and summer 2009) caused hypersulfidic subaqueous soil to transform to sulfuric soil. Subsequent rewetting resulted in this sulfuric soil transforming to sulfuric subaqueous soil overlain by acidic water. A second period of drying resulted in this material transforming back to sulfuric soil. Inundation, following winter 2010, promoted the formation of hypersulfidic subaqueous soil.

Profiles collected at sites LF12-A and LF12-C (Figure 12-1) were classified as sulfuric soil with high acidification hazard ratings (Table 12-1). They generally had positive net acidity, little or no ANC, moderate to high TAA, S_{CR} and RA and medium to high acidification potential (Figure 12-3; Table 12-1). During drought conditions, acidity within surface sediments (i.e. < 25 cm deep) was dominated by TAA (Figure 12-3). Following reflooding, acidity was dominated by S_{CR} (Figure 12-3). Hence, reflooding seems to have caused some flushing of acidity (H^+) from surface sediments and encouraged reducing conditions and sulfate reduction, resulting in the formation of hypersulfidic subaqueous soils (Table 12-2).

Profiles collected at site LF12-B were classified as hyposulfidic and hypersulfidic soil with medium acidification hazard ratings (Figure 12-3; Table 12-1). They generally had positive net acidity, little or no ANC, low to moderate TAA and S_{CR} and medium to high acidification potential (Figure 12-3; Table 12-1). At the time of Sampling-a, there was a thin red surface layer of clay that contained high NA (Figure 12-2; Figure 12-3). This layer had been physically eroded by the time of Sampling-b (Figure 12-3). Reflooding had no significant impact upon this site, acidity was dominated by S_{CR} and soil material remained hypersulfidic with medium acidification hazard ratings (Table 12-2).

Overall, soil at Loveday Bay was considered to pose a high acidification hazard.

Table 12-1 Summary of acidification potential, ASS material classification, ASS subtype classification and acidification hazard (* indicates sulfuric soil material). The soil texture in brackets following the ASS subtype classification indicates the dominant texture of the profile

Sample	Sampling	Depth (cm)	pH$_{OX}$ < 2.5	pH$_{INC}$ < 4.0	NA > 0	Acidification potential	ASS material classification	ASS subtype classification	Acidification hazard
LF12-A									
LFa12-A.1	a	0-1	0	0	1	1	Hyposulfidic crust	Sulfuric subaqueous soil (clay)	High
LFa12-A.2	a	1-15	0	1	1	2*	Sulfuric sand		
LFa12-A.3	a	15-40	1	1	1	3	Hypersulfidic sandy clay		
LFa12-A.4	a	40-100	1	1	1	3	Hypersulfidic medium clay		
LFb12-A.1	b	0-0.5	0	1	1	2*	Sulfuric crust	Sulfuric soil (clay)	High
LFb12-A.2	b	0.5-1.5	0	1	1	2*	Sulfuric sand		
LFb12-A.3	b	1.5-7	1	1	0	2*	Sulfuric loamy sand		
LFb12-A.4	b	7-23	1	1	1	3*	Sulfuric loamy sand		
LFb12-A.5	b	23-50	1	1	1	3	Hypersulfidic sandy clay		
LFb12-A.6	b	50-100	1	1	1	3	Hypersulfidic sandy clay		
LFc12-A.1	c	0-9	1	1	1	3	Loamy sand	Hypersulfidic subaqueous soil (clay)	High
LFc12-A.2	c	9-17	1	1	1	3	Hypersulfidic loamy sand		
LFc12-A.3	c	17-37	0	1	1	2	Hypersulfidic sandy clay		
LFc12-A.4	c	37-58	1	1	1	3	Hypersulfidic sandy clay		
LFc12-A.5	c	58-74	0	1	1	2	Hypersulfidic clay		
LFd12-A.1	d	0-10	1	1	1	3	Hypersulfidic loamy sand	Hypersulfidic subaqueous clay soil (clay)	High
LFd12-A.2	d	10-18	1	1	1	3	Hypersulfidic sandy loam		
LFd12-A.3	d	18-30	1	1	1	3	Hypersulfidic sandy clay		
LFd12-A.4	d	30-47	1	1	1	3	Hypersulfidic sandy clay		
LFd12-A.5	d	47-76	1	1	1	3	Hypersulfidic clay		
LFe12-A.1	e	0-8	1	1	1	3	Hypersulfilidic loamy sand	Hypersulfidic subaqueous clay soil (clay)	High
LFe12-A.2	e	8-21	1	1	0	2	Hypersulfilidic loamy sand		
LFe12-A.3	e	21-33	1	1	1	3	Hypersulfilidic sandy clay		
LFe12-A.4	e	33-49	1	1	1	3	Hypersulfilidic sandy clay		
LFe12-A.5	e	49-72	1	1	1	3	Hypersulfilidic sandy clay		
LFf12-A.1	f	0-8	1	1	1	3	Hypersulfilidic loamy sand	Hypersulfidic subaqueous clay soil (clay)	High
LFf12-A.2	f	8-15	1	1	1	3	Hypersulfilidic loamy sand		
LFf12-A.3	f	15-33	1	1	1	3	Hypersulfilidic sandy clay		
LFf12-A.4	f	33-50	1	1	1	3	Hypersulfilidic sandy clay		
LFf12-A.5	f	50-71	1	1	1	3	Hypersulfilidic fine sandy clay		
LFf12-A.6	f	71-84	1	1	1	3	Hypersulfilidic heavy clay		
LF12-B									
LFa12-B.1	a	0-2	0	0	1	1	Hyposulfidic clay	Hypersulfidic subaqueous clay soil (sand)	Medium
LFa12-B.2	a	0-2	0	1	1	2	Hyposulfidic clay		
LFa12-B.3	a	2-16	0	0	1	1	Hyposulfidic sand		
LFa12-B.4	a	16-25	0	0	0	0	Hyposulfidic sand		
LFb12-B.1	b	0-10	0	0	1	1	Hyposulfidic sand	Hypersulfidic soil (sand)	Medium
LFb12-B.2	b	10-35	0	0	0	0	Hyposulfidic loamy sand		
LFb12-B.3	b	35-40	1	1	1	3	Hypersulfidic sand		
LFb12-B.4	b	40-60	1	1	1	3	Hypersulfidic sandy clay		
LFc12-B.1	c	0-12	0	0	0	0	Loamy sand	Hypersulfidic subaqueous clay soil (clay)	Medium
LFc12-B.2	c	12-32	0	1	1	2	Hypersulfidic loamy sand		
LFc12-B.3	c	32-63	1	1	1	3	Hypersulfidic sandy clay loam		
LFc12-B.4	c	63-76	1	1	1	3	Hypersulfidic clay		
LFd12-B.1	d	0-10	0	0	1	1	Sand	Hypersulfidic subaqueous clay soil (clay)	Medium
LFd12-B.2	d	10-26	0	1	1	2	Hypersulfidic loamy sand		
LFd12-B.3	d	26-35	1	1	1	3	Hypersulfidic loamy sand		
LFd12-B.4	d	35-70	1	1	1	3	Hypersulfidic clay		
LFe12-B.1	e	0-10	0	1	1	2	Hypersulfilidic sand	Hypersulfidic subaqueous clay soil (clay)	Medium
LFe12-B.3	e	12-38	0	1	0	1	Hypersulfilidic medium clay		
LFe12-B.4	e	38-60	1	1	1	3	Hypersulfilidic loamy sand		
LFe12-B.5	e	60-74	1	1	1	3	Hypersulfilidic sandy clay loam		
LFf12-B.1	f	0-9	0	0	1	1	Hyposulfidic loamy sand	Hypersulfidic subaqueous soil (sand)	Medium
LFf12-B.2	f	9-15	0	1	1	2	Hypersulfilidic organic loamy clay		
LFf12-B.3	f	15-30	0	0	1	1	Hyposulfidic loamy sand		
LFf12-B.4	f	30-43	0	1	0	1	Loamy sand		
LFf12-B.5	f	43-67	1	1	1	3	Hypersulfilidic loamy sand		
LFf12-B.6	f	67-84	1	1	1	3	Hypersulfilidic sandy clay loam		
LF12-C									
LFa12-C.1	a	0-0.5	0	1	1	2*	Sulfuric crust	Sulfuric soil (sand)	High
LFa12-C.2	a	0.5-10	0	1	1	2*	Sulfuric sand		
LFa12-C.3	a	10-40	0	1	1	2*	Sulfuric sand		
LFa12-C.4	a	40-60	0	1	1	2*	Sulfuric sand		
LFa12-C.5	a	60-80	0	1	1	2	Hypersulfidic sand		
LFb12-C.1	b	0-10	0	1	1	2*	Sulfuric sand	Sulfuric soil (sand)	High
LFb12-C.2	b	10-23	0	1	1	2*	Sulfuric sand		
LFb12-C.3	b	23-36	0	1	1	2*	Sulfuric sand		
LFb12-C.4	b	36-48	1	1	1	3*	Sulfuric loamy sand		
LFb12-C.5	b	48-80	1	1	1	3	Hypersulfidic loamy sand		

LFc12-C.1	c	0-11	0	1	1	2	Loamy sand	Hypersulfidic subaqueous soil (sand)	Medium
LFc12-C.2	c	11-36	1	1	1	3	Loamy sand		
LFc12-C.3	c	36-50	1	1	1	3	Hypersulfidic loamy sand		
LFc12-C.4	c	50-66	1	1	1	3	Hypersulfidic loamy sand		
LFd12-C.1	d	0-12	1	1	1	3	Hypersulfidic loamy sand	Hypersulfidic subaqueous soil (sand)	High
LFd12-C.2	d	12-34	1	1	1	3	Loamy sand		
LFd12-C.3	d	34-50	1	1	1	3	Hypersulfidic loamy sand		
LFd12-C.4	d	50-64	1	1	1	3	Hypersulfidic loamy sand		
LFe12-C.1	e	0-13	0	1	0	1	Loamy sand	Hypersulfidic subaqueous soil (sand)	Medium
LFe12-C.2	e	13-32	0	1	1	2	Loamy sand		
LFe12-C.3	e	32-45	0	1	1	2	Loamy sand		
LFf12-C.1	f	0-10	0	1	1	2	Loamy sand	Hypersulfidic subaqueous soil (sand)	Medium
LFf12-C.2	f	10-40	1	1	1	3	Loamy sand		
LFf12-C.3	f	40-77	1	1	1	3	Hypersufilidic loamy sand		

Table 12-2 Summary of temporal and spatial variations and changes in ASS subtypes at each site (**A, B and C**). Note: (i) Cells shaded orange summarise data presented within this report, (ii) Cells shaded green represent a period of during which it is postulated that drying occurred that resulted in the formation of Sulfuric soil at these sites (iii) all other cells are based on/extrapolated from data presented in Fitzpatrick *et al.* (2010a; 2008a; 2008b; 2009b; 2008c) and (iii) cells bordered in blue indicate subaqueous conditions

Loveday Bay Sites		Pre-drought Winter 2007 (h1)	Postulated period of drying between summer 2007 summer 2009	Drought Summer 2009 (h2)	Drought End winter 2009 (a)	Drought End summer 2010 (b)	Post drought Summer 2011 (c)	Post drought Winter 2011 (d)	Post-drought start summer 2011/12 (e)	Post-drought start winter 2011/12 (f)	Summary
LF12-A	[1]Classification & [2]Acid hazard	Hypersulfidic subaqueous (H)	Sulfuric (H)	Sulfuric subaqueous (H)	Sulfuric subaqueous (H)	Sulfuric* (H)	Hypersulfidic subaqueous (H)	Hypersulfidic subaqueous clay (H)	Hypersulfidic subaqueous clay (H)	Hypersulfidic subaqueous clay (H)	During the extreme drought period (2007 to 2009) the drying of Loveday Bay (postulated to have occurred between summer 2007 and summer 2009) caused Hypersulfidic subaqueous soil to transform to Sulfuric soil. Subsequent rewetting resulted in this Sulfuric soil transforming to Sulfuric subaqueous soil overlain by acidic water. A second period of drying resulted in this material transforming to Sulfuric soil. Inundation, following winter 2010, caused the formation of Hypersulfidic subaqueous soil.
	Dominant water and ASS process	UW & Sulfide	LW & Sulfuric	RW & Sulfuric	UW & Sulfuric	LW & Sulfuric	RW & Sulfide	UW & Sulfide	UW & Sulfide	UW & Sulfide	
LF12-B	[1]Classification & [2]Acid hazard	Hypersulfidic subaqueous (M)	Hypersulfidic (M)	Hypersulfidic subaqueous (M)	Hypersulfidic subaqueous (M)	Hypersulfidic (M)	Hypersulfidic subaqueous clay (M)	Hypersulfidic subaqueous clay (M)	Hypersulfidic subaqueous clay (M)	Hypersulfidic subaqueous clay (M)	During the extreme drought period (2007 to 2009) the drying of Loveday Bay (postulated to have occurred between summer 2007 and summer 2009) caused Hypersulfidic subaqueous soil to transform to Hypersulfidic soil. Subsequent rewetting resulted in this Hypersulfidic soil transforming to Hypersulfidic subaqueous soil overlain by acidic water. A second period of drying resulted in this material transforming to Hypersulfidic soil. Inundation, following winter 2010, caused the formation of Hypersulfidic subaqueous soil.
	Dominant water and ASS process	UW & Sulfide	LW & Sulfide	RW & Sulfide	UW & Sulfide	LW & Sulfide	RW & Sulfide	UW & Sulfide	UW & Sulfide	UW & Sulfide	
LF12-C	[1]Classification & [2]Acid hazard	Hypersulfidic subaqueous (H)	Sulfuric (H)	Sulfuric (H)	Sulfuric* (H)	Sulfuric (H)	Hypersulfidic subaqueous (M)	Hypersulfidic subaqueous (H)	Hypersulfidic subaqueous (M)	Hypersulfidic subaqueous (M)	During the extreme drought period (2007 to 2009) the drying of Loveday Bay caused Hypersulfidic subaqueous soil to transform to Sulfuric soil. Inundation, following winter 2010, caused the formation of Hypersulfidic subaqueous soil.
	Dominant water and ASS process	UW & Sulfide	LW & Sulfuric	LW & Sulfuric	LW & Sulfuric	LW & Sulfuric	RW & Sulfide	UW & Sulfide	UW & Sulfide	UW & Sulfide	

[1] **Classification – Acid Sulfate Soil subtype classification**
[2] **Acid hazard – Acidification hazard: H = High; M = medium; L = Low; VL = Very Low**
Dominant Water process
LW – Lowering water level regime to expose soil to air due to drought conditions and water evaporation
UW – Unchanged water regime, which had not yet evaporated to expose soil to air
RW – Rising water level regime to inundate and saturate soils by reflooding (e.g. due to pumping, regulator installation, river flow and groundwater)
RF – Rain fall rewetting and natural reflooding to inundate and saturate soils

Dominant ASS – process
Sulfuric – Sulfuricization - oxidation of pyrite in hypersulfidic material due to onset of aerobic conditions to form sulfuric material
Sulfuric* – As above with acidic minerals and/or salt efflorescences noted (i.e. measurable RA)
Sulfide – Sulfidization due to sulfide accumulation to form hypersulfidic material
Monosulfide – Monosulfidization due to monosulfide accumulation to form monosulfidic material
Leach – Leaching of acid from soil by winter rain fall
Sulfuric **subaqueous** with **overlying circa neutral water** pH >4: = font coloured blue or default
Sulfuric **subaqueous** soil with **overlying acid water** pH <4: = font coloured red
Where h1 to h3 = historical sampling; (a) – (b) sampling conducted in this project

13. LF13 – TAUWITCHERE

Summary

Overall, soil at Tauwitcherie was considered to pose a low acidification hazard.

During drought conditions, profiles collected in the reeds were classified as sulfuric soil with high acidification hazard ratings. Following reflooding, in October 2010, the net acidity of surface sediments changed from positive to negative and soil material transformed from sulfuric to hyposulfidic subaqueous. This may be the result of the extreme heterogeneity of the reed bed (i.e. distribution of organic matter) or flushing of acidity (H^+) from surface sediments and/or the onset of reducing conditions and subsequent sulfate reduction.

13.1 Background

Study area LF13 was located at the southern extent of Lake Alexandrina, on the northern side of the Tauwitchere Barrage (Figure 1-1). As part of this study, sampling was carried out in December 2011 and June 2012 (Samplings-e/f). Previous samplings were undertaken in May and June 2011 (Sampling-d), January and February 2011 (Sampling-c), March 2010 (Sampling-b) and November 2009 (Sampling-a). Additionally, data from historic sampling (Sampling-h_1), carried out in February 2008, were reassessed as part of this study. Sampling site locations are displayed in Figure 13-1.
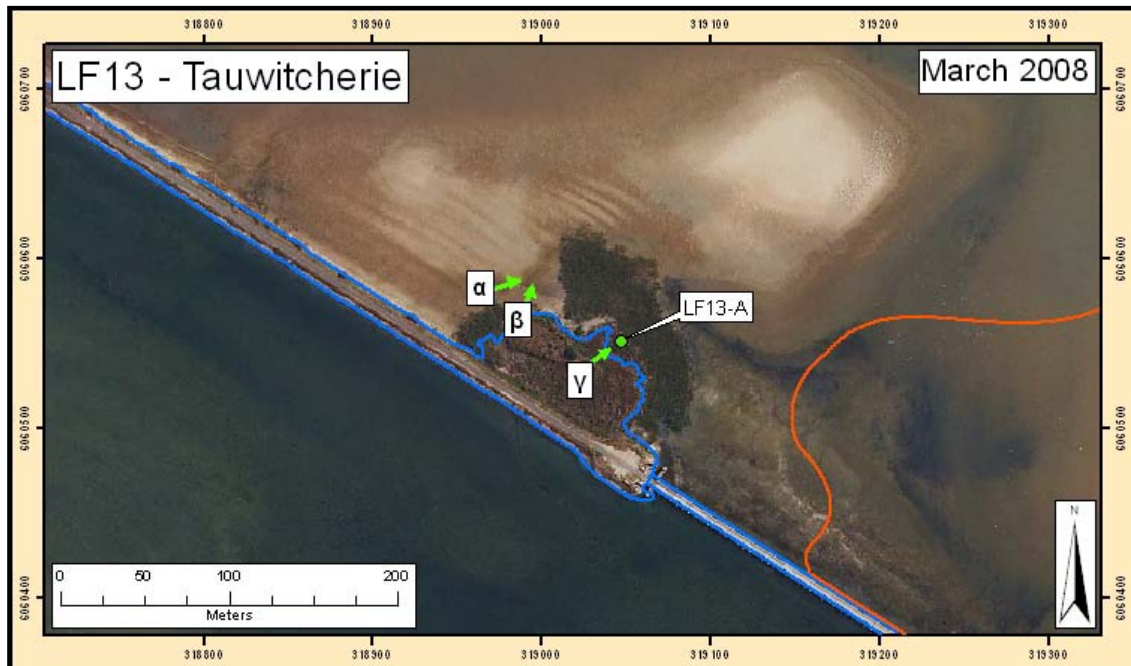
Figure 13-1 Sample location map. Aerial photograph taken in March 2008 (Orange line: sampling-a & b water level, Blue line: sampling-c, d, e & f water level)

At the time of Sampling-c/d/e, the lake level had risen to approximately 0.65 m AHD respectively and the study area had been completely re-flooded (Figure 13-1: Figure 13-2). Prior to this, at the time of the historic sampling in February 2008 (Sampling-h_1), the lake level was low and the study area to the north of the Tauwitchere Barrage comprised a reed bed and an area of dry, desiccated lakebed (Figure 13-2). By November 2009 (Sampling-a) the lakebed around the reed bed had been revegetated (Figure 13-2). No significant changes were noted in March 2010 (Sampling-b).

α (h₁) - February 2008

β (a) - November 2009

γ (b) - March 2010

β (c) - February 2011

β (d) - June 2011

γ (e) - December 2011

β (f) – June 2012
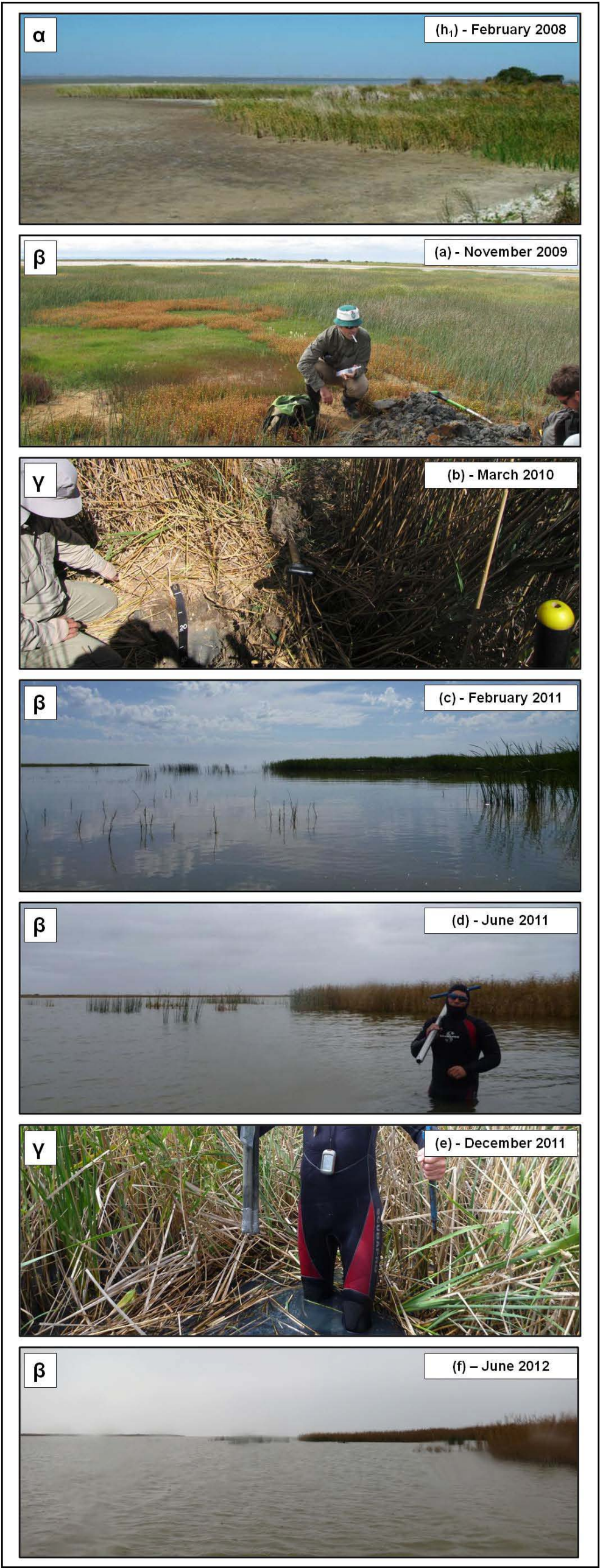
Figure 13-2 Site photographs. Refer to Figure 13-1 for the location and direction that photographs were taken, indicated by α, β or γ (photographs were selected that best depicted the environmental conditions at the study area during each sampling)

13.2 Soils

Soils at Tauwitchere generally comprised sulfuric sand hyposulfidic sand. A summary of encountered soils is provided below and site locations are presented in Figure 13-1. Detailed profile descriptions are presented in Appendix 4 and Appendix 8. Profile photographs are presented in Appendix 5.

LF13-A
During previous studies, when the study area was dry, profiles were collected at this site on three occasions (Samplings-h_1/a/b). The historic sampling encountered a 1 cm thick pale grey crust (possibly dried MBO). Underlying this, to a depth of 10 cm, was a peaty root mat with inclusions of grey clay. From 10 to 25 cm was peaty grey clay. Underlying this, to a depth of 40 cm, was yellow grey saturated sand with many live roots. This was underlain, to the maximum extent of investigation (60 cm), by dark grey sand. Sampling-a encountered 13 cm of grey fibric silty clay root mat with yellow jarosite mottles. Underlying this, to a depth of 18 cm, was brownish grey loamy sand with jarosite mottles. Underlying this, to the maximum extent of investigation (50 cm), was grey loamy sand with shell fragments and coarse roots. Sampling-b encountered 12 cm of grey fibric silty clay root mat with red brown mottles. Underlying this, to a depth of 20 cm, was brown loamy sand with common fine roots. Underlying this, to the maximum extent of investigation (50 cm), was grey sand with shell fragments and coarse roots.

When water levels rose and the study area became inundated (Samplings-c/d), a UWS was used to collect subaqueous soil profiles on two occasions. The investigations encountered 10 and 12 cm of black fibric peat with bands of black sand and many roots. This was underlain, to depths of 35 and 36 cm, by grey silty, loamy sand with prominent black mottles, common roots and common shell fragments. Underlying this, to a depth of 50 cm, was grey sand with shell fragments and coarse roots.

As part of this study, a UWS was used to collect subaqueous soil profiles (Samplings-e). The investigations encountered 12 to 13 cm of black monosulfidic fibric peaty material with coarse and fine phragmites roots. This was underlain, to depths of 22 to 31 cm, by dark to very dark grey loamy sand with black mottles, phragmites roots and shell fragments in Sampling-e. Underlying this, to depths of 40 to 47 cm, was dark grey loamy sand with common shell fragments. This was underlain, to the maximum extent of investigation (50 and 65 cm), by dark to dark grey sandy clay loam with few shell fragments.

13.3 Soil acidity and acid-base accounting

Acid-base accounting was carried out according to the methods described in Section 2.3. Acid-base accounting and pH data (pH_{OX}, pH_{INC} & pH_W), for each soil layer, are presented in Figure 13-3. These data were used to inform the acidification hazard assessment that is presented in Table 13-1.
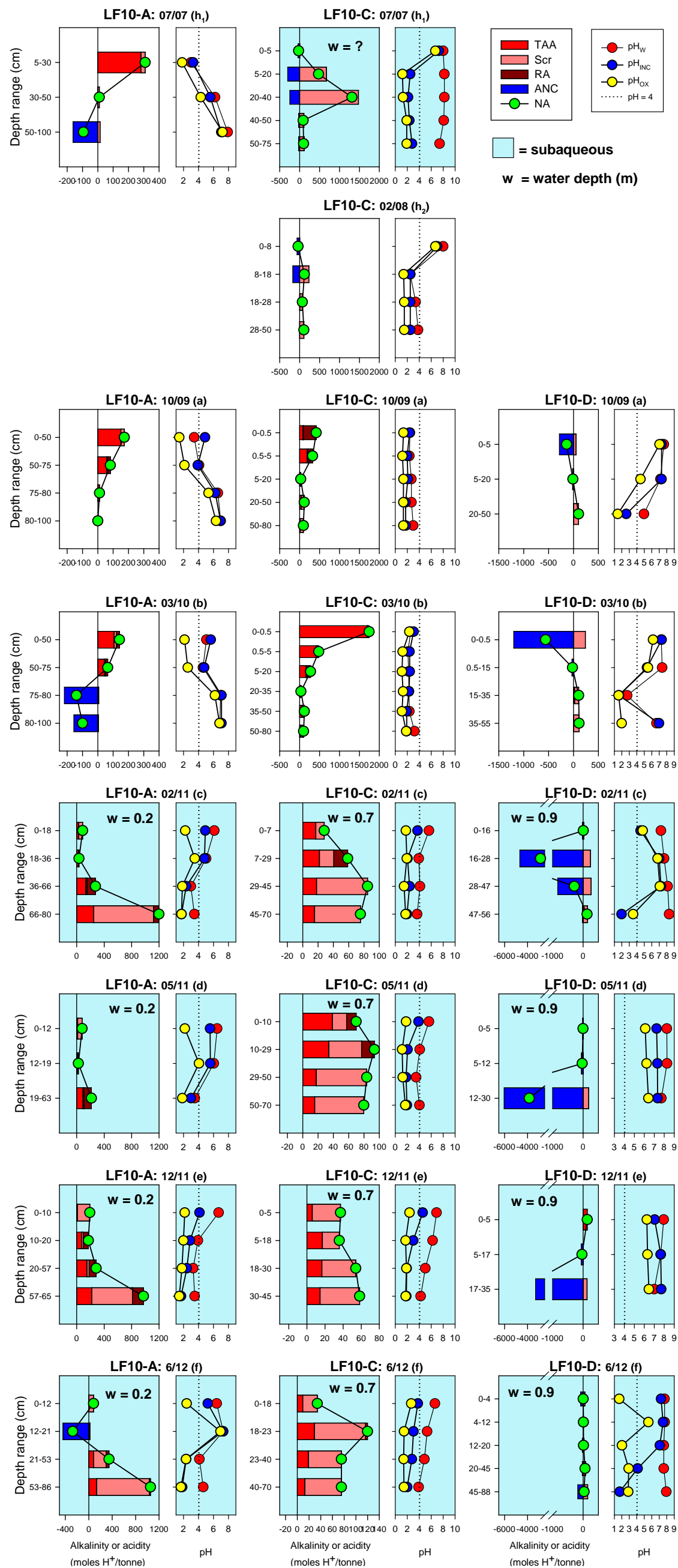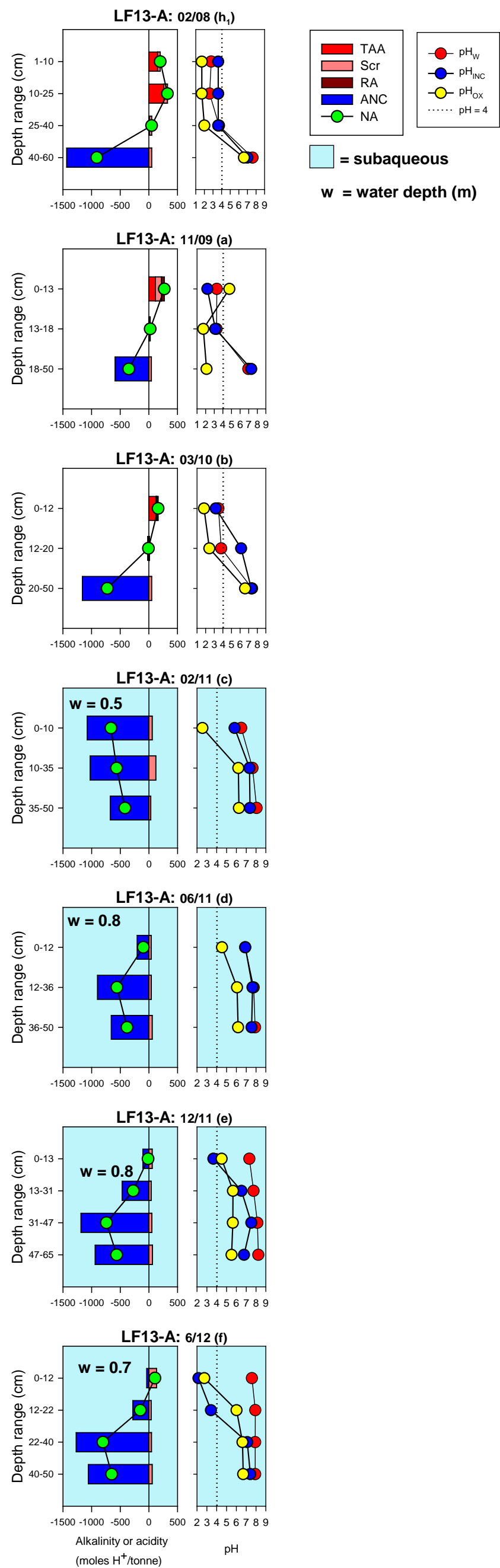
Figure 13-3 pH and acid-base accounting data plotted against depth for each profile collected

13.4 Summary and discussion

Acidification potential assessment and ASS material classification were carried out for each soil sample collected, according to the definitions and methods presented in Section 1.3 and Section 2.4 respectively. A summary of acidification potential and ASS material classification is presented in Table 13-1.

Acidification hazard assessment and ASS subtype classification were carried out for each soil profile collected. ASS subtype classification was achieved using the methods described in Appendix 2. Acidification hazard assessment was based on: (i) landscape position (Figure 13-1), (ii) soil morphology (Section 13.2), (iii) acid-base accounting (Figure 13-3), (iv) pH data (Figure 13-3), (v) acidification potential (Table 13-1) and (vi) ASS material and subtype classification (Table 13-1). Acidification hazard categories were: (i) very low, (ii) low, (iii) medium and (iv) high. A summary of ASS subtype classification and acidification hazard for each profile collected between February 2008 and June 2012 is presented in Table 13-1.

Soil profiles at Tauwitcherie generally comprised hyposulfidic and sulfuric soil with very low to high acidification hazard ratings (Table 13-1). During drought conditions, profiles collected in the reeds (LF13-A; Figure 13-1) were classified as sulfuric soil with high acidification hazard ratings (Table 13-1). The upper portion of the profiles (above 20 cm) generally had positive net acidity, little or no ANC, moderate TAA, S_{CR} and RA and medium to high acidification potential (Figure 13-3; Table 13-1). The lower portion of the profiles had negative net acidity, very high levels of ANC, low TAA and S_{CR} and very low acidification potential (Figure 13-3; Table 13-1). Following reflooding, in October 2010, the net acidity of surface sediments changed from positive to negative and soil material transformed from sulfuric to hyposulfidic subaqueous (Figure 13-3). This may be the result of the extreme heterogeneity of the reed bed (i.e. distribution of organic matter) or flushing of acidity (H^+) from surface sediments and/or the onset of reducing conditions and subsequent sulfate reduction.

Overall, soil at Tauwitcherie was considered to pose a low acidification hazard.

Table 13-1 Summary of acidification potential, ASS material classification, ASS subtype classification and acidification hazard (* indicates sulfuric soil material). The soil texture in brackets following the ASS subtype classification indicates the dominant texture of the profile

Sample	Sampling	Depth (cm)	pH$_{OX}$ < 2.5	pH$_{INC}$ < 4.0	NA > 0	Acidification potential	ASS material classification	ASS subtype classification	Acidification hazard
LF13-A									
AA 33.2	h$_1$	1-10	1	1	1	3*	Sulfuric peat		
AA33.3	h$_1$	10-25	1	1	1	3*	Sulfuric clay	Sulfuric clay soil	High
AA 33.4	h$_1$	25-40	1	1	1	3*	Sulfuric sand	(sand)	
AA 33.5	h$_1$	40-60	0	0	0	0	Hyposulfidic sand		
LFa13-A.1	a	0-13	0	1	1	2*	Sulfuric silty clay	Sulfuric soil	
LFa13-A.2	a	13-18	1	1	1	3*	Sulfuric loamy sand	(sand)	High
LFa13-A.3	a	18-50	1	0	0	1	Hyposulfidic loamy sand		
LFb13-A.1	b	0-12	1	1	1	3*	Sulfuric silty heavy clay	Sulfuric soil	
LFb13-A.2	b	12-20	1	0	0	1*	Sulfuric loamy sand	(sand)	High
LFb13-A.3	b	20-50	0	0	0	0	Hyposulfidic loamy sand		
LFc13-A.1	c	0-10	0	0	0	0	Hyposulfidic fibric peat	Hyposulfidic	
LFc13-A.2	c	10-35	0	0	0	0	Hyposulfidic silty sand	subaqueous soil	Low
LFc13-A.3	c	35-50	0	0	0	0	Hyposulfidic silty sand	(sand)	
LFd13-A.1	d	0-12	0	0	0	0	Hyposulfidic peaty sand	Hyposulfidic	
LFd13-A.2	d	12-36	0	0	0	0	Hyposulfidic loamy sand	subaqueous soil	Low
LFd13-A.3	d	36-50	0	0	0	0	Hyposulfidic sandy loam	(sand)	
LFe13-A.2	e	0-13	0	1	0	1	Hypersufilidic fibric peat	Hyposulfidic	
LFe13-A.3	e	13-31	0	0	0	0	Hyposulfidic loamy sand	subaqueous soil	Low
LFe13-A.4	e	31-47	0	0	0	0	Hyposulfidic loamy sand	(sand)	
LFe13-A.5	e	47-65	0	0	0	0	Hyposulfidic sandy clay loam		
LFf13-A.1	f	0-12	0	1	1	2	Hypersufilidic fibric peat	Hypersulfidic	
LFf13-A.2	f	12-22	0	1	0	1	Hypersufilidic loamy sand	subaqueous	
LFf13-A.3	f	22-40	0	0	0	0	Hyposulfidic loamy sand	organic soil	Low
LFf13-A.4	f	40-50	0	0	0	0	Hyposulfidic loamy sand	(sand)	

Table 13-2 Summary of temporal and spatial variations and changes in ASS subtypes. Note: (i) Cells shaded orange summarise data presented within this report, (ii) all other cells are based on/extrapolated from data presented in Fitzpatrick *et al.* (2008a; 2008b; 2009b; 2008c) and (iii) cells bordered in blue indicate subaqueous

Tauwitchere Sites		Drought Summer 2008 (h₁)	Drought End winter 2009 (a)	Drought End summer 2010 (b)	Post drought Summer 2011 (c)	Post drought Winter 2011 (d)	Post-drought start summer 2011/12 (e)	Post-drought start winter 2011/12 (f)	Summary
LF13-A	¹Classification & ²Acid hazard	Sulfuric clay (H)	Sulfuric* (H)	Sulfuric* (H)	Hyposulfidic subaqueous (L)	Hyposulfidic subaqueous (L)	Hyposulfidic subaqueous (L)	Hypersulfidic subaqueous (L)	During the extreme drought period (2007 to 2009) soil remained Sulfuric. Inundation, following winter 2010, caused the formation of Hypersulfidic and Hyposulfidic subaqueous soil.
	Dominant water and ASS process	LW & Sulfuric	LW & Sulfuric	LW & Sulfuric	RW & Sulfide	UW & Sulfide	UW & Sulfide	UW & Sulfide	

¹ **Classification – Acid Sulfate Soil subtype classification**
² **Acid hazard – Acidification hazard: H = High; M = medium; L = Low; VL = Very Low**
Dominant Water process
LW – Lowering water level regime to expose soil to air due to drought conditions and water evaporation
UW – Unchanged water regime, which had not yet evaporated to expose soil to air
RW – Rising water level regime to inundate and saturate soils by reflooding (e.g. due to pumping, regulator installation, river flow and groundwater)
RF – Rain fall rewetting and natural reflooding to inundate and saturate soils

Dominant ASS – process
Sulfuric – Sulfuricization - oxidation of pyrite in hypersulfidic material due to onset of aerobic conditions to form sulfuric material
Sulfuric* – As above with acidic minerals and/or salt efflorescences noted (i.e. measurable RA)
Sulfide – Sulfidization due to sulfide accumulation to form hypersulfidic material
Monosulfide – Monosulfidization due to monosulfide accumulation to form monosulfidic material
Leach – Leaching of acid from soil by winter rain fall
Sulfuric **subaqueous** with **overlying circa neutral water** pH >4: = font coloured blue or default
Sulfuric **subaqueous** soil with **overlying acid water** pH <4: = font coloured red
Where h₁ to h₃ = historical sampling; (a) – (b) sampling conducted in this project

14. LF15 – BOGGY CREEK

Summary

Overall, soil at Boggy Creek was considered to pose a high acidification hazard.

Profiles collected within the dry creek bed were classified as sulfuric and hypersulfidic clay soil with high acidification hazard ratings. During drought conditions, the upper portion of each profile (above 35 to 45 cm) comprised sulfuric soil with moderate to high net acidity and no ANC. Following reflooding, in September 2010, there was a significant decrease of acidity in surface sediments that was most likely caused by surface water flushing. As a result, these profiles transformed from sulfuric to hypersulfidic subaqueous. It should be noted that the acidification hazard of these soil materials remained high.

14.1 Background

Study area LF15 was located in Boggy Creek, a tributary of Holmes Creek that forms the eastern boundary of Hindmarsh Island (Figure 1-1). As part of this study, sampling was carried out in November 2011 and June 2012 (Samplings-e/f). Previous samplings were undertaken in May and June 2011 (Sampling-d), January and February 2011 (Sampling-c), March 2010 (Sampling-b) and November 2009 (Sampling-a). Additionally, data from historic sampling (Sampling-h_1), carried out in July 2009, were reassessed as part of this study. Sampling site locations are displayed in Figure 14-1.
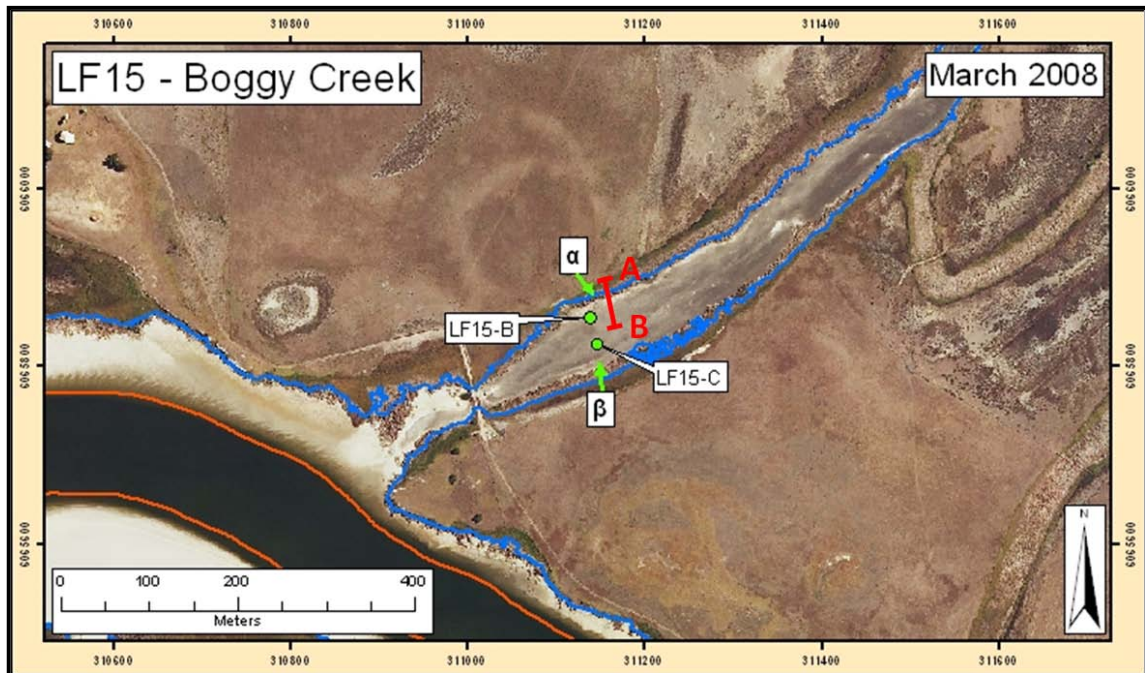
Figure 14-1 Sample location map. Aerial photograph taken in March 2008 (Orange line: sampling-a & b water level, Blue line: sampling-c, d, e & f water level). Red line indicates cross section presented in Section 22.5

At the time of Samplings-c/d/e, the lake level had risen to approximately 0.75 m AHD and Boggy Creek had completely refilled (Figure 14-1: Figure 14-2). Prior to this, the study area comprised a dried creek bed with a mixture of rushes and mixed grasses along the banks and was bounded by open fields (Figure 14-1). At the time of the historic sampling (Sampling-h_1) in July 2009, the creek bed was moist in places and ponded water was noted upstream of the study area (Figure 14-2). In October 2009 and March 2010 (Samplings-a/b) the creek was completely dry and there was no evidence of ponded water. No other significant changes were noted in the study area during the monitoring period.
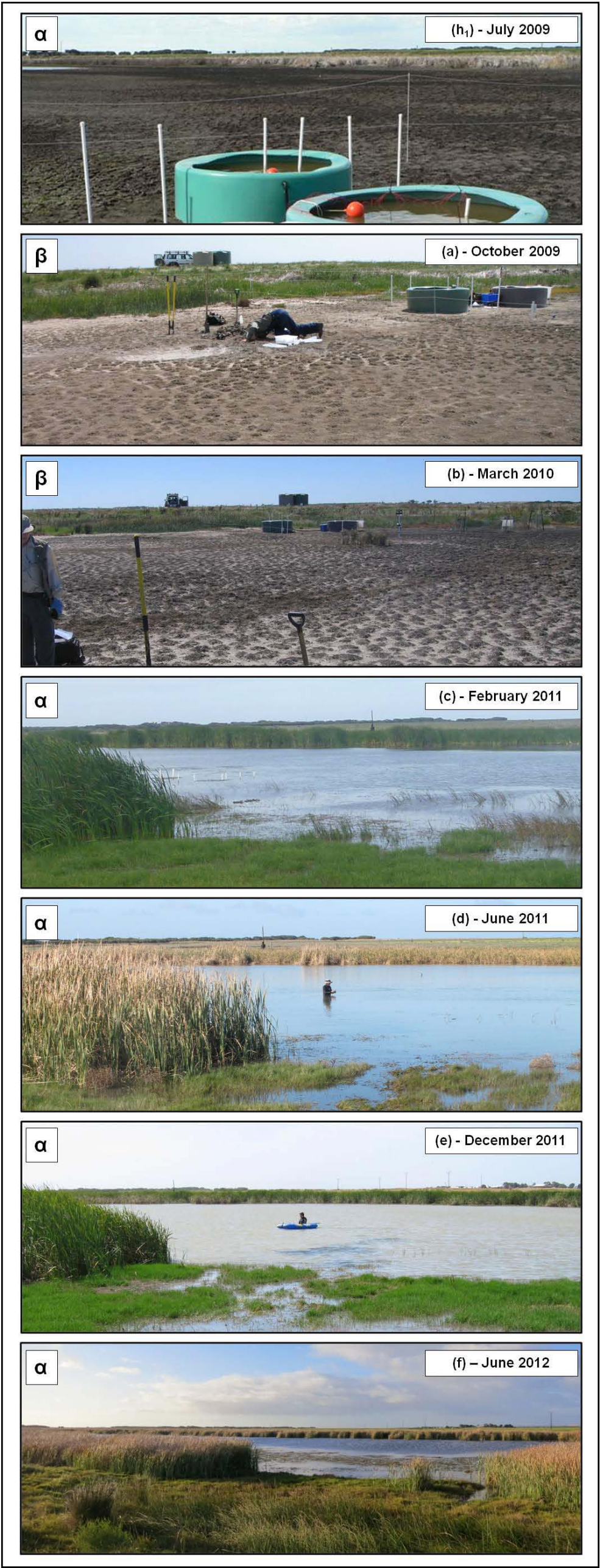
Figure 14-2 Site photographs. Refer to Figure 14-1 for the location and direction that photographs were taken, indicated by α or β (photographs were selected that best depicted the environmental conditions at the study area during each sampling)

14.2 S oils

Soils at Boggy Creek generally comprised: (i) LF15-A: hyposulfidic clay, (ii) LF15-B: sulfuric and hypersulfidic sand over hyposulfidic sand and (iii) LF15-C: sulfuric and hypersulfidic clay. A summary of encountered soils is provided below and site locations are presented in Figure 14-1. Detailed profile descriptions are presented in Appendix 4 and Appendix 8. Profile photographs are presented in Appendix 5.

LF15-B
During previous studies, when the study area was dry, profiles were collected at this site on three occasions (Samplings-h_1/a/b). The historic sampling encountered 3 cm of black fine sandy clay loam with algae on surface and MBO in cracks. Underlying this, to a depth of 15 cm, was greyish brown sandy clay loam. Between 15 and 20 cm was dark greyish brown fine sandy clay, which was underlain, to a depth of 30 cm, by light olive grey light clay with yellow mottles. From 30 to 38 cm was greyish brown light clay with yellow mottles. This was underlain, to a depth of 80cm, by grey fine clayey sand with clay lenses. From 80 to 100 cm was olive grey fine clayey sand with few large shells, calcrete fragments and clay lenses. This was underlain, to the maximum extent of investigation (180 cm), by grey fine clayey sand with few large shell fragments and clay lenses. Sampling-a encountered 5 cm of fluffy brown sandy clay, which was underlain, to a depth of 20 cm, by light brown sand with lenses of soft grey sandy clay. From 20 to 25 cm was grey sandy clay with light yellow mottles associated with root voids that were infilled with sand. Underlying this, was light brown sandy clay with red orange mottles associated with root voids. This was underlain, to the maximum extent of investigation (70 cm), by grey clayey sand. Sampling-b encountered 5 cm of fluffy brown sandy clay, which was underlain, to a depth of 15 cm, by greyish brown sand with some darker and lighter mottles. Between 15 and 20 cm was grey brown sandy clay with pale yellow mottles. Underlying this, to a depth of 30 cm, was greyish brown sandy clay with pale yellow jarosite mottles and bluish grey mottles and red coarse mottles in root channels. Between 30 and 45 cm was grey to dark grey sandy loam with distinct yellow brown and olive mottles. This was underlain, to the maximum extent of investigation (70 cm), was blueish grey sandy clay with large diffuse black mottles and paler grey filled root channels.

When water levels rose and the study area became inundated (Samplings-c/d), a UWS was used to collect subaqueous soil profiles on two occasions. The investigations encountered 6 and 10 cm of black organic sand. This was underlain, to depths of 12 and 20 cm, by grey loamy sand with 10 % pale yellow mottles. Underlying this, to depths of 24 and 35 cm, was dark grey to grey sandy clay loam with 30 % distinct pale yellow mottles especially along old root channels. Underlying this, to depths of 60 and 55 cm, was dark grey sandy clay loam. Shell fragments and yellow mottles were noted during Sampling-c. Underlying this, to the maximum extent of investigation (80 and 68 cm), was dark grey sandy clay. Shell fragments were noted during Sampling-c but not during Sampling-d.

As part of this study, a UWS was used to collect subaqueous soil profiles (Samplings-e/f). Sampling-e encountered 7 cm of black sandy MBO gel. This was underlain, to a depth of 14 cm, by grey loamy sand with diffuse jarosite mottles. Underlying this, to a depth of 32 cm, was dark grey sandy loam with prominent jarosite mottles associated with root channels. This was underlain, to a depth of 39 cm, by dark grey sandy clay with diffuse yellow-brown mottles. This was underlain, to the maximum extent of investigation (84 cm), by dark grey sandy clay with fine shell fragments. Sampling-f encountered 2 cm of black monosulfidic sapric peat. This was underlain, to a depth of 12 cm, by dark grey loamy sand. Underlying this, to a depth of 27 cm, was olive grey sandy loam with prominent pale yellow jarosite mottles. This was underlain, to a depth of 54 cm, by dark grey sandy clay. Underlying this, to the maximum extent of investigation (82 cm), was dark grey sandy clay with clayey lenses.

LF15-C

During previous studies, profiles were collected at this site on two separate sampling occasions (Samplings-a/b). Sampling-a encountered 0.3 cm of white salt efflorescence, which was underlain, to a depth of 10 cm, by soft brown sandy clay with yellow and orange mottles. Between 10 and 20 cm was dark grey sand with fine to medium sand in root voids. Underlying this, to a depth of 30 cm, was grey clayey sand with few cracks infilled with light brown sandy clay with red brown centres. This was underlain, to the maximum extent of investigation (70 cm), by grey sandy clay. Sampling-b encountered 10 cm of grey brown sandy clay with coatings of gypsum and jarosite. This was underlain, to a depth of 20 cm, by brownish grey to grey heavy clay with pale yellow jarosite mottles associated with root channels and ped faces. Between 20 and 35 cm was pale brown sandy clay with diffuse yellow jarosite mottles and brownish red coatings on vertical ped faces. Underlying this, to a depth of 60 cm, was blueish grey sandy clay with yellow and pale brownish red mottles. This was underlain, to the maximum extent of investigation (70 cm), by grey sandy clay with small shell fragments.

When water levels rose and the study area became inundated (Samplings-c/d), a UWS was used to collect subaqueous soil profiles on two occasions. The investigations encountered 5 cm of black sandy clay. This was underlain, to a depth of 20 cm, by light olive grey clay with diffuse yellow mottles. Underlying this, to a depth of 38 cm, was grey clay with diffuse yellow mottles. Underlying this, to the maximum extent of investigation (70 cm), was dark grey sandy clay. Shell fragments were noted during Sampling-c but not during Sampling-d.

As part of this study, a UWS was used to collect subaqueous soil profiles (Samplings-e/f). Sampling-e encountered 14 cm of black sandy gel. This was underlain, to a depth of 34 cm, by light olive grey medium clay with distinct yellow mottles. Underlying this, to a depth of 60 cm, was grey heavy clay with prominent yellow and brownish yellow mottles. This was underlain, to the maximum extent of investigation (95 cm), by dark grey sandy clay with fine to medium shell fragments. Sampling-f encountered 8 cm of black heavy clay. This was underlain, to a depth of 17 cm, by light olive grey clay with diffuse yellow mottles. Underlying this, to a depth of 35 cm, was dark grey heavy clay with light olive grey mottles. This was underlain, to a depth of 62 cm, was dark grey to greenish grey sandy clay with few shell fragments. Underlying this, to the maximum extent of investigation (80 cm), was dark grey sandy clay with fine to medium shell fragments.

14.3 Soil acidity and acid-base accounting

Acid-base accounting was carried out according to the methods described in Section 2.3. Acid-base accounting and pH data (pH_{OX}, pH_{INC} & pH_W), for each soil layer, are presented in Figure 14-3. These data were used to inform the acidification hazard assessment that is presented in Table 14-1.

Figure 14-3 pH and acid-base accounting data plotted against depth for each profile collected

14.4 Summary and discussion

Acidification potential assessment and ASS material classification were carried out for each soil sample collected, according to the definitions and methods presented in Section 1.3 and Section 2.4 respectively. A summary of acidification potential and ASS material classification is presented in Table 14-1.

Acidification hazard assessment and ASS subtype classification were carried out for each soil profile collected. ASS subtype classification was achieved using the methods described in Appendix 2. Acidification hazard assessment was based on: (i) landscape position (Figure 14-1), (ii) soil morphology (Section 14.2), (iii) acid-base accounting (Figure 14-3) (iv) pH data (Figure 14-3), (v) acidification potential (Table 14-1) and (vi) ASS material and subtype classification (Table 14-1). Acidification hazard categories were: (i) very low, (ii) low, (iii) medium and (iv) high. A summary of ASS subtype classification and acidification hazard for each profile collected between July 2009 and June 2012 is presented in Table 14-1.

Soil profiles at Boggy Creek comprised hyposulfidic, hypersulfidic and sulfuric soil with low to high acidification hazard ratings (Table 14-1).

Profiles collected within the dry creek bed (LF15-B and LF15-C; Figure 14-1) were classified as sulfuric and hypersulfidic clay soil with high acidification hazard ratings (Table 14-1). During drought conditions, the upper portion of each profile (above 35 to 45 cm) comprised sulfuric soil with moderate to high net acidity and no ANC (Table 14-1). Acidity comprised a combination of RA, S_{CR} and TAA (Figure 14-3). At depth, soil profiles generally comprised hyposulfidic clayey sand with negative net acidity, high levels of ANC and moderate levels of TAA and S_{CR} (Figure 14-3; Table 14-1). Following reflooding, in September 2010, there was a significant decrease of acidity in surface sediments that was most likely caused by surface water flushing (Figure 14-3). As a result, these profiles transformed from sulfuric to hypersulfidic subaqueous (Table 14-2). It should be noted that the acidification hazard of these soil materials remained high (Table 14-1).

Overall, soil at Boggy Creek was considered to pose a high acidification hazard.

Table 14-1 Summary of acidification potential, ASS material classification, ASS subtype classification and acidification hazard (* indicates sulfuric soil material). The soil texture in brackets following the ASS subtype classification indicates the dominant texture of the profile

Sample	Sampling	Depth (cm)	pH$_{OX}$ < 2.5	pH$_{INC}$ < 4.0	NA > 0	Acidification potential	ASS material classification	ASS subtype classification	Acidification hazard
LF15-B									
BCM 1.1	h$_1$	0-3	1	1	1	3	Hypersulfidic sandy clay loam		
BCM 1.2	h$_1$	3-15	1	1	1	3*	Sulfuric sandy clay loam		
BCM 1.3	h$_1$	15-20	1	1	1	3*	Sulfuric sandy clay loam		
BCM 1.4	h$_1$	20-30	1	1	1	3*	Sulfuric light clay		
BCM 1.5	h$_1$	30-38	1	1	1	3*	Sulfuric light clay	Sulfuric clay soil (sand)	High
BCM 1.6	h$_1$	38-50	0	0	0	0	Hyposulfidic clayey sand		
BCM 1.7	h$_1$	50-60	0	0	0	0	Hyposulfidic clayey sand		
BCM 1.8	h$_1$	60-80	0	0	0	0	Hyposulfidic clayey sand		
BCM 1.9	h$_1$	80-100	0	0	0	0	Hyposulfidic clayey sand		
BCM 1.10	h$_1$	100-160	0	0	0	0	Hyposulfidic clayey sand		
LFa15-B.1	a	0-5	1	1	1	3*	Sulfuric sandy clay		
LFa15-B.2	a	5-20	1	1	1	3*	Sulfuric sandy clay		
LFa15-B.3	a	20-25	1	1	1	3*	Sulfuric sandy clay	Sulfuric clay soil (clay)	High
LFa15-B.4	a	25-35	1	1	1	3*	Sulfuric sandy clay		
LFa15-B.5	a	35-70	0	0	0	0	Hyposulfidic clayey sand		
LFb15-B.1	b	0-5	1	1	1	3*	Sulfuric loam		
LFb15-B.2	b	5-15	1	1	1	3*	Sulfuric sand		
LFb15-B.3	b	15-20	1	1	1	3*	Sulfuric sandy clay	Sulfuric clay soil (clay)	High
LFb15-B.4	b	20-30	1	1	1	3*	Sulfuric sandy clay		
LFb15-B.5	b	30-45	1	1	1	3*	Sulfuric sandy loam		
LFb15-B.6	b	45-70	0	0	0	0	Hyposulfidic sandy clay		
LFc15-B.1	c	0-6	1	0	1	2	Hyposulfidic sand		
LFc15-B.2	c	6-12	1	1	1	3	Hypersulfidic sand		
LFc15-B.3	c	12-24	1	1	0	2	Hypersulfidic sandy clay	Hypersulfidic subaqueous clay soil (clay)	High
LFc15-B.4	c	24-60	0	0	0	0	Hyposulfidic sandy loam		
LFc15-B.5	c	60-80	0	0	1	1	Hyposulfidic sandy clay		
LFd15-B.1	d	0-6	1	1	1	3	Hypersulfidic sandy gel		
LFd15-B.2	d	6-12	1	1	1	3	Hypersulfidic loamy sand		
LFd15-B.3	d	12-24	1	1	1	3	Hypersulfidic sandy loam	Hypersulfidic subaqueous clay soil (clay)	High
LFd15-B.4	d	24-60	0	0	0	0	Hyposulfidic sandy clay		
LFd15-B.5	d	60-80	0	0	0	0	Hyposulfidic sandy clay		
LFe15-B.1	e	0-7	0	1	1	2	Hypersufilidic gel		
LFe15-B.3	e	14-32	0	1	1	2	Hypersufilidic sandy loam	Hypersulfidic subaqueous clay soil (clay)	Medium
LFe15-B.5	e	39-60	0	0	0	0	Hyposulfidic sandy loam		
LFe15-B.6	e	60-84	0	0	0	0	Hyposulfidic sandy		
LFf15-B.2	f	2-12	0	1	1	2	Hypersufilidic loamy sand		
LFf15-B.3	f	12-27	0	1	1	2	Hypersufilidic sandy loam	Hypersulfidic subaqueous soil (clay)	Medium
LFf15-B.4	f	27-54	0	0	0	0	Hyposulfidic sandy clay		
LFf15-B.5	f	54-82	0	0	0	0	Hyposulfidic sandy clay		
LF15-C									
LFa15-C.1	a	0.3-10	1	1	1	3*	Sulfuric sandy clay		
LFa15-C.2	a	10-20	1	1	1	3*	Sulfuric sandy clay	Sulfuric clay soil (clay)	High
LFa15-C.3	a	20-30	1	1	1	3*	Sulfuric clayey sand		
LFa15-C.4	a	30-70	0	1	1	2	Hypersulfidic sandy clay		
LFb15-C.1	b	0-10	1	1	1	3*	Sulfuric sandy clay		
LFb15-C.2	b	10-20	1	1	1	3*	Sulfuric heavy clay	Sulfuric clay soil (clay)	High
LFb15-C.3	b	20-35	1	1	1	3*	Sulfuric sandy clay		
LFb15-C.4	b	35-60	1	1	1	3	Hypersulfidic sandy clay		
LFb15-C.5	b	30-70	0	0	0	0	Hyposulfidic sandy clay		
LFc15-C.1	c	0-5	1	1	1	3	Hypersulfidic sandy clay		
LFc15-C.2	c	5-20	1	1	1	3	Hypersulfidic clay		
LFc15-C.3	c	20-38	1	1	0	2	Hypersulfidic clay	Hypersulfidic subaqueous clay soil (clay)	High
LFc15-C.4	c	38-60	0	0	0	0	Hyposulfidic sandy clay		
LFc15-C.5	c	60-70	0	0	1	1	Hyposulfidic sandy clay		
LFd15-C.1	d	0-5	1	1	1	3	Hypersulfidic sandy gel		
LFd15-C.2	d	5-20	1	1	1	3	Hypersulfidic clay		
LFd15-C.3	d	20-38	0	0	1	1	Hyposulfidic clay	Hypersulfidic subaqueous clay soil (clay)	High
LFd15-C.4	d	38-60	0	0	0	0	Hyposulfidic sandy clay		
LFd15-C.5	d	60-70	0	0	0	0	Hyposulfidic sandy clay		
LFe15-C.1	e	0-14	0	1	1	2	Hypersufilidic sandy gel		
LFe15-C.2	e	14-34	1	1	1	3	Hypersufilidic medium clay	Hypersulfidic subaqueous clay soil (clay)	High
LFe15-C.3	e	34-60	0	0	1	1	Hyposulfidic heavy clay		
LFe15-C.4	e	60-95	0	0	0	0	Hyposulfidic sandy clay		
LFf15-C.1	f	0-8	0	1	1	2	Hypersufilidic heavy clay		
LFf15-C.2	f	8-17	1	1	1	3	Hypersufilidic clay	Hypersulfidic subaqueous clay soil (clay)	High
LFf15-C.3	f	17-35	0	1	1	2	Hypersufilidic heavy clay		
LFf15-C.4	f	35-62	0	0	0	0	Hyposulfidic sandy clay		
LFf15-C.5	f	62-80	0	0	0	0	Hyposulfidic sandy clay		

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Table 14-2 Summary of temporal and spatial variations and changes in ASS subtypes at each site (**B and C**). Note: (i) Cells shaded orange summarise data presented within this report, (ii) all other cells are based on/extrapolated from data presented in Fitzpatrick *et al.* (2008a; 2008b; 2009b; 2008c) and (iii) cells bordered in blue indicate subaqueous

Boggy Creek Sites		Drought Winter 2009 (h₁)	Drought End winter 2009 (a)	Drought End summer 2010 (b)	Post drought Summer 2011 (c)	Post drought Winter 2011 (d)	Post-drought start summer 2011/12 (e)	Post-drought start winter 2011/12 (f)	Summary
LF15-B	¹Classification & ²Acid hazard	Sulfuric clay (H)	Sulfuric* clay (H)	Sulfuric* clay (H)	Hypersulfidic subaqueous clay (H)	Hypersulfidic subaqueous clay (H)	Hypersulfidic subaqueous clay (M)	Hypersulfidic subaqueous clay (M)	During the extreme drought period (2007 to 2009) soil remained Sulfuric. Inundation, following winter 2010, encouraged sulfate reduction and caused the formation of Hypersulfidic subaqueous clays.
	Dominant water and ASS process	LW & Sulfuric	LW & Sulfuric	LW & Sulfuric	RW & Sulfide	UW & Sulfide	UW & Sulfide	UW & Sulfide	
LF15-C	¹Classification & ²Acid hazard	Sulfuric clay (H)	Sulfuric* clay (H)	Sulfuric* clay (H)	Hypersulfidic subaqueous clay (H)	Hypersulfidic subaqueous clay (H)	Hypersulfidic subaqueous clay (H)	Hypersulfidic subaqueous clay (H)	During the extreme drought period (2007 to 2009) soil remained Sulfuric. Inundation, following winter 2010, encouraged sulfate reduction and caused the formation of Hypersulfidic subaqueous clays.
	Dominant water and ASS process	LW & Sulfuric	LW & Sulfuric	LW & Sulfuric	RW & Sulfide	UW & Sulfide	UW & Sulfide	UW & Sulfide	

¹ Classification – Acid Sulfate Soil subtype classification
² Acid hazard – Acidification hazard: H = High; M = medium; L = Low; VL = Very Low
Dominant Water process
LW – Lowering water level regime to expose soil to air due to drought conditions and water evaporation
UW – Unchanged water regime, which had not yet evaporated to expose soil to air
RW – Rising water level regime to inundate and saturate soils by reflooding (e.g. due to pumping, regulator installation, river flow and groundwater)
RF – Rain fall rewetting and natural reflooding to inundate and saturate soils

Dominant ASS – process
Sulfuric – Sulfuricization - oxidation of pyrite in hypersulfidic material due to onset of aerobic conditions to form sulfuric material
Sulfuric* – As above with acidic minerals and/or salt efflorescences noted (i.e. measurable RA)
Sulfide – Sulfidization due to sulfide accumulation to form hypersulfidic material
Monosulfide – Monosulfidization due to monosulfide accumulation to form monosulfidic material
Leach – Leaching of acid from soil by winter rain fall
Sulfuric **subaqueous** with **overlying circa neutral water** pH >4: = font coloured blue or default
Sulfuric **subaqueous** soil with **overlying acid water** pH <4: = font coloured red
Where h₁ to h₃ = historical sampling; (a) – (b) sampling conducted in this project

15. LF17 – POINT STURT SOUTH

Summary

Overall, soil at Point Sturt South was considered to pose a high acidification hazard.

Profiles approximately 50 and 200 m from the shoreline were classified as sulfuric and hypersulfidic soil with high acidification hazard ratings. Following reflooding, in September 2010, less RA and TAA was present within near surface soil layers. At the time of Sampling-d, having been inundated for more than nine months, soil profiles remained sulfuric. At the time of Sampling-e, having been inundated for more than 15 months, slight increases in soil pH≈(0.3 pH units), meant that these profiles had converted to hypersulfidic. However, during Sampling-f, soils were again classified as sulfuric and these profiles were considered to pose a high acidification hazard.

15.1 Background

Study area LF17 was located on the southern side of Point Sturt on the south western side of Lake Alexandrina (Figure 1-1). As part of this study, sampling was carried out in December 2011 and June 2012 (Samplings-e/f). Previous samplings were undertaken in May and June 2011 (Sampling-d), January and February 2011 (Sampling-c), March 2010 (Sampling-b) and November 2009 (Sampling-a). Additionally, data from historic sampling (Sampling-h), carried out in July 2009, were reassessed as part of this study. Sampling site locations are displayed in Figure 15-1.
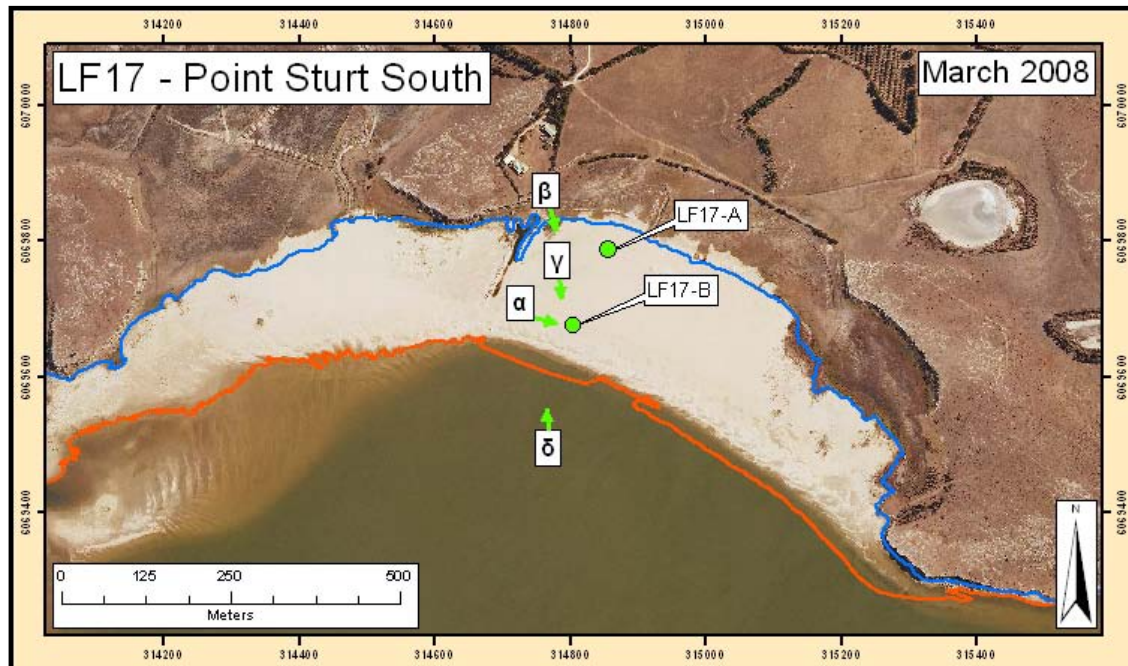
Figure 15-1 Sample location map. Aerial photograph taken in March 2008 (Orange line: sampling-a & b water level, Blue line: sampling-c, d, e & f water level)

At the time of Sampling-c/d/e, the lake level had risen to approximately 0.6 m AHD and the study area had been completely re-flooded (Figure 15-1: Figure 15-2). Prior to this, the study area comprised an extensive area of beach, which extended from the pre-drought (pre 2006) shore to the waterline, approximately 220 m south (Figure 15-1). During the sampling period, the water level in Lake Alexandrina fluctuated between a high of -0.72 m AHD (October 2009) and a low of -0.92 m AHD (January 2010)(MDBA 2011). The lake level had dropped from -0.80 m AHD in November 2009 (Sampling-a) to a low of -0.95 m AHD in January 2010. However, by March 2010 (Sampling-b) the lake level had risen back to -0.80 m AHD (MDBA 2011). In March 2010, windblown sand had accumulated on the beach and a few small sand dunes (height < 20 cm) had formed against sparse vegetation.

α (h₁) - July 2009

β (a) - October 2009

γ (b) - March 2010

δ (c) - February 2011

δ (d) - June 2011

δ (e) - December 2011

δ (f) – June 2012

Figure 15-2 Site photographs. Refer to Figure 15-1 for the location and direction that photographs were taken, indicated by α, β, γ or δ (photographs were selected that best depicted the environmental conditions at the study area during each sampling)

15.2 Soils

Soils at Point Sturt South generally comprised hypersulfidic and sulfuric sand. A summary of encountered soils is provided below and site locations are presented in Figure 15-1. Detailed profile descriptions are presented in Appendix 4 and Appendix 8. Profile photographs are presented in Appendix 5.

LF17-A
During previous studies, profiles were collected at this site on two separate sampling occasions (Samplings-a/b). Sampling-a encountered 15 cm of light brown sand with common yellow orange mottles associated with roots. This was underlain, to a depth of 30 cm, by dark grey sandy clay with common relic roots and light yellow mottles. Between 30 and 45 cm was light brown sand with lenses of grey light medium clay and common yellow orange mottles. This was underlain, to the maximum extent of investigation (60 cm), by grey sand with coarse relic roots and orange coatings. Sampling-b encountered a 2 cm thick crust of light brown grey medium sand with bright yellow jarosite mottles and red brown mottles. Underlying this, to a depth of 30 cm, was grey brown medium sand with lenses of dark grey light clay with bright yellow and red mottles associated with clay lenses. Between 30 and 38 cm was brown grey sand with lenses of dark grey clay, jarosite mottles and red brown mottles associated with clay lenses. Underlying this, to a depth of 58 cm, was dark grey medium clay loam with lenses of dark grey light clay and red brown mottles associated with few relic roots. This was underlain, to the maximum extent of investigation (68 cm), by moist, dark grey sandy clay loam with red brown mottles.

When water levels rose and the study area became inundated (Samplings-c/d), a UWS was used to collect subaqueous soil profiles on two occasions. The investigations encountered 40 and 47 cm of light brown grading to grey brown sand with pale yellow jarosite mottles. This was underlain, to depths of 53 and 60 cm, by dark grey sandy clay loam with yellow mottles and relict roots. Underlying this, to the maximum extent of investigation (60 and 73 cm), was dark grey to black sandy clay loam. Carbonate nodules were encountered during Sampling-c, but not during Sampling-d.

As part of this study, a UWS and push tube were used to collect subaqueous soil profiles (Samplings-e/f). Sampling-e encountered 10 cm of dark grey loamy sand with 30% black mottles. This was underlain, to a depth of 16 cm, by greyish brown loamy sand with black mottles along root channels. Underlying this, to a depth of 19 cm, was very dark greyish brown heavy clay with reed fragments. This was underlain, to a depth of 42 cm, by greyish brown loamy sand with distinct yellow jarosite mottles. Underlying this, to the maximum extent of investigation (48 cm), was very dark brown sapric peat. Sampling-f encountered 17 cm of dark grey loamy sand with a greyish brown oxidised surface layer. This was underlain, to a depth of 46 cm, by greyish brown loamy sand with 15 to 30 % yellow jarosite mottles with clayey bands and organic matter. Underlying this, to the maximum extent of investigation (80 cm), was dark grey sandy clay and sandy loam.

LF17-B
During previous studies, when the study area was dry, profiles were collected at this site on three occasions (Samplings-h/a/b). The historic sampling encountered 1 cm of green and white crystal, which overlay, to a depth of 40 cm, loose light brown grey sand. Between 40 and 60 cm was very soft light grey sand. This was underlain, to the maximum extent of investigation (160 cm), by very soft greyish brown sandy clay. Sampling-a encountered 15 cm of light brown sand with diffuse grey mottles. This was underlain, to a depth of 30 cm, by light brown sand with live roots and diffused yellow mottles around root voids and red orange mottles associated with remnant roots. Between 30 and 50 cm was grey fine to medium sand with red orange mottles along relic root channels. Underlying this, to the maximum extent of investigation (70 cm), was grey sand with lenses of sapric material and few coarse diffuse black mottles. Sampling-b encountered 20 cm of light grey sand with diffuse yellow mottles associated with fine roots. Between 20 and 40 cm was grey sand with diffuse yellow jarosite mottles and few brown mottles associated with roots. Underlying this, to a depth of 68 cm, was dark green grey sand with distinct olive brown mottles and few dark grey clayey sand lenses. This was underlain, to the maximum extent of investigation (90 cm), by dark green grey clayey sand with diffuse grey mottles.

When water levels rose and the study area became inundated (Samplings-c/d), a UWS was used to collect subaqueous soil profiles on two occasions. The investigations encountered 25 cm of brownish grey sand with pale yellow mottles. This was underlain, to depths 0f 50 and 52 cm , by grey to dark grey sand and loamy sand and a few pale yellow mottles. Underlying this, to the maximum extent of investigation (68 and 72 cm), was dark grey sandy clay.

As part of this study, a UWS and push tube were used to collect subaqueous soil profiles (Samplings-e/f). Sampling-e encountered 8 cm of light greyish brown medium sand. This was underlain, to a depth of 14 cm, by dark greyish brown medium sand with few black mottles. Underlying this, to a depth of 29 cm, was grey sand. This was underlain, to the maximum extent of investigation (48 cm), by very dark grey loamy sand. Sampling-f encountered 23 cm of greyish brown loamy sand. This was underlain, to a depth of 44 cm, by greyish brown loamy sand with 5 to 10 % distinct jarosite mottles. Underlying this, to a depth of 57 cm, was grey loamy sand. This was underlain, to the maximum extent of investigation (89 cm), by olive grey sandy clay loam and loamy sand.

15.3 Soil acidity and acid-base accounting

Acid-base accounting was carried out according to the methods described in Section 2.3. Acid-base accounting and pH data (pH_{OX}, pH_{INC} & pH_W), for each soil layer, are presented in Figure 15-3. These data were used to inform the acidification hazard assessment that is presented in Table 15-1.
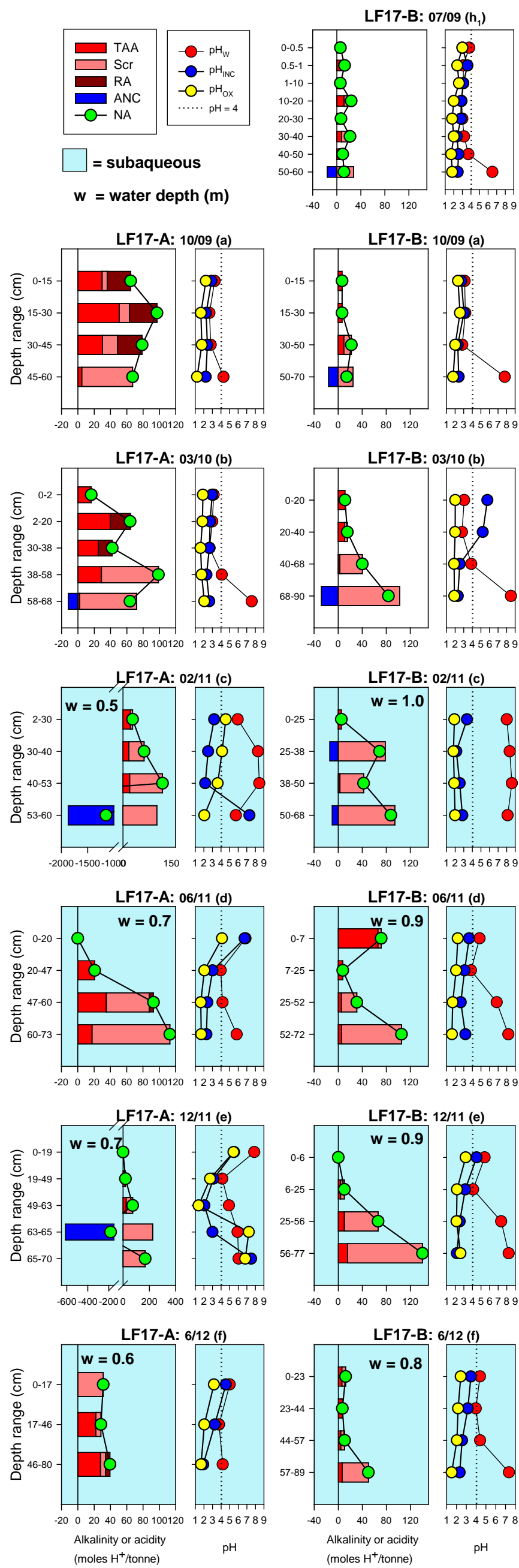
Figure 15-3 pH and acid-base accounting data plotted against depth for each profile collected

15.4 Summary and discussion

Acidification potential assessment and ASS material classification were carried out for each soil sample collected, according to the definitions and methods presented in Section 1.3 and Section 2.4 respectively. A summary of acidification potential and ASS material classification is presented in Table 15-1.

Acidification hazard assessment and ASS subtype classification were carried out for each soil profile collected. ASS subtype classification was achieved using the methods described in Appendix 2. Acidification hazard assessment was based on: (i) landscape position (Figure 15-1), (ii) soil morphology (Section 15.2), (iii) acid-base accounting (Figure 15-3), (iv) pH data (Figure 15-3), (v) acidification potential (Table 15-1) and (vi) ASS material and subtype classification(Table 15-1). Acidification hazard categories were: (i) very low, (ii) low, (iii) medium and (iv) high. A summary of ASS subtype classification and acidification hazard for each profile collected between July 2009 and June 2012 is presented in Table 15-1.

Soil profiles at Point Sturt South generally comprised hypersulfidic and sulfuric soil with high acidification hazard ratings (LF17-A and LF17-B; Figure 15-1; Table 15-1). They had positive net acidity, little or no ANC, relatively high acidity and high acidification potential (Figure 15-3; Table 15-1). At site LF17-A, during drought conditions, acidity in near surface soil layers predominantly comprised TAA and RA with minor S_{CR} (Figure 15-3). At site LF17-B acidity predominantly comprised S_{CR} in the lower half of the profile and TAA in the upper half (Figure 15-3). Following reflooding, in September 2010, less RA and TAA was present within near surface soil layers (Figure 15-3). At the time of Sampling-d, having been inundated for more than nine months, soil profiles remained sulfuric (Table 15-2). At the time of Sampling-e, having been inundated for more than 15 months, slight increases in soil pH ($\approx$ 0.3 pH units), meant that these profiles had converted to hypersulfidic. However, during Sampling-f, soils were again classified as sulfuric and these profiles were considered to pose a high acidification hazard.

Overall, soil at Point Sturt South was considered to pose a high acidification hazard.

Table 15-1 Summary of acidification potential, ASS material classification, ASS subtype classification and acidification hazard (* indicates sulfuric soil material). The soil texture in brackets following the ASS subtype classification indicates the dominant texture of the profile

Sample	Sampling	Depth (cm)	pH$_{OX}$ < 2.5	pH$_{INC}$ < 4.0	NA > 0	Acidification potential	ASS material classification	ASS subtype classification	Acidification hazard
LF17-A									
LFa17-A.1	a	0-15	1	1	1	3*	Sulfuric sand		
LFa17-A.2	a	15-30	1	1	1	3*	Sulfuric sandy clay	Sulfuric soil	High
LFa17-A.3	a	30-45	1	1	1	3*	Sulfuric sand	(sand)	
LFa17-A.4	a	45-60	1	1	1	3	Hypersulfidic sand		
LFb17-A.1	b	0-2	1	1	1	3*	Sulfuric sand		
LFb17-A.2	b	2-20	1	1	1	3*	Sulfuric sand		
LFb17-A.3	b	30-38	1	1	1	3*	Sulfuric sand	Sulfuric soil (sand)	High
LFb17-A.4	b	38-58	1	1	1	3	Hypersulfidic clay loam		
LFb17-A.5	b	58-68	1	1	1	3	Hypersulfidic sandy clay loam		
LFc17-A.2	c	2-30	0	1	1	2	Hypersulfidic sand		
LFc17-A.3	c	30-40	0	1	1	2	Hypersulfidic sand	Hypersulfidic subaqueous	Medium
LFc17-A.4	c	40-53	0	1	1	2	Hypersulfidic clayey loam	soil (sand)	
LFc17-A.5	c	53-60	1	0	0	1	Hyposulfidic sandy clay loam		
LFd17-A.1	d	0-20	0	0	0	0	Sandy		
LFd17-A.2	d	20-47	1	1	1	3*	Sulfuric loamy sand	Sulfuric subaqueous	High
LFd17-A.3	d	47-60	1	1	1	3	Hypersulfidic sandy clay loam	soil (sand)	
LFd17-A.4	d	60-73	1	1	1	3	Hypersulfidic sandy loam		
LFe17-A.1	e	0-19	0	0	0	0	Loamy sand		
LFe17-A.2	e	19-49	0	1	1	2	Loamy sand	Hypersulfidic	
LFe17-A.3	e	49-63	1	1	1	3	Hypersulfilidic heavy clay	subaqueous	Medium
LFe17-A.4	e	63-65	0	1	0	1	Hypersufilidic loamy sand	soil (sand)	
LFe17-A.5	e	65-70	0	0	1	1	Hyposulfidic sapric peat		
LFf17-A.1	f	0-17	0	0	1	1	Hyposulfidic loamy sand	Sulfuric	
LFf17-A.2	f	17-46	1	1	1	3*	Sulfuric sandy clay	subaqueous	High
LFf17-A.3	f	46-80	1	1	1	3	Hypersufilidic sandy clay	clay soil (clay)	
LF17-B									
PSM 1.1	h$_1$	0-0.5	0	1	1	2*	Sulfuric crystals		
PSM 1.2	h$_1$	0.5-1	1	1	1	3*	Sulfuric crystals		
PSM 1.3	h$_1$	1-10	0	1	1	2*	Sulfuric sand		
PSM 1.4	h$_1$	10-20	1	1	1	3*	Sulfuric sand		
PSM 1.5	h$_1$	20-30	1	1	1	3*	Sulfuric sand	Sulfuric soil (sand)	High
PSM 1.6	h$_1$	30-40	1	1	1	3*	Sulfuric sand		
PSM 1.7	h$_1$	40-50	1	1	1	3*	Sulfuric sand		
PSM 1.8	h$_1$	50-60	1	1	1	3	Hypersulfidic sandy clay		
LFa17-B.1	a	0-15	1	1	1	3*	Sulfuric sand		
LFa17-B.2	a	15-30	0	1	1	2*	Sulfuric sand	Sulfuric soil	High
LFa17-B.3	a	30-50	1	1	1	3*	Sulfuric sand	(sand)	
LFa17-B.4	a	50-70	1	1	1	3	Hypersulfidic sand		
LFb17-B.1	b	0-20	1	0	1	2*	Sulfuric sand		
LFb17-B.2	b	20-40	1	0	1	2*	Sulfuric sand	Sulfuric soil	High
LFb17-B.3	b	40-68	1	1	1	3*	Sulfuric sand	(sand)	
LFb17-B.4	b	68-90	1	1	1	3	Hypersulfidic sand		
LFc17-B.1	c	0-25	1	1	1	3	Sand		
LFc17-B.2	c	25-38	1	1	1	3	Hypersulfidic sand	Hypersulfidic	
LFc17-B.3	c	38-50	1	1	1	3	Hypersulfidic sand	subaqueous	High
LFc17-B.4	c	50-68	1	1	1	3	Hypersulfidic clayey sand	soil (sand)	
LFd17-B.1	d	0-7	1	1	1	3	Sand		
LFd17-B.2	d	7-25	1	1	1	3*	Sulfuric sand	Sulfuric	
LFd17-B.3	d	25-52	1	1	1	3	Hypersulfidic loamy sand	subaqueous	High
LFd17-B.4	d	52-72	1	1	1	3	Hypersulfidic sandy clay loam	soil (sand)	
LFe17-B.1	e	0-6	0	0	0	0	Sand		
LFe17-B.2	e	6-25	1	1	1	3	Hypersufilidic sand	Hypersulfidic	
LFe17-B.3	e	25-56	1	1	1	3	Hypersufilidic sand	subaqueous	High
LFe17-B.4	e	56-77	0	1	1	2	Hypersufilidic clayey sand	soil (sand)	
LFf17-B.1	f	0-23	1	1	1	3	Hypersufilidic loamy sand	Sulfuric	
LFf17-B.2	f	23-44	1	1	1	3*	Sulfuric loamy sand	subaqueous	High
LFf17-B.3	f	44-57	1	1	1	3	Hypersufilidic loamy sand	soil (sand)	
LFf17-B.4	f	57-89	1	1	1	3	Hypersufilidic sandy clay loam		

Table 15-2 Summary of temporal and spatial variations and changes in ASS subtypes at each site (**A and B**). Note: (i) Cells shaded orange summarise data presented within this report, (ii) all other cells are based on/extrapolated from data presented in Fitzpatrick *et al.* (2008a; 2008b; 2009b; 2008c) and (iii) cells bordered in blue indicate subaqueous

Point Sturt South Sites		Drought Winter 2009 (h₁)	Drought End winter 2009 (a)	Drought End summer 2010 (b)	Post drought Summer 2011 (c)	Post drought Winter 2011 (d)	Post-drought start summer 2011/12 (e)	Post-drought start winter 2011/12 (f)	Summary
LF17-A	¹Classification & ²Acid hazard	Sulfuric (H)	Sulfuric* (H)	Sulfuric* (H)	Hypersulfidic subaqueous (M)	Sulfuric* subaqueous (H)	Hypersulfidic subaqueous (M)	Sulfuric* subaqueous (H)	During the extreme drought period (2007 to 2009) soil remained Sulfuric. Inundation, following winter 2010, caused the formation of Sulfuric and Hypersulfidic subaqueous soil.
	Dominant water and ASS process	LW & Sulfuric	LW & Sulfuric	LW & Sulfuric	RW & Sulfide	UW & Sulfuric	UW & Sulfide	UW & Sulfuric	
LF17-B	¹Classification & ²Acid hazard	Sulfuric (H)	Sulfuric (H)	Sulfuric (H)	Hypersulfidic subaqueous (H)	Sulfuric subaqueous (H)	Hypersulfidic subaqueous (H)	Sulfuric subaqueous (H)	During the extreme drought period (2007 to 2009) soil remained Sulfuric. Inundation, following winter 2010, caused the formation of Sulfuric and Hypersulfidic subaqueous soil.
	Dominant water and ASS process	LW & Sulfuric	LW & Sulfuric	LW & Sulfuric	RW & Sulfide	UW & Sulfuric	UW & Sulfide	UW & Sulfuric	

¹ **Classification – Acid Sulfate Soil subtype classification**
² **Acid hazard – Acidification hazard: H = High; M = medium; L = Low; VL = Very Low**
Dominant Water process
LW – Lowering water level regime to expose soil to air due to drought conditions and water evaporation
UW – Unchanged water regime, which had not yet evaporated to expose soil to air
RW – Rising water level regime to inundate and saturate soils by reflooding (e.g. due to pumping, regulator installation, river flow and groundwater)
RF – Rain fall rewetting and natural reflooding to inundate and saturate soils

Dominant ASS – process
Sulfuric – Sulfuricization - oxidation of pyrite in hypersulfidic material due to onset of aerobic conditions to form sulfuric material
Sulfuric* – As above with acidic minerals and/or salt efflorescences noted (i.e. measurable RA)
Sulfide – Sulfidization due to sulfide accumulation to form hypersulfidic material
Monosulfide – Monosulfidization due to monosulfide accumulation to form monosulfidic material
Leach – Leaching of acid from soil by winter rain fall
Sulfuric **subaqueous** with **overlying circa neutral water** pH >4: = font coloured blue or default
Sulfuric **subaqueous** soil with **overlying acid water** pH <4: = font coloured red
Where h₁ to h₃ = historical sampling; (a) – (b) sampling conducted in this project

16. LF19 – DOG LAKE

Summary

Soil at Dog Lake was considered to pose a high acidification hazard.

Soil profiles at Dog Lake comprised sulfuric and hypersulfidic clay soil with high acidification ratings. At site LF19-A, when the profile was dry, acidity above 50 cm was dominated by TAA and there was no ANC present. Below 50 cm, there was a combination of both TAA and S_{CR}. Following reflooding, in September 2010, the amount of acidity above 25 cm decreased but was still dominated by TAA, with only a slight increase in S_{CR}. Below 25 cm, acidity was dominated by S_{CR} and calcrete rubble was encountered below 40 cm. Inundation, for a period of 21 months, seems to have caused limited flushing of acidity (H^+) from surface sediments. Regardless, soil material has remained sulfuric with high acidification hazard ratings.

A new site (LF19-B) was established during Sampling-e that was located approximately 2 km south west of LF19-A. This site had been inundated for 15 and 21 months since drought conditions had abated. Above 13 cm and below 45 cm, S_{CR} and ANC dominated the profile. Between 13 cm and 45 cm there was no ANC present and acidity comprised RA, TAA and S_{CR}. Soil material classified as hypersulfidic and was considered to pose a high acidification hazard.

16.1 Background

Study area LF19 was located in Dog Lake on the north eastern side of Lake Alexandrina (Figure 1-1). As part of this study, sampling was carried out in December 2011 and June 2012 (Samplings-e/f). Previous samplings were undertaken in May and June 2011 (Sampling-d), January and February 2011 (Sampling-c) and March 2010 (Sampling-b). Sampling site locations are displayed in Figure 16-1.
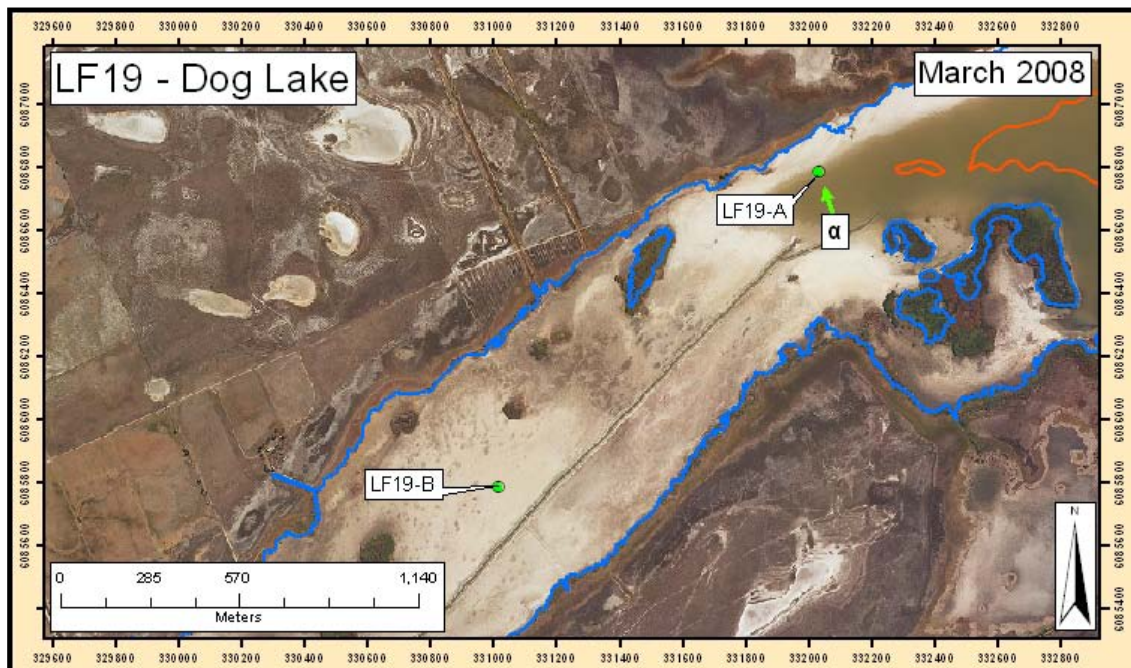
Figure 16-1 Sample location map. Aerial photograph taken in March 2008 (Orange line: sampling-b water level, Blue line: sampling-c, d, e & f water level)

At the time of Sampling-c/d/e, the lake level had risen to approximately 0.65 m AHD and the study area had been completely re-flooded (Figure 16-1: Figure 16-2). Prior to this, in May 2010 (Sampling-b), the lake level was at -0.50 AHD (MDBA 2011) and Dog Lake was dry (Figure 16-2).

Figure 16-2 Site photographs. Refer to Figure 16-1 for the location and direction that photographs were taken, indicated by α (photographs were selected that best depicted the environmental conditions at the study area during each sampling)

16.2 Soils

Soils at Dog Lake generally comprised sulfuric clay soil. A summary of encountered soils is provided below and site locations are presented in Figure 16-1. Detailed profile descriptions are presented in Appendix 4 and Appendix 8. Profile photographs are presented in Appendix 5.

LF19-A
When water levels rose and the study area became inundated (Samplings-c/d), a UWS was used to collect subaqueous soil profiles on two occasions. The investigations encountered 12 and 19 cm of grey brown loamy sand with 15 to 20 % yellow jarosite mottles and bands of darker organic matter near the base. This was underlain, to a depth of 29 cm, by greyish brown loamy sand. Sampling-c encountered 25 % light yellow jarosite mottles and Sampling-d encountered 10 % jarosite mottles. Underlying this, to depths of 43 and 45 cm, by dark grey clay with few pale yellow jarosite mottles associated with root channels. This was underlain, to the maximum extent of investigation (50 and 58 cm), by grey heavy clay with common carbonate rubble.

As part of this study, a push tube was used to collect subaqueous soil profiles (Samplings-e/f). The investigations encountered 18 and 16 cm of greyish brown loamy sand with 5 to 10 % coarse jarosite mottles. This was underlain, to depths of 24 to 32 cm, by grey brown loamy sand with 10 to 20 % coarse jarosite mottles. Underlying this, to depths of 42 to 46 cm (46 cm was the maximum extent of investigation during Sampling-f), was dark greenish grey loamy clay with fine prominent mottles. During Sampling-e, this was underlain, to the maximum extent of investigation (72 cm), by olive grey heavy clay.

LF19-B
As part of this study, a push tube was used to collect subaqueous soil profiles (Samplings-e/f). The investigation encountered 8 to 13 cm of black monosulfidic clay gel. This was underlain, to depths of 26 to 27 cm, by very dark grey loamy clay. Underlying this, to depths of 36 to 45 cm, was dark grey loamy clay with 10 to 20 % jarosite mottles. This was underlain, to the maximum extent of investigation (49 to 56 cm), by dark grey brown heavy clay with 30 % greenish grey coarse mottles.

16.3 Soil acidity and acid-base accounting

Acid-base accounting was carried out according to the methods described in Section 2.3. Acid-base accounting and pH data (pH_{OX}, pH_{INC} & pH_W), for each soil layer, are presented in Figure 16-3. These data were used to inform the acidification hazard assessment that is presented in Table 16-1.
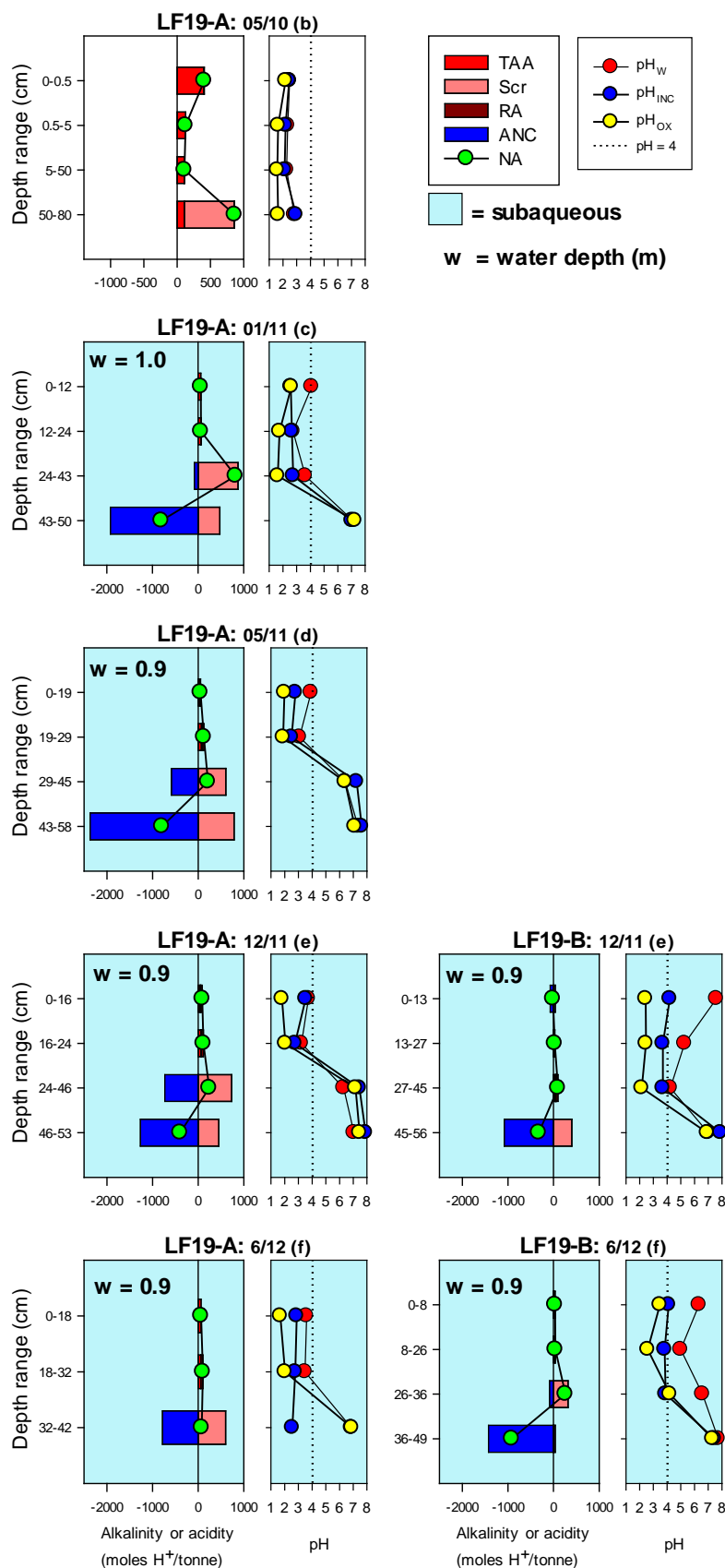
Figure 16-3 pH and acid-base accounting data plotted against depth for each profile collected

16.4 Summary and discussion

Acidification potential assessment and ASS material classification were carried out for each soil sample collected, according to the definitions and methods presented in Section 1.3 and Section 2.4 respectively. A summary of acidification potential and ASS material classification is presented in Table 16-1.

Acidification hazard assessment and ASS subtype classification were carried out for each soil profile collected. ASS subtype classification was achieved using the methods described in Appendix 2. Acidification hazard assessment was based on: (i) landscape position (Figure 16-1), (ii) soil morphology (Section 16.2), (iii) acid-base accounting (Figure 16-3), (iv) pH data (Figure 16-3), (v) acidification potential (Table 16-1) and (vi) ASS material and subtype classification (Table 16-1).

Acidification hazard categories were: (i) very low, (ii) low, (iii) medium and (iv) high. A summary of ASS subtype classification and acidification hazard for each profile collected between May 2010 and June 2012 is presented in (Table 16-1).

Soil profiles at Dog Lake comprised sulfuric and hypersulfidic clay soil with high acidification hazard ratings (Table 16-1).

Under drought conditions, at site LF19-A (Figure 16-1), acidity above 50 cm was dominated by TAA and there was no ANC present (Figure 16-3). Below 50 cm, there was a combination of TAA and S_{CR}. Following reflooding in September 2010, the amount of acidity above 25 cm decreased but was still dominated by TAA, with only a slight increase in S_{CR} (Figure 16-3). Below 25 cm, acidity was dominated by S_{CR} and calcrete rubble was encountered below 40 cm. Inundation, for a period of 21 months, seems to have caused limited flushing of acidity (H+) from surface sediments. Regardless, soil material has remained sulfuric with high acidification hazard ratings (Table 16-2).

A new site (LF19-B; Figure 16-1) was established during Sampling-e that was located approximately 2 km south west of LF19-A. This site had been inundated for 15 and 21 months since drought conditions had abated. Above 13 cm and below 45 cm, S_{CR} and ANC dominated the profile. Between 13 cm and 45 cm there was no ANC present and acidity comprised RA, TAA and S_{CR} (Figure 16-3). Soil material classified as hypersulfidic and was considered to pose a medium acidification hazard.

Soil at Dog Lake were considered to pose a high acidification hazard.

Table 16-1 Summary of acidification potential, ASS material classification, ASS subtype classification and acidification hazard (* indicates sulfuric soil material). The soil texture in brackets following the ASS subtype classification indicates the dominant texture of the profile

Sample	Sampling	Depth (cm)	pH$_{OX}$ < 2.5	pH$_{INC}$ < 4.0	NA > 0	Acidification potential	ASS material classification	ASS subtype classification	Acidification hazard
LF19-A									
LFb19 A.1	b	0-0.5	1	1	1	3*	Sulfuric loamy sand	Sulfuric clay soil (clay)	High
LFb19 A.2	b	0.5-5	1	1	1	3*	Sulfuric loamy sand		
LFb19 A.3	b	5-50	1	1	1	3*	Sulfuric clay		
LFb19 A.4	b	50-80	1	1	1	3*	Sulfuric clay		
LFc19-A.1	c	0-12	0	1	1	2	Loamy sand	Sulfuric subaqueous clay soil (clay)	High
LFc19-A.2	c	12-24	1	1	1	3*	Sulfuric loamy sand		
LFc19-A.3	c	24-43	1	1	1	3*	Sulfuric clay		
LFc19-A.4	c	43-50	0	0	0	0	Hyposulfidic clay		
LFd19-A.1	d	0-19	1	1	1	3*	Sulfuric loamy sand	Sulfuric subaqueous soil (sand)	High
LFd19-A.2	d	19-29	1	1	1	3*	Sulfuric clayey sand		
LFd19-A.3	d	29-45	0	0	1	1	Hyposulfidic sandy clay		
LFd19-A.4	d	43-58	0	0	0	0	Hyposulfidic clay		
LFe19-A.1	e	0-16	1	1	1	3*	Sulfuric loamy sand	Sulfuric subaqueous soil (clay)	High
LFe19-A.2	e	16-24	1	1	1	3*	Sulfuric loamy sand		
LFe19-A.3	e	24-46	0	0	1	1	Hyposulfidic loamy clay		
LFe19-A.4	e	46-53	0	0	0	0	Hyposulfidic heavy clay		
LFf19-A.1	f	0-18	1	1	1	3*	Sulfuric loamy sand	Sulfuric subaqueous soil (sand)	High
LFf19-A.2	f	18-32	1	1	1	3*	Sulfuric clayey sand		
LFf19-A.3	f	32-42	0	1	1	2	Hypersufilidic light clay		
LF19-B									
LFe19-B.1	e	0-13	1	0	0	1	Hyposulfidic medium clay	Hypersulfidic subaqueous clay soil (clay)	Medium
LFe19-B.2	e	13-27	1	1	1	3	Hypersufilidic loamy clay		
LFe19-B.3	e	27-45	1	1	1	3	Hypersufilidic loamy clay		
LFe19-B.4	e	45-56	0	0	0	0	Hyposulfidic heavy clay		
LFf19-B.1	f	0-8	0	0	1	1	Hyposulfidic clay loam	Hypersulfidic subaqueous clay soil (clay)	Medium
LFf19-B.2	f	8-26	0	1	1	2	Hypersufilidic light clay		
LFf19-B.3	f	26-36	0	1	1	2	Hypersufilidic light clay		
LFf19-B.4	f	36-49	0	0	0	0	Hyposulfidic heavy clay		

Table 16-2 Summary of temporal and spatial variations and changes in ASS subtypes at each site (**A**). Note: (i) Cells shaded orange summarise data presented within this report, (ii) all other cells are based on/extrapolated from data presented in Fitzpatrick *et al.* (2008a; 2008b; 2009b; 2008c) and (iii) cells bordered in blue indicate subaqueous

Dog Lake		Drought Winter 2010 (b)	Post drought Summer 2011 (c)	Post drought Winter 2011 (d)	Post-drought start summer 2011/12 (e)	Post-drought start winter 2011/12 (f)	Summary
LF19-A	[1]Classification & [2]Acid hazard	**Sulfuric* clay (H)**	**Sulfuric subaqueous clay (H)**	**Sulfuric* subaqueous (H)**	**Sulfuric* subaqueous (H)**	**Sulfuric* subaqueous (H)**	During the extreme drought period (2007 to 2009) soil remained Sulfuric. Inundation, following winter 2010, caused the formation of Sulfuric subaqueous soil.
	Dominant water and ASS process	**LW & Sulfuric**	**RW & Sulfuric**	**UW & Sulfuric**	**UW & Sulfuric**	**UW & Sulfuric**	
LF19-B	[1]Classification & [2]Acid hazard	**No data**	**No data**	**No data**	**Hypersulfidic subaqueous clay (H)**	**Hypersulfidic subaqueous clay (H)**	Following inundation in winter 2010, soil material remained Hypersulfidic subaqueous clay soil.
	Dominant water and ASS process	**No data**	**No data**	**No data**	**UW & Sulfide**	**UW & Sulfide**	

[1] **Classification – Acid Sulfate Soil subtype classification**
[2] **Acid hazard – Acidification hazard: H = High; M = medium; L = Low; VL = Very Low**
Dominant Water process
LW – Lowering water level regime to expose soil to air due to drought conditions and water evaporation
UW – Unchanged water regime, which had not yet evaporated to expose soil to air
RW – Rising water level regime to inundate and saturate soils by reflooding (e.g. due to pumping, regulator installation, river flow and groundwater)
RF – Rain fall rewetting and natural reflooding to inundate and saturate soils

Dominant ASS – process
Sulfuric – Sulfuricization - oxidation of pyrite in hypersulfidic material due to onset of aerobic conditions to form sulfuric material
Sulfuric* – As above with acidic minerals and/or salt efflorescences noted (i.e. measurable RA)
Sulfide – Sulfidization due to sulfide accumulation to form hypersulfidic material
Monosulfide – Monosulfidization due to monosulfide accumulation to form monosulfidic material
Leach – Leaching of acid from soil by winter rain fall
Sulfuric **subaqueous** with **overlying circa neutral water** pH >4: = font coloured blue or default
Sulfuric **subaqueous** soil with **overlying acid water** pH <4: = font coloured red
Where h_1 to h_3 = historical sampling; (a) – (b) sampling conducted in this project

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

17. LF20 – BOGGY LAKE

Summary

Soil at Boggy Lake was considered to pose a high acidification hazard.

Soil profiles at Boggy Lake comprised sulfuric and hypersulfidic clay soil with high acidification hazard ratings. At site LF20-A, when the profile was dry, acidity above 25 cm was dominated by TAA and there was no ANC present. Below 25 cm, there was a combination of RA, TAA and S_{CR}. Reflooding and inundation, for a period of 21 months, resulted in an increase in the proportion of S_{CR} relative to TAA and RA above 30 to 40 cm. At depth, NA remained extremely high and was dominated by S_{CR}. Soil material has remained hypersulfidic or sulfuric with high acidification hazard ratings.

A new site was established during Sampling-e that was located in the middle of Boggy Lake, approximately 750 m north west of LF20-A. This site had been inundated for 15 and 21 months since drought conditions had abated. Acidity was dominated throughout the profile by high concentrations of S_{CR} (> 600 moles H$^+$/tonne) with TAA and RA present. No ANC was present in Sampling-f or above 58 cm in Sampling-e. Soil material classified as hypersulfidic and was considered to pose a high acidification hazard.

17.1 Background

Study area LF20 was located in Boggy Lake on the north eastern side of Lake Alexandrina (Figure 1-1). As part of this study, sampling was carried out in December 2011 and June 2012 (Samplings-e/f). Previous samplings were undertaken in May and June 2011 (Sampling-d), January and February 2011 (Sampling-c) and March 2010 (Sampling-b). Sampling site locations are displayed in Figure 17-1.
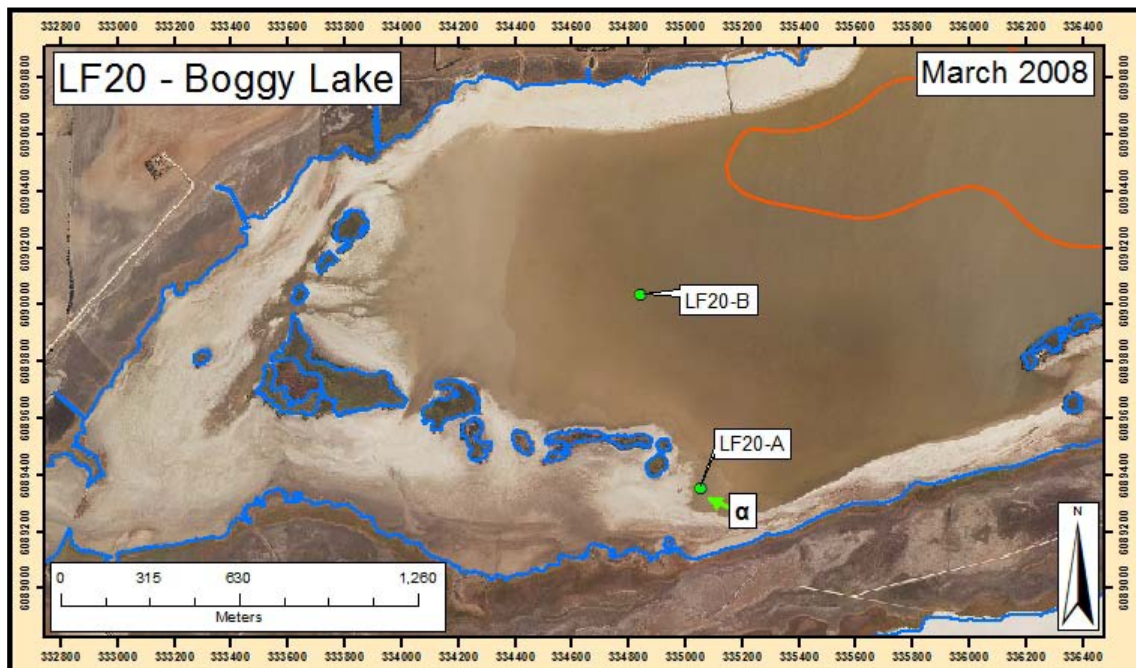
Figure 17-1 Sample location map. Aerial photograph taken in March 2008 (Orange line: sampling-b water level, Blue line: sampling-c, d, e & f water level)

At the time of Sampling-c/d/e, the lake level had risen to approximately 0.65 m AHD and the study area had been completely re-flooded (Figure 17-1: Figure 17-2). Prior to this, in May 2010 (Sampling-b), the lake level was at -0.50 AHD (MDBA 2011) and Dog Lake was completely dry (Figure 17-2).

Figure 17-2 Site photographs. Refer to Figure 17-2 for the location and direction that photographs were taken, indicated by α (photographs were selected that best depicted the environmental conditions at the study area during each sampling)

17.2 Soils

Soils at Boggy Lake generally comprised sulfuric and hypersulfidic clay soil. A summary of encountered soils is provided below and site locations are presented in Figure 17-1. Detailed profile descriptions are presented in Appendix 4 and Appendix 8. Profile photographs are presented in Appendix 5.

LF20-A
When water levels rose and the study area became inundated (Samplings-c/d), a UWS was used to collect subaqueous soil profiles on two occasions. The investigations encountered slightly different profiles. Sampling-c encountered 36 cm of dark grey fine sandy clay with jarosite mottles between 26 and 36 cm. Underlying this, to a depth of 49 cm, was greyish brown fine sandy clay with 20 % yellow jarosite mottles. This was underlain, to a depth of 65 cm, by very dark greyish brown heavy clay with 5 % yellow jarosite mottles and common medium roots. Underlying this, to the maximum extent of investigation (80 cm), was dark grey fine sandy clay with 20 % black mottles. Sampling-d encountered 6 cm of black sticky clay with few roots. This was underlain, to a depth of 15 cm, by dark greyish brown light clay with few jarosite mottles. Underlying this, to a depth of 29 cm, was greyish brown medium clay, with common clear yellow jarosite mottles, often associated with root channels. Between 29 and 55 cm, was dark greyish brown medium clay with rare jarosite mottles associated with fine root channels. This was underlain, to the maximum extent of investigation (78 cm), by dark greenish grey light clay with some fine sand.

As part of this study, a push tube was used to collect subaqueous soil profiles (Samplings-e/f). Sampling-e encountered 10 cm of black clay. This was underlain, to a depth of 17 cm, by dark greyish brown clay with few distinct jarosite mottles. Underlying this, to a depth of 30 cm, was greyish brown clay with 30 % clear and prominent jarosite mottles. This was underlain, to a depth of 55 cm, by dark grey clay with rare jarosite mottles. Underlying this, to the maximum extent of investigation (89 cm), was dark greenish grey clay. Sampling-f encountered 8 cm of olive grey heavy clay and black sand. This was underlain, to a depth of 18 cm, by dark greyish brown clay with few distinct jarosite mottles. Underlying this, to a depth of 42 cm, was greyish brown clay with 30 % clear and prominent jarosite mottles. This was underlain, to a depth of 57 cm, by dark grey clay with rare jarosite mottles. Underlying this, to the maximum extent of investigation (92 cm), was dark greenish grey heavy clay.

LF20-B
As part of this study, a push tube was used to collect subaqueous soil profiles (Samplings-e/f). The investigations encountered 8 to 11 cm of very dark greyish brown heavy clay. This was underlain, to depths of 16 to 20 cm, by very dark greyish brown heavy clay brown staining and 5 % jarosite mottles. Underlying this, to depths of 35 to 38 cm, was dark greyish brown heavy clay with 20 % jarosite mottles. This was underlain, to depths of 58 to 60 cm, by dark grey heavy clay with few sandy lenses. Underlying this, to depths of 60 to 66 cm, was dark sandy loam with few black mottles. In Sampling-e, this was underlain, to the maximum extent of investigation (80 cm), by dark olive grey heavy clay with some carbonate nodules. In Sampling-f, this was underlain, to the maximum extent of investigation (70 cm), by dark grey sandy loam.

17.3 Soil acidity and acid-base accounting

Acid-base accounting was carried out according to the methods described in Section 2.3. Acid-base accounting and pH data (pH_{OX}, pH_{INC} & pH_W), for each soil layer, are presented in Figure 17-2. These data were used to inform the acidification hazard assessment that is presented in Table 17-1.
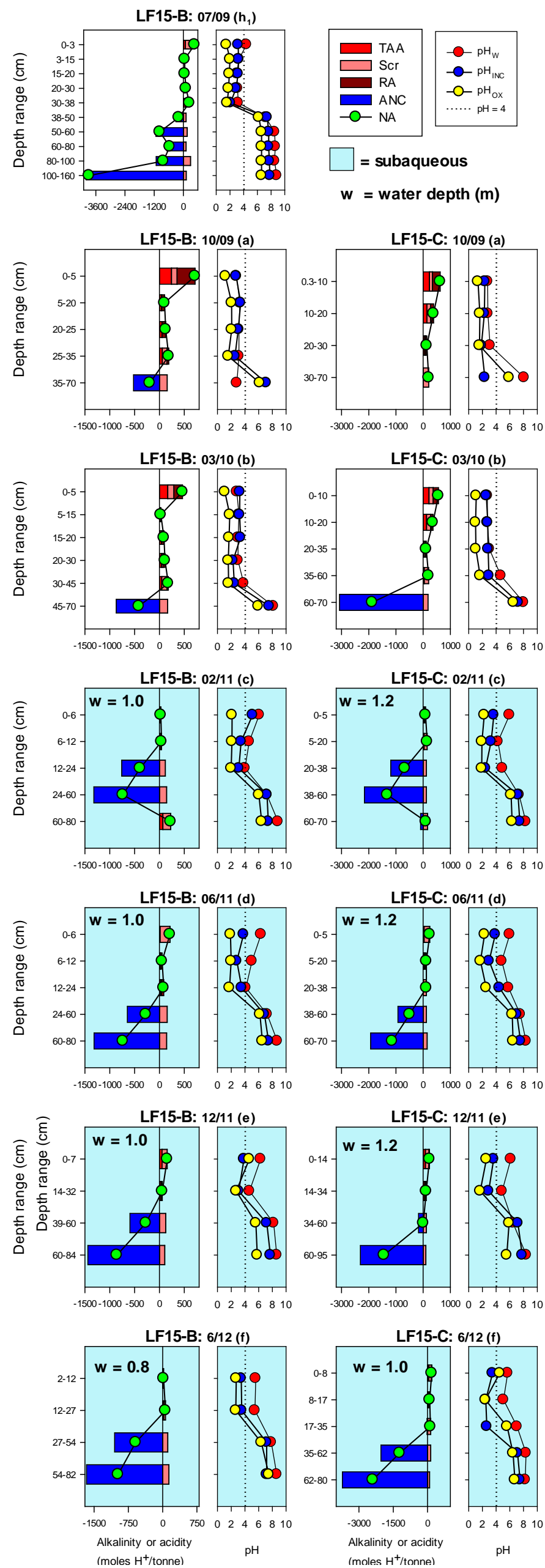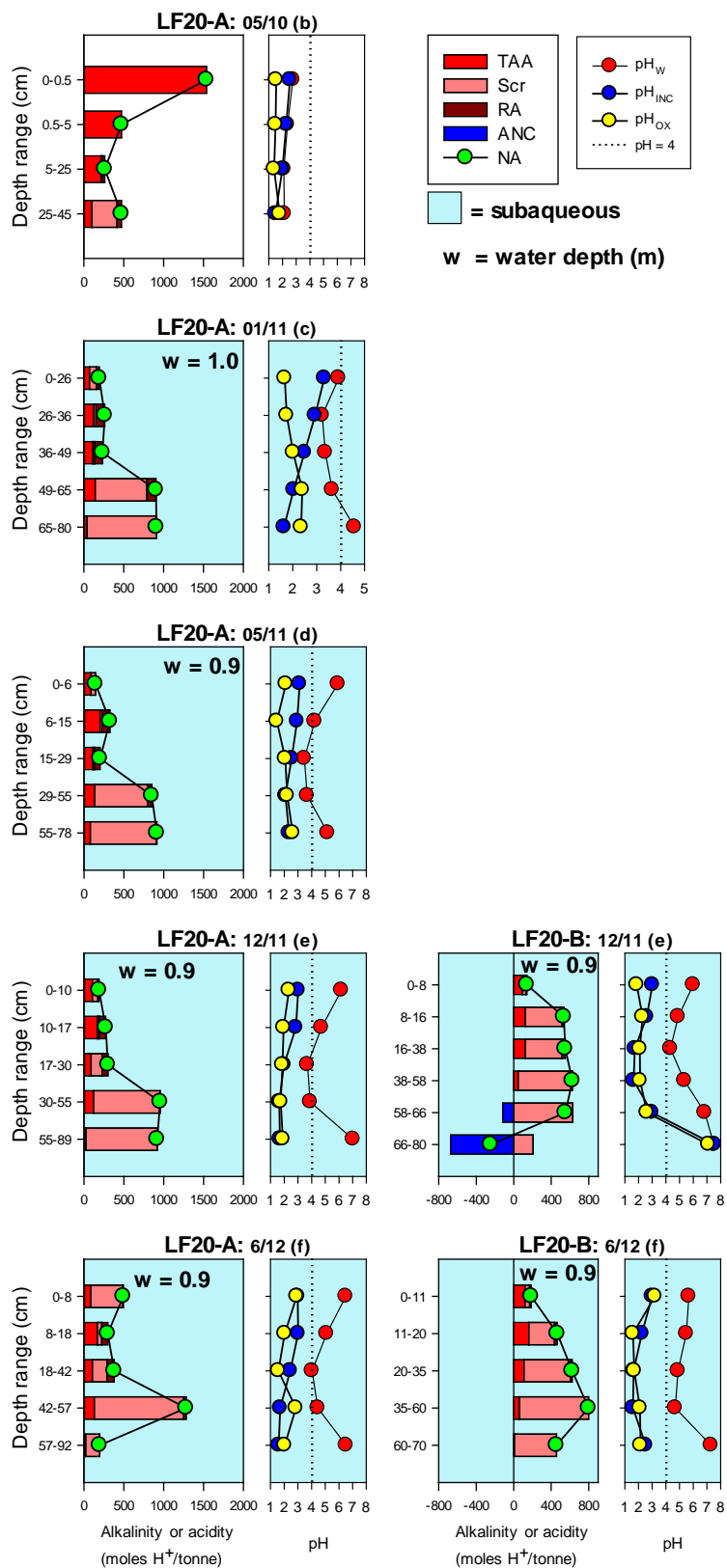
Figure 17-3 pH and acid-base accounting data plotted against depth for each profile collected. Note: pH$_{KCl}$ was used in plot LF20-A:01/11 (c) because not pH$_w$ measurements were available

17.4 Summary and discussion

Acidification potential assessment and ASS material classification were carried out for each soil sample collected, according to the definitions and methods presented in Section 1.3 and Section 2.4 respectively. A summary of acidification potential and ASS material classification is presented in Table 17-1.

Acidification hazard assessment and ASS subtype classification were carried out for each soil profile collected. ASS subtype classification was achieved using the methods described in Appendix 2. Acidification hazard assessment was based on: (i) landscape position (Figure 17-1), (ii) soil morphology (Section 17.2), (iii) acid-base accounting (Figure 17-3), (iv) pH data (Figure 17-3), (v) acidification potential (Table 17-1) and (vi) ASS material and subtype classification (Table 17-1). Acidification hazard categories were: (i) very low, (ii) low, (iii) medium and (iv) high. A summary of ASS subtype classification and acidification hazard for each profile collected between May 2010 and June 2012 is presented in Table 17-1.

Soil profiles at Boggy Lake comprised sulfuric and hypersulfidic clay soil with high acidification hazard ratings (Table 17-1). At site LF20-A, when the profile was dry, acidity above 25 cm was dominated by TAA and there was no ANC present (Figure 17-3). Below 25 cm, there was a combination of RA, TAA and S_{CR}. Reflooding and inundation, for a period of 21 months, resulted in an increase in the proportion of S_{CR} relative to TAA and RA above 30 to 40 cm (Table 17-2). At depth, NA remained extremely high and was dominated by S_{CR}. Soil material has remained hypersulfidic or sulfuric with high acidification hazard ratings (Table 16-2).

A new site (LF20-B; Figure 17-1) was established during Sampling-e that was located in the middle of Boggy Lake, approximately 750 m north west of LF20-A. This site had been inundated for 15 and 21 months since drought conditions had abated. Acidity was dominated throughout the profile by high concentrations of S_{CR} (> 600 moles H^+/tonne) with TAA and RA present. No ANC was present in Sampling-f or above 58 cm in Sampling-e (Figure 17-3). Soil material classified as hypersulfidic and was considered to pose a high acidification hazard.

Soil at Boggy Lake was considered to pose a high acidification hazard.

Table 17-1 Summary of acidification potential, ASS material classification, ASS subtype classification and acidification hazard (* indicates sulfuric soil material). The soil texture in brackets following the ASS subtype classification indicates the dominant texture of the profile

Sample	Sampling	Depth (cm)	pH$_{OX}$ < 2.5	pH$_{INC}$ < 4.0	NA > 0	Acidification potential	ASS material classification	ASS subtype classification	Acidification hazard
LF20-A									
LFb20-A.1	b	0-0.5	1	1	1	3*	Sulfuric sandy clay		
LFb20-A.2	b	0.5-5	1	1	1	3*	Sulfuric sandy clay	Sulfuric clay	
LFb20-A.3	b	5-25	1	1	1	3*	Sulfuric sandy clay	soil (clay)	High
LFb20-A.4	b	25-45	1	1	1	3*	Sulfuric sandy clay		
LFc20-A.1	c	0-26	1	1	1	3*	Sulfuric sandy clay		
LFc20-A.2	c	26-36	1	1	1	3*	Sulfuric sandy clay	Sulfuric	
LFc20-A.3	c	36-49	1	1	1	3*	Sulfuric sandy clay	subaqueous	High
LFc20-A.4	c	49-65	1	1	1	3*	Sulfuric clay	clay soil (clay)	
LFd20-A.1	d	0-6	1	1	1	3	Hypersulfidic clay		
LFd20-A.2	d	6-15	1	1	1	3	Hypersulfidic clay	Sulfuric	
LFd20-A.3	d	15-29	1	1	1	3*	Sulfuric clay	subaqueous	High
LFd20-A.4	d	29-55	1	1	1	3*	Sulfuric clay	clay soil (clay)	
LFd20-A.5	d	55-78	0	1	1	2	Hypersulfidic clay		
LFe20-A.1	e	0-10	1	1	1	3	Hypersufilidic medium clay		
LFe20-A.2	e	10-17	1	1	1	3	Hypersufilidic medium clay	Sulfuric	
LFe20-A.3	e	17-30	1	1	1	3*	Sulfuric medium clay	subaqueous	High
LFe20-A.4	e	30-55	1	1	1	3*	Sulfuric medium clay	clay soil (clay)	
LFe20-A.5	e	55-89	1	1	1	3	Hypersufilidic medium clay		
LFf20-A.1	f	0-8	0	1	1	2	Hypersufilidic heavy clay		
LFf20-A.2	f	8-18	1	1	1	3	Hypersufilidic heavy clay	Hypersulfidic	
LFf20-A.3	f	18-42	1	1	1	3	Hypersufilidic heavy clay	subaqueous	High
LFf20-A.4	f	42-57	0	1	1	2	Hypersufilidic heavy clay	clay soil (clay)	
LFf20-A.5	f	57-92	1	1	1	3	Hypersufilidic heavy clay		
LF20-B									
LFe20-B.1	e	0-8	1	1	1	3	Hypersufilidic heavy clay		
LFe20-B.2	e	8-16	1	1	1	3	Hypersufilidic heavy clay	Hypersulfidic	
LFe20-B.3	e	16-38	1	1	1	3	Hypersufilidic heavy clay	subaqueous	High
LFe20-B.4	e	38-58	1	1	1	3	Hypersufilidic heavy clay	clay soil (clay)	
LFe20-B.5	e	58-66	0	1	1	2	Hypersufilidic sandy loam		
LFe20-B.6	e	66-80	0	0	0	0	Hyposulfidic heavy clay		
LFf20-B.1	f	0-11	0	1	1	2	Hypersufilidic heavy clay		
LFf20-B.2	f	11-20	1	1	1	3	Hypersufilidic heavy clay	Hypersulfidic	
LFf20-B.3	f	20-35	1	1	1	3	Hypersufilidic heavy clay	subaqueous	High
LFf20-B.4	f	35-60	1	1	1	3	Hypersufilidic heavy clay	clay soil (clay)	
LFf20-B.5	f	60-70	1	1	1	3	Hypersufilidic sandy loam		

Table 17-2 Summary of temporal and spatial variations and changes in ASS subtypes at each site (**A** and **B**). Note: (i) Cells shaded orange summarise data presented within this report, (ii) all other cells are based on/extrapolated from data presented in Fitzpatrick *et al.* (2008a; 2008b; 2009b; 2008c) and (iii) cells bordered in blue indicate subaqueous

Boggy Lake		Drought End winter 2010 (b)	Post drought Summer 2011 (c)	Post drought Winter 2011 (d)	Post-drought start summer 2011/12 (e)	Post-drought start winter 2011/12 (f))	Summary
LF20-A	[1]Classification & [2]Acid hazard	Sulfuric* clay (H)	Sulfuric* subaqueous clay (H)	Sulfuric* subaqueous clay (H)	Sulfuric* subaqueous clay (H)	Hypersulfidic subaqueous clay (H)	During the extreme drought period (2007 to 2009) soil remained Sulfuric. Inundation, following winter 2010, caused the formation of Hypersulfidic and Sulfuric subaqueous soil.
	Dominant water and ASS process	LW & Sulfuric	UW & Sulfuric	UW & Sulfuric	UW & Sulfuric	UW & Sulfide	
LF20-A	[1]Classification & [2]Acid hazard	No data	No data	No data	Hypersulfidic subaqueous clay (H)	Hypersulfidic subaqueous clay (H)	Following inundation in winter 2010, soil material remained Hypersulfidic subaqueous clay soil.
	Dominant water and ASS process	No data	No data	No data	UW & Sulfide	UW & Sulfide	

[1] **Classification – Acid Sulfate Soil subtype classification**
[2] **Acid hazard – Acidification hazard: H = High; M = medium; L = Low; VL = Very Low**
Dominant Water process
LW – Lowering water level regime to expose soil to air due to drought conditions and water evaporation
UW – Unchanged water regime, which had not yet evaporated to expose soil to air
RW – Rising water level regime to inundate and saturate soils by reflooding (e.g. due to pumping, regulator installation, river flow and groundwater)
RF – Rain fall rewetting and natural reflooding to inundate and saturate soils

Dominant ASS – process
Sulfuric – Sulfuricization - oxidation of pyrite in hypersulfidic material due to onset of aerobic conditions to form sulfuric material
Sulfuric* – As above with acidic minerals and/or salt efflorescences noted (i.e. measurable RA)
Sulfide – Sulfidization due to sulfide accumulation to form hypersulfidic material
Monosulfide – Monosulfidization due to monosulfide accumulation to form monosulfidic material
Leach – Leaching of acid from soil by winter rain fall
Sulfuric **subaqueous** with **overlying circa neutral water** pH >4: = font coloured blue or default
Sulfuric **subaqueous** soil with **overlying acid water** pH <4: = font coloured red
Where h_1 to h_3 = historical sampling; (a) – (b) sampling conducted in this project

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

18. LF21 – WINDMILL SITE

Summary

Overall, soil at the Windmill Site was considered to pose a medium to high acidification hazard.

Profiles were all collected after a period of drought (2007 to 2009) and following reflooding in October 2010. Closest to the shoreline, soil profiles were classified as hypersulfidic subaqueous with high acidification hazard ratings. Acidity was dominated by S_{CR} with minor TAA and no ANC. Approximately 250 m from the shoreline, soil profiles were classified as hypersulfidic subaqueous with medium acidification hazard ratings. Once again, acidity was dominated by S_{CR} but the presence of a few small gastropods contributed ANC to the profile above 50 cm. There were no significant differences noted between Samplings-c, d, e & f.

18.1 Background

Study area LF21 was located on the northern side of Lake Albert (Figure 1-1). As part of this study, sampling was carried out in December 2011 and June 2012 (Samplings-e/f). Previous samplings were undertaken in January and February 2011 (Sampling-c) and May and June 2011 (Sampling-d). Sampling site locations are displayed in Figure 18-1.
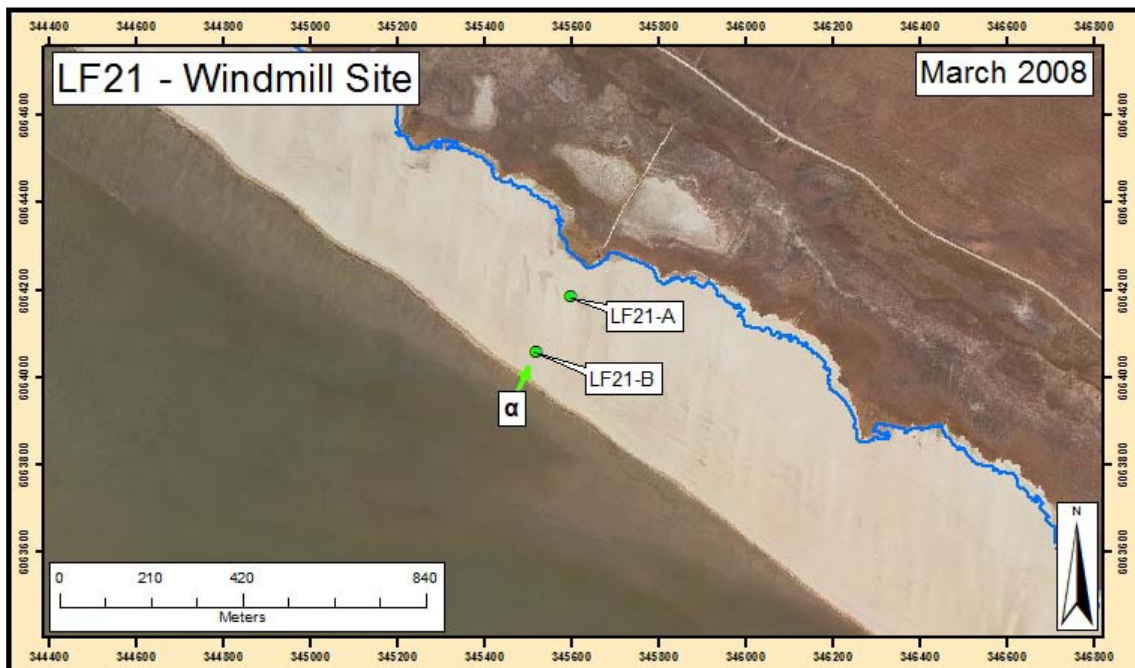
Figure 18-1 Sample location map. Aerial photograph taken in March 2008 (Blue line: sampling-c, d, e & f water level)

At the time of Sampling-c/d/e, the lake level had risen to approximately 0.6 m AHD and the study area had been completely re-flooded (Figure 18-1: Figure 18-2). Prior to this, the aerial photograph taken in March 2008 shows that the study area comprised an extensive beach (Figure 18-1).

Figure 18-2 Site photographs. Refer to Figure 18-1 for the location and direction that photographs were taken, indicated by α (photographs were selected that best depicted the environmental conditions at the study area during each sampling)

18.2 Soils

Soils at the Windmill Site generally comprised hypersulfidic soil. A summary of encountered soils is provided below and site locations are presented in Figure 18-1. Detailed profile descriptions are presented in Appendix 4 and Appendix 8. Profile photographs are presented in Appendix 5.

LF21-A
When water levels rose and the study area became inundated (Samplings-c/d), a UWS was used to collect subaqueous soil profiles on two occasions. The investigations encountered dark grey sand with few black mottles and medium roots. This was underlain, to depths of 36 and 37 cm, by dark grey and olive grey sand to loamy sand with layers of dark grey organic material and medium Phragmites roots. Underlying this, to the maximum extent of investigation (62 and 65 cm), was grey loamy sand with few roots.
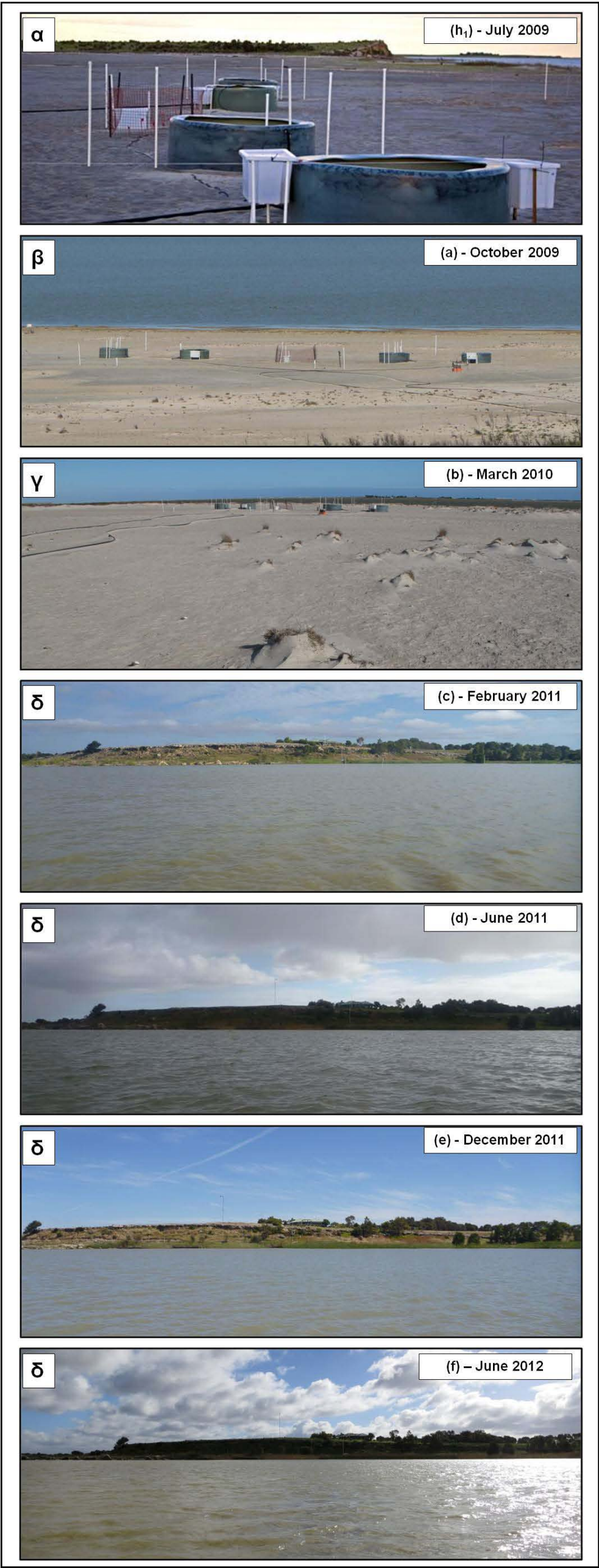
As part of this study, a UWS and push tube were used to collect subaqueous soil profiles (Samplings-e/f). Sampling-e encountered 16 cm of dark grey sand. This was underlain, to a depth of 32 cm, by dark grey sand with few medium coarse roots. Underlying this, to the maximum extent of investigation (59 cm), was grey loamy sand. Sampling-f encountered 6 cm of dark grey sand. This was underlain, to a depth of 26 cm, by dark grey sand with few medium coarse roots. Underlying this, to a depth of 47 cm, was dark grey sand with 20% darker coarse mottles and few shell fragments. This was underlain, to the maximum extent of investigation (67 cm), by grey loamy sand.

LF21-B
When water levels rose and the study area became inundated (Samplings-c/d), a UWS was used to collect subaqueous soil profiles on two occasions. The investigations encountered 27 and 36 cm of light olive brown sand with brown and black mottles and few small whole bivalve shells. This was underlain, to depths of 52 and 61 cm, by dark olive grey spongy clay loam with bands (1 cm) of spongy organic material (Coorongite). Underlying this, to the maximum extent of investigation (62 and 73 cm), was dark grey loamy sand with black band and common shell fragments.

As part of this study, a UWS and push tube were used to collect subaqueous soil profiles (Samplings-e/f). Sampling-e encountered 21 cm of light brownish grey sand with darker bands and bivalve shells. This was underlain, to a depth of 44 cm, by very dark grey loamy light clay. Underlying this, to the maximum extent of investigation (54 cm), was dark grey sand with common shell fragments. Sampling-f encountered 25 cm of dark grey sand with few medium roots. This was underlain, to a depth of 58 cm, by dark grey sand with few fine roots and bivalve shells. Underlying this, to a depth of 84 cm, was very dark grey loamy light clay with few fine roots. This was underlain, to the maximum extent of investigation (88 cm), by dark grey loamy sand with clayey bands and bivalves.

18.3 Soil acidity and acid-base accounting

Acid-base accounting was carried out according to the methods described in Section 2.3. Acid-base accounting and pH data (pH_{OX}, pH_{INC} & pH_W), for each soil layer, are presented in Figure 18-2. These data were used to inform the acidification hazard assessment that is presented in Table 18-1.
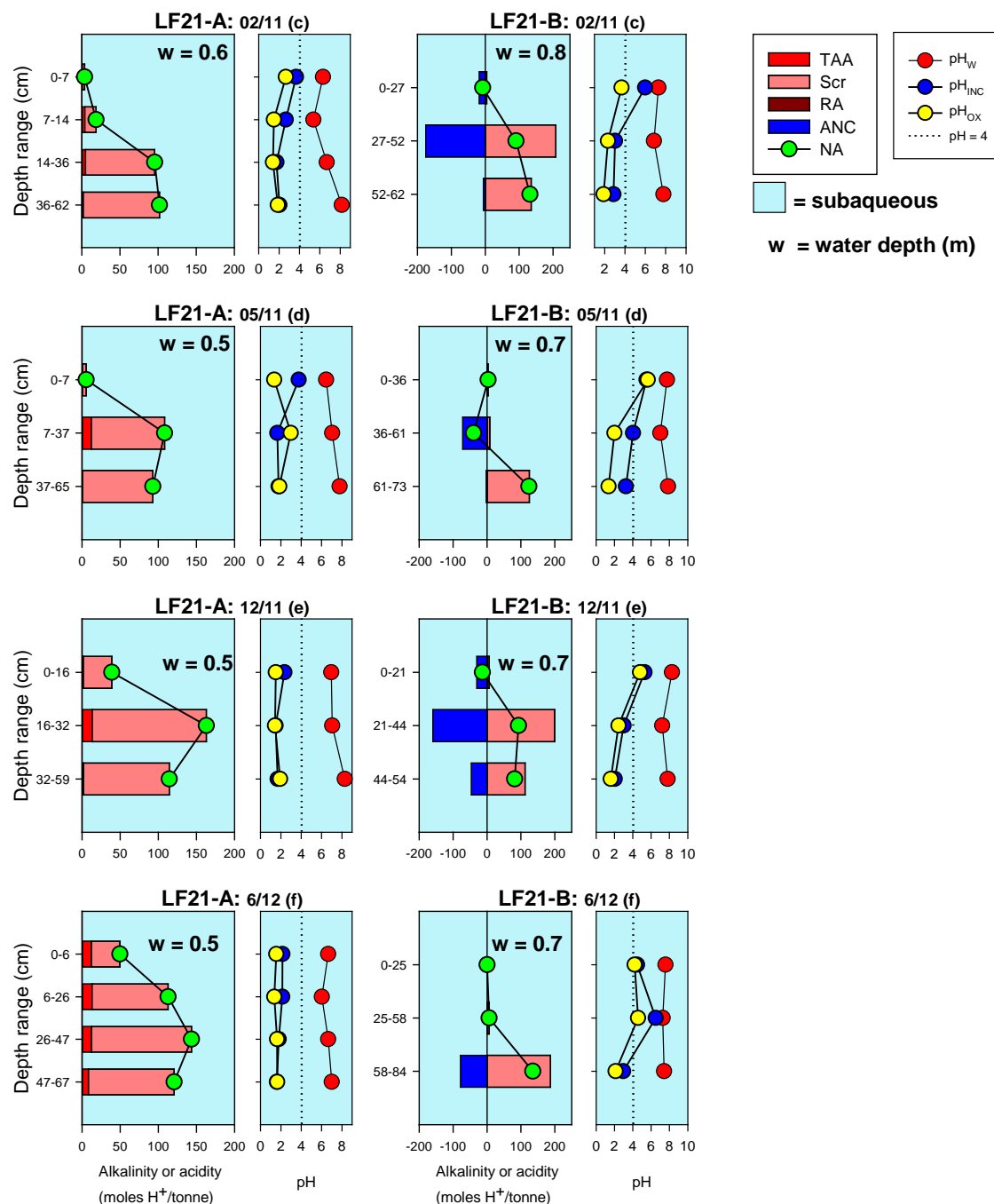
Figure 18-3 pH and acid-base accounting data plotted against depth for each profile collected

18.4 Summary and discussion

Acidification potential assessment and ASS material classification were carried out for each soil sample collected, according to the definitions and methods presented in Section 1.3 and Section 2.4 respectively. A summary of acidification potential and ASS material classification is presented in Table 18-1.

Acidification hazard assessment and ASS subtype classification were carried out for each soil profile collected. ASS subtype classification was achieved using the methods described in Appendix 2. Acidification hazard assessment was based on: (i) landscape position (Figure 18-1), (ii) soil morphology

(Section 18.2), (iii) acid-base accounting (Figure 18-3), (iv) pH data (Figure 18-3), (v) acidification potential (Table 18-1) and (vi) ASS material and subtype classification (Table 18-1). Acidification hazard categories were: (i) very low, (ii) low, (iii) medium and (iv) high. A summary of ASS subtype classification and acidification hazard for each profile collected between February 2011 and June 2012 is presented in Table 18-1.

Profiles at the Windmill Site were all collected after a period of drought (2007 to 2009) and following reflooding in October 2010. Closest to the shoreline (LF21-A; Figure 18-1), soil profiles were classified as hypersulfidic subaqueous with high acidification hazard ratings (Table 18-1). Acidity was dominated by S_{CR} with minor TAA and no ANC (Figure 18-3). Approximately 250 m from the shoreline (LF21-B; Figure 18-1), soil profiles were classified as hypersulfidic subaqueous with medium acidification hazard ratings (Table 18-1). Once again, acidity was dominated by S_{CR} but the presence of small gastropods contributed ANC above 50 cm (Figure 18-3). There were no significant differences noted between Samplings-c, d, e and f.

Overall, soil at the Windmill Site was considered to pose a medium to high acidification hazard.

Table 18-1 Summary of acidification potential, ASS material classification, ASS subtype classification and acidification hazard (* indicates sulfuric soil material). The soil texture in brackets following the ASS subtype classification indicates the dominant texture of the profile

Sample	Sampling	Depth (cm)	pH_{OX} < 2.5	pH_{INC} < 4.0	NA > 0	Acidification potential	ASS material classification	ASS subtype classification	Acidification hazard
LF21-A									
LFc21-A.1	c	0-7	0	1	1	2	Sand	Hypersulfidic subaqueous soil (sand)	High
LFc21-A.2	c	7-14	1	1	1	3	Hypersulfidic sand		
LFc21-A.3	c	14-36	1	1	1	3	Hypersulfidic loamy sand		
LFc21-A.4	c	36-62	1	1	1	3	Hypersulfidic loamy sand		
LFd21-A.1	d	0-7	1	1	1	3	Sand	Hypersulfidic subaqueous soil (sand)	High
LFd21-A.2	d	7-37	0	1	1	2	Hypersulfidic loamy sand		
LFd21-A.3	d	37-65	1	1	1	3	Hypersulfidic clay		
LFe21-A.1	e	0-16	1	1	1	3	Hypersulfilidic sand	Hypersulfidic subaqueous soil (sand)	High
LFe21-A.2	e	16-32	1	1	1	3	Hypersulfilidic sand		
LFe21-A.3	e	32-59	1	1	1	3	Hypersulfilidic loamy sand		
LFf21-A.1	f	0-6	1	1	1	3	Hypersulfilidic sand	Hypersulfidic subaqueous soil (sand)	High
LFf21-A.2	f	6-26	1	1	1	3	Hypersulfilidic sand		
LFf21-A.3	f	26-47	1	1	1	3	Hypersulfilidic sand		
LFf21-A.4	f	47-67	1	1	1	3	Hypersulfilidic loamy sand		
LF21-B									
LFc21-B.1	c	0-27	0	0	0	0	Loam	Hypersulfidic subaqueous soil (loam)	Medium
LFc21-B.2	c	27-52	1	1	1	3	Hypersulfidic loam		
LFc21-B.3	c	52-62	1	1	1	3	Hypersulfidic clayey sand		
LFd21-B.1	d	0-36	0	0	1	1	Sand	Hypersulfidic subaqueous soil (sand)	Low
LFd21-B.2	d	36-61	1	0	0	1	Hyposulfidic loamy clay		
LFd21-B.3	d	61-73	1	1	1	3	Hypersulfidic loamy sand		
LFe21-B.1	e	0-21	0	0	0	0	Hyposulfidic sand	Hypersulfidic subaqueous soil (sand)	Medium
LFe21-B.2	e	21-44	1	1	1	3	Hypersulfilidic loamy clay		
LFe21-B.3	e	44-54	1	1	1	3	Hypersulfilidic loamy sand		
LFf21-B.1	f	0-25	0	0	0	0	Sand	Hypersulfidic subaqueous clay soil (sand)	Low
LFf21-B.2	f	25-58	0	0	1	1	Hyposulfidic sand		
LFf21-B.3	f	58-84	1	1	1	3	Hypersufilidic loamy light clay		

Table 18-2 Summary of temporal and spatial variations and changes in ASS subtypes at each site (**A** and **B**). Note: (i) Cells shaded orange summarise data presented within this report, (ii) all other cells are based on/extrapolated from data presented in Fitzpatrick *et al*. (2008a; 2008b; 2009b; 2008c) and (iii) cells bordered in blue indicate subaqueous

Windmill Site		Post drought Summer 2011 (c)	Post drought Winter 2011 (d)	Post-drought start summer 2011/12 (e)	Post-drought start winter 2011/12 (f)	Summary
LF21-A	[1]Classification & [2]Acid hazard	**Hypersulfidic subaqueous (H)**	**Hypersulfidic subaqueous (H)**	**Hypersulfidic subaqueous (H)**	**Hypersulfidic subaqueous (H)**	Following inundation in winter 2010, soil material remained Hypersulfidic subaqueous.
	Dominant water and ASS process	**RW & Sulfide**	**UW & Sulfide**	**UW & Sulfide**	**UW & Sulfide**	
LF21-B	[1]Classification & [2]Acid hazard	**Hypersulfidic subaqueous (M)**	**Hypersulfidic subaqueous (L)**	**Hypersulfidic subaqueous (M)**	**Hypersulfidic subaqueous (L)**	Following inundation in winter 2010, soil material remained Hypersulfidic subaqueous.
	Dominant water and ASS process	**RW & Sulfide**	**UW & Sulfide**	**UW & Sulfide**	**UW & Sulfide**	

[1] **Classification – Acid Sulfate Soil subtype classification**
[2] **Acid hazard – Acidification hazard: H = High; M = medium; L = Low; VL = Very Low**
Dominant Water process
LW – Lowering water level regime to expose soil to air due to drought conditions and water evaporation
UW – Unchanged water regime, which had not yet evaporated to expose soil to air
RW – Rising water level regime to inundate and saturate soils by reflooding (e.g. due to pumping, regulator installation, river flow and groundwater)
RF – Rain fall rewetting and natural reflooding to inundate and saturate soils

Dominant ASS – process
Sulfuric – Sulfuricization - oxidation of pyrite in hypersulfidic material due to onset of aerobic conditions to form sulfuric material
Sulfuric* – As above with acidic minerals and/or salt efflorescences noted (i.e. measurable RA)
Sulfide – Sulfidization due to sulfide accumulation to form hypersulfidic material
Monosulfide – Monosulfidization due to monosulfide accumulation to form monosulfidic material
Leach – Leaching of acid from soil by winter rain fall
Sulfuric **subaqueous** with **overlying circa neutral water** pH >4: = font coloured blue or default
Sulfuric **subaqueous** soil with **overlying acid water** pH <4: = font coloured red
Where h_1 to h_3 = historical sampling; (a) – (b) sampling conducted in this project

19. LF23 – LOWER CURRENCY

Summary

Soil in Lower Currency was considered to pose a medium to high acidification hazard.

Soil profiles comprised sulfuric and hypersulfidic soil with high and medium acidification hazard ratings. Under drought conditions and shortly after reflooding (Sampings-h_1/h_2), acidity within the profile comprised S_{CR} and TAA. These profiles were classified as sulfuric with high acidification hazard ratings. By the time of Samplings-c/d, the site had been inundated for 12 and 18 months respectively, the amount of acidity above 30 cm had decreased and the amount of S_{CR} relative to TAA had increased. At the time of Sampling-e/f, the site had been inundated for approximately 2 and 2 ½ years respectively. No significant changes were noted between Samplings-d & e/f. It appears that reflooding has encouraged reducing conditions and limited sulfate reduction. Additionally, it may have caused some flushing of acidity (H^+) from surface sediments (i.e. either down through the profile and/or into the water column). This has resulted in previously sulfuric sediments transforming to hypersulfidic subaqueous soil.

19.1 Background

Study area LF23 was located in the lower reaches of Currency Creek (Figure 1-1). As part of this study, sampling was carried out in December 2011 and June 2012 (Samplings-e/f). Previous samplings were undertaken in May and June 2011 (Sampling-d) and January and February 2011 (Sampling-c). Additionally, data from historic sampling (Sampling-h_1 & h_2), carried out in November 2008 and December 2009, were reassessed as part of this study. Sampling site locations are displayed in Figure 19-1.
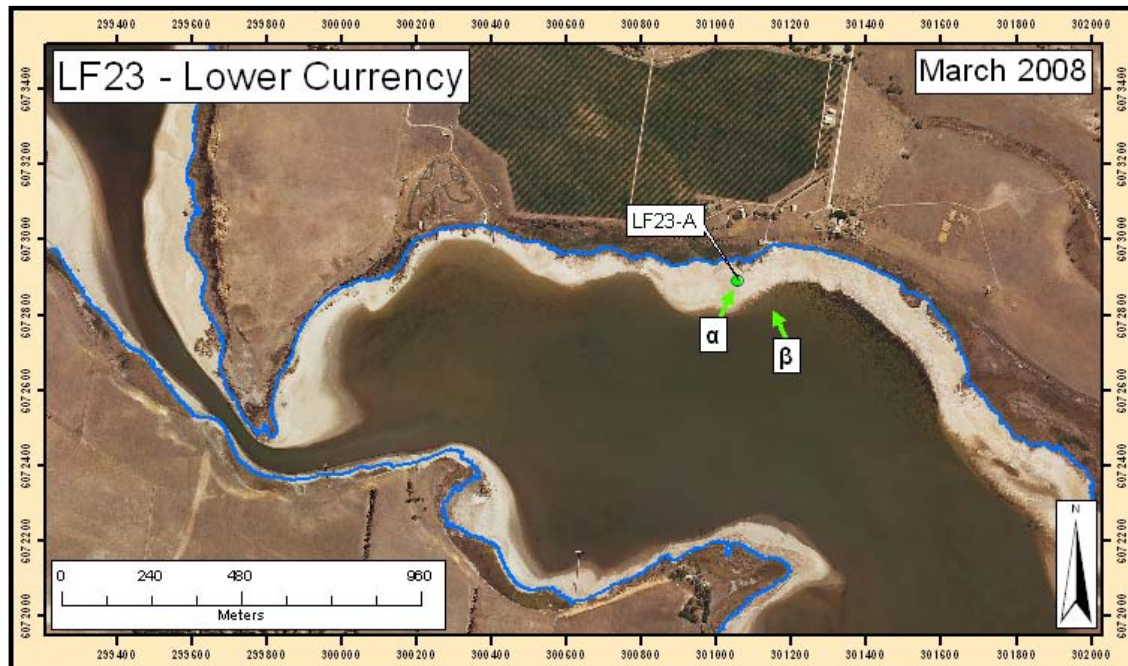
Figure 19-1 Sample location map. Aerial photograph taken in March 2008 (Blue line: sampling-c, d, e & f water level)

At the time of Samplings-c/d/e, the study area had been completely re-flooded (Figure 19-1: Figure 19-2). Prior to this, in November 2008 (Sampling-h_1), the study area was dry and the soil surface was desiccated (Figure 19-2). By December 2009 (Sampling-h_2), water level had risen in Currency Creek (caused by the construction of the Currency Creek Regulator) and the study area was subaqueous (Figure 19-2).
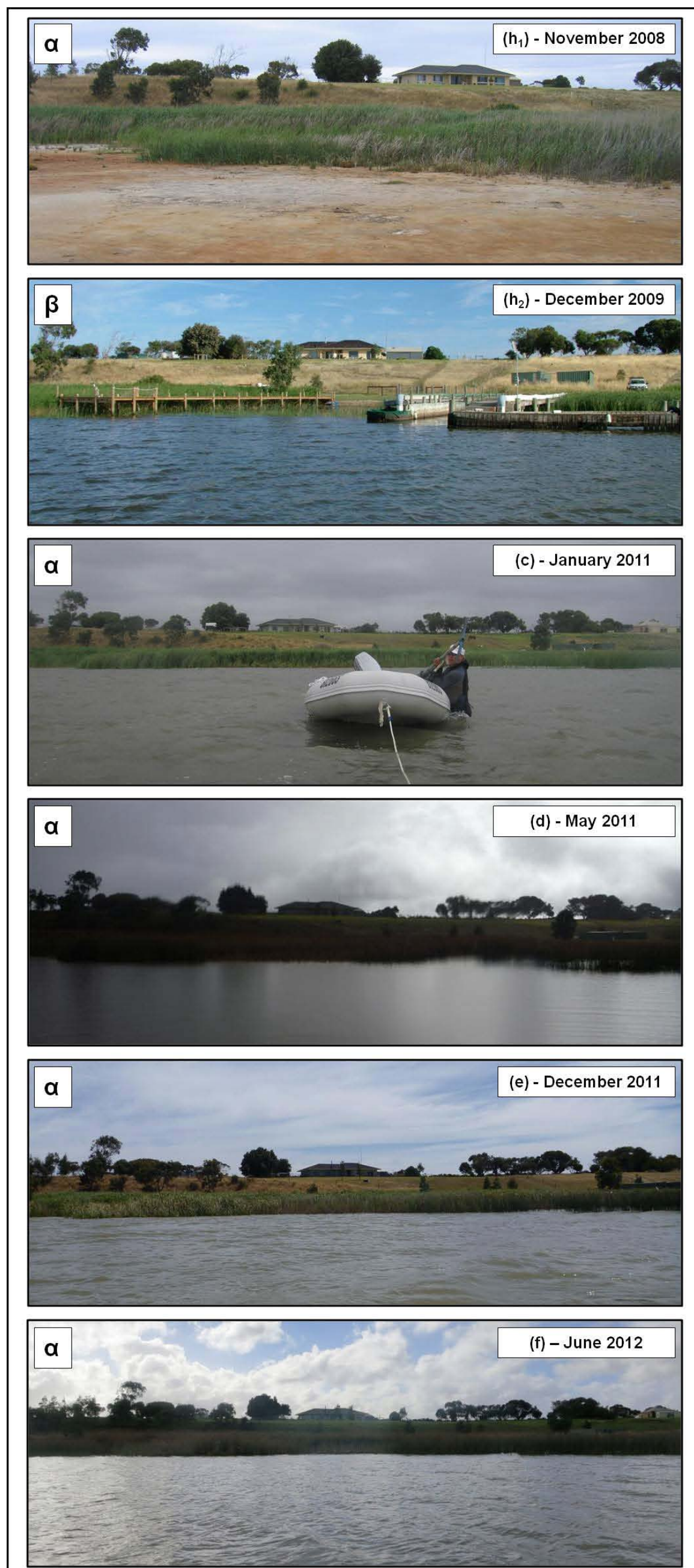
Figure 19-2 Site photographs. Refer to Figure 19-1 for the location and direction that photographs were taken, indicated by α or β (photographs were selected that best depicted the environmental conditions at the study area during each sampling)

19.2 Soils

Soils at the Lower Currency site generally comprised sulfuric and hypersulfidic sand. A summary of encountered soils is provided below and site locations are presented in Figure 19-1. Detailed profile descriptions are presented in Appendix 4 and Appendix 8. Profile photographs are presented in Appendix 5.

LF23-A
During previous studies, profiles were collected at this site on two occasions (Sampling-h_1/h_2). Samplings encountered 2 cm of black monosulfidic sand overlying 27 cm of grey loamy sand with 20 % distinct jarosite mottles. This was underlain, to a depth of 60 cm, by grey loamy sand with reddish brown mottles (5 %) and common roots with jarosite coatings. This was underlain, to the maximum extent of investigation (90 cm), by dark grey to olive loamy sand with common relic roots and few jarosite mottles along root channels.

When water levels rose and the study area became inundated (Samplings-c/d), a UWS was used to collect subaqueous soil profiles on two occasions. The investigations encountered dark grey sand with few medium roots. This was underlain, to depths of 33 and 28 cm, by light brownish grey sand. Distinct jarosite mottles were present during Sampling-c and faint remnant jarosite mottles were noted during Sampling-d. This was underlain, to the maximum extent of investigation (46 and 54 cm), by greyish brown loamy sand with dark grey bands.

As part of this study, a UWS and push tube were used to collect subaqueous soil profiles (Samplings-e/f). The investigations encountered 7 to 8 cm of very dark grey to black sand. This was underlain, to depths of 25 to 26 cm, by greyish brown sand with 10 % pale jarosite mottles in Sampling-e. Underlying this, to depths of 40 to 49 cm, was grey sand with diffuse darker bands and 10 % distinct jarosite mottles in Sampling-f. This was underlain, to depths of 72 to 75 cm (75 cm was the maximum extent of investigation during Sampling-e), by very dark grey sand with clay bands. During Sampling-f, this was underlain, to the maximum extent of investigation (83 cm), by dark grey medium sand with clayey bands.

19.3 Soil acidity and acid-base accounting

Acid-base accounting was carried out according to the methods described in Section 2.3. Acid-base accounting and pH data (pH_{OX}, pH_{INC} & pH_W), for each soil layer, are presented in Figure 19-2. These data were used to inform the acidification hazard assessment that is presented in Table 19-1.
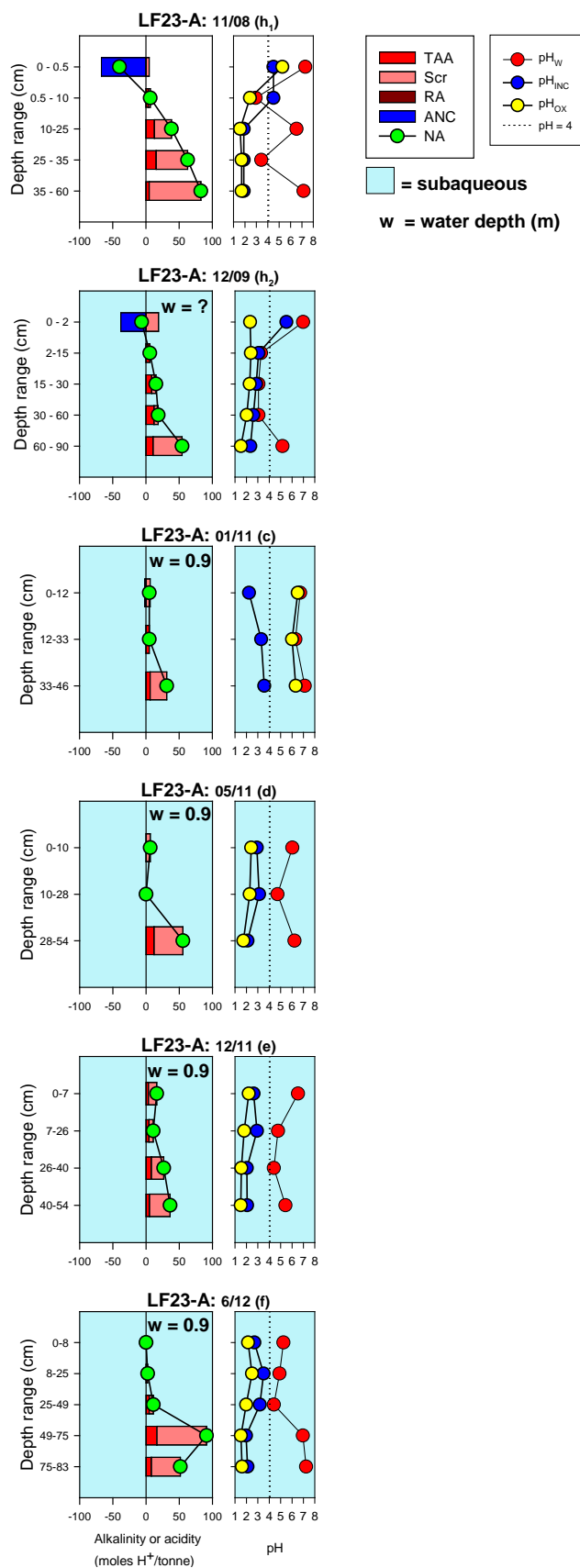
Figure 19-3 pH and acid-base accounting data plotted against depth for each profile collected

19.4 Summary and discussion

Acidification potential assessment and ASS material classification were carried out for each soil sample collected, according to the definitions and methods presented in Section 1.3 and Section 2.4 respectively. A summary of acidification potential and ASS material classification is presented in Table 19-1.

Acidification hazard assessment and ASS subtype classification were carried out for each soil profile collected. ASS subtype classification was achieved using the methods described in Appendix 2. Acidification hazard assessment was based on: (i) landscape position (Figure 19-1), (ii) soil morphology (Section 19.2), (iii) acid-base accounting (Figure 19-3), (iv) pH data (Figure 19-3), (v) acidification potential (Table 19-1) and (vi) ASS material and subtype classification (Table 19-1). Acidification hazard categories were: (i) very low, (ii) low, (iii) medium and (iv) high. A summary of ASS subtype classification and acidification hazard for each profile collected between November 2008 and June 2012 is presented in Table 19-1.

Soil profiles in the Lower Currency comprised sulfuric and hypersulfidic soil with high and medium acidification hazard ratings (Table 19-1). Under drought conditions and shortly after reflooding (Samplings-h_1/h_2), acidity within the profile comprised S_{CR} and TAA (Figure 19-3). These profiles were classified as sulfuric with high acidification hazard ratings. By the time of Samplings-c/d, the site had been inundated for 12 and 18 months respectively, the amount of acidity above 30 cm had decreased and the amount of S_{CR} relative to TAA had increased (Figure 19-3). At the time of Sampling-e, the site had been inundated for approximately 2 years. No significant changes were noted between Samplings-d & e/f. Reflooding may have encouraged reducing conditions and limited sulfate reduction. Additionally, it may have caused some flushing of acidity (H^+) from surface sediments (i.e. either down through the profile and/or into the water column). This has resulted in previously sulfuric sediments transforming to hypersulfidic subaqueous soil (Table 19-2).

Soil in the Lower Currency was considered to pose a medium to high acidification hazard.

Table 19-1 Summary of acidification potential, ASS material classification, ASS subtype classification and acidification hazard (* indicates sulfuric soil material). The soil texture in brackets following the ASS subtype classification indicates the dominant texture of the profile

Sample	Sampling	Depth (cm)	pH$_{OX}$ < 2.5	pH$_{INC}$ < 4.0	NA > 0	Acidification potential	ASS material classification	ASS subtype classification	Acidification hazard
LF23-A									
LFh(1)23-A.1	h$_1$	0 - 0.5	0	0	0	0	Sand		
LFh(1)23-A.2	h$_1$	0.5 - 10	1	0	1	2*	Sulfuric loamy sand		
LFh(1)23-A.3	h$_1$	10-25	1	1	1	3	Hypersulfidic loamy sand	Sulfuric soil (sand)	High
LFh(1)23-A.4	h$_1$	25 - 35	1	1	1	3*	Sulfuric loamy sand		
LFh(1)23-A.5	h$_1$	35 - 60	1	1	1	3	Hypersulfidic loamy sand		
LFh(2)23-A.1	h$_2$	0 - 2	1	0	0	1	Hyposulfidic sand		
LFh(2)23-A.2	h$_2$	2-15	1	1	1	3*	Sulfuric loamy sand		
LFh(2)23-A.3	h$_2$	15 - 30	1	1	1	3*	Sulfuric loamy sand	Sulfuric soil (sand)	High
LFh(2)23-A.4	h$_2$	30 - 60	1	1	1	3*	Sulfuric loamy sand		
LFh(2)23-A.5	h$_2$	60 - 90	1	1	1	3	Hypersulfidic loamy sand		
LFc23-A.1	c	0-12	0	1	1	2	Hypersulfidic sand		
LFc23-A.2	c	12-33	0	1	1	2	Sand	Hypersulfidic subaqueous soil (sand)	Medium
LFc23-A.3	c	33-46	0	1	1	2	Hypersulfidic sand		
LFd23-A.1	d	0-10	1	1	1	3	Hypersulfidic sand		
LFd23-A.2	d	10-28	1	1	0	2	Sand	Hypersulfidic subaqueous soil (sand)	High
LFd23-A.3	d	28-54	1	1	1	3	Hypersulfidic loamy sand		
LFe23-A.1	e	0-7	1	1	1	3	Hypersufilidic sand		
LFe23-A.2	e	7-26	1	1	1	3	Hypersufilidic sand	Hypersulfidic subaqueous soil (sand)	High
LFe23-A.3	e	26-40	1	1	1	3	Hypersufilidic sand		
LFe23-A.4	e	40-54	1	1	1	3	Hypersufilidic sand		
LFf23-A.1	f	0-8	1	1	0	2	Loamy sand		
LFf23-A.2	f	8-25	1	1	1	3	Sand		
LFf23-A.3	f	25-49	1	1	1	3	Hypersufilidic sand	Hypersulfidic subaqueous soil (sand)	Medium
LFf23-A.4	f	49-75	1	1	1	3	Hypersufilidic sand		
LFf23-A.5	f	75-83	1	1	1	3	Hypersufilidic sand		

Table 19-2 Summary of temporal and spatial variations and changes in ASS subtypes at each site (**A**). Note: (i) Cells shaded orange summarise data presented within this report, (ii) all other cells are based on/extrapolated from data presented in Fitzpatrick *et al.* (2008a; 2008b; 2009b; 2008c) and (iii) cells bordered in blue indicate subaqueous

Lower Currency		Drought: pre regulator Start summer 2008 (h₁)	Drought: post regulator Summer 2009 (h₂)	Post drought Summer 2011 (c)	Post drought Winter 2011 (d)	Post-drought start summer 2011/12 (e)	Post-drought start winter 2011/12 (f)	Summary
LF23-A	[1]Classification & [2]Acid hazard	**Sulfuric (H)**	**Sulfuric (H)**	**Hypersulfidic subaqueous (M)**	**Hypersulfidic subaqueous (H)**	**Hypersulfidic subaqueous (H)**	**Hypersulfidic subaqueous (H)**	During the extreme drought period (2007 to 2009) soil remained Sulfuric. Inundation, following winter 2010, caused the formation of Hypersulfidic subaqueous soil.
	Dominant water and ASS process	**LW & Sulfuric**	**LW & Sulfuric**	**RW & Sulfide**	**UW & Sulfide**	**UW & Sulfide**	**UW & Sulfide**	

[1] **Classification – Acid Sulfate Soil subtype classification**
[2] **Acid hazard – Acidification hazard: H = High; M = medium; L = Low; VL = Very Low**
Dominant Water process
LW – Lowering water level regime to expose soil to air due to drought conditions and water evaporation
UW – Unchanged water regime, which had not yet evaporated to expose soil to air
RW – Rising water level regime to inundate and saturate soils by reflooding (e.g. due to pumping, regulator installation, river flow and groundwater)
RF – Rain fall rewetting and natural reflooding to inundate and saturate soils

Dominant ASS – process
Sulfuric – Sulfuricization - oxidation of pyrite in hypersulfidic material due to onset of aerobic conditions to form sulfuric material
Sulfuric* – As above with acidic minerals and/or salt efflorescences noted (i.e. measurable RA)
Sulfide – Sulfidization due to sulfide accumulation to form hypersulfidic material
Monosulfide – Monosulfidization due to monosulfide accumulation to form monosulfidic material
Leach – Leaching of acid from soil by winter rain fall
Sulfuric **subaqueous** with **overlying circa neutral water** pH >4: = font coloured blue or default
Sulfuric **subaqueous** soil with **overlying acid water** pH <4: = font coloured red
Where h₁ to h₃ = historical sampling; (a) – (b) sampling conducted in this project

20. LF24 – LOWER FINNISS

Summary

Overall, soil in the Lower Finniss was considered to pose a high acidification hazard.

Soil profiles in the Lower Finniss comprised sulfuric and hypersulfidic soil with high acidification hazard ratings. Under drought conditions and shortly after reflooding (Sampings-h_1/h_2), acidity within the profile comprised S_{CR}, TAA and RA. These profiles were classified as sulfuric and hypersulfidic with high acidification hazard ratings. By the time of Samplings-c/d, the sites had been inundated for 12 and 18 months respectively and some TAA had converted to S_{CR}. At the time of Samplings-e/f, the sites had been inundated for approximately 2 and 2 ½ years respectively. No significant changes were noted between Samplings-d & e/f. Prolonged inundation most likely encouraged reducing conditions, leading to limited sulfate reduction and the transformation of previously sulfuric sediments to hypersulfidic subaqueous soil.

Although soils converted from sulfuric to hypersulfidic subaqueous, net acidities remained very high and TAA and RA were still present in the profiles. Neutralisation was considered to be limited at this site and the soil material was considered to pose a high acidification hazard. On drying, soil material is likely to re-acidify rapidly and may impact surface waters upon rewetting.

20.1 Background

Study area LF24 was located in the lower reaches of Finniss River (Figure 1-1). As part of this study, sampling was carried out in December 2011 and June 2012 (Samplings-e/f). Previous samplings were undertaken in May and June 2011 (Sampling-d) and January and February 2011 (Sampling-c). Additionally, data from historic sampling (Sampling-h_1 & h_2), carried out in November 2008 and December 2009, were reassessed as part of this study. Sampling site locations are displayed in Figure 20-1.
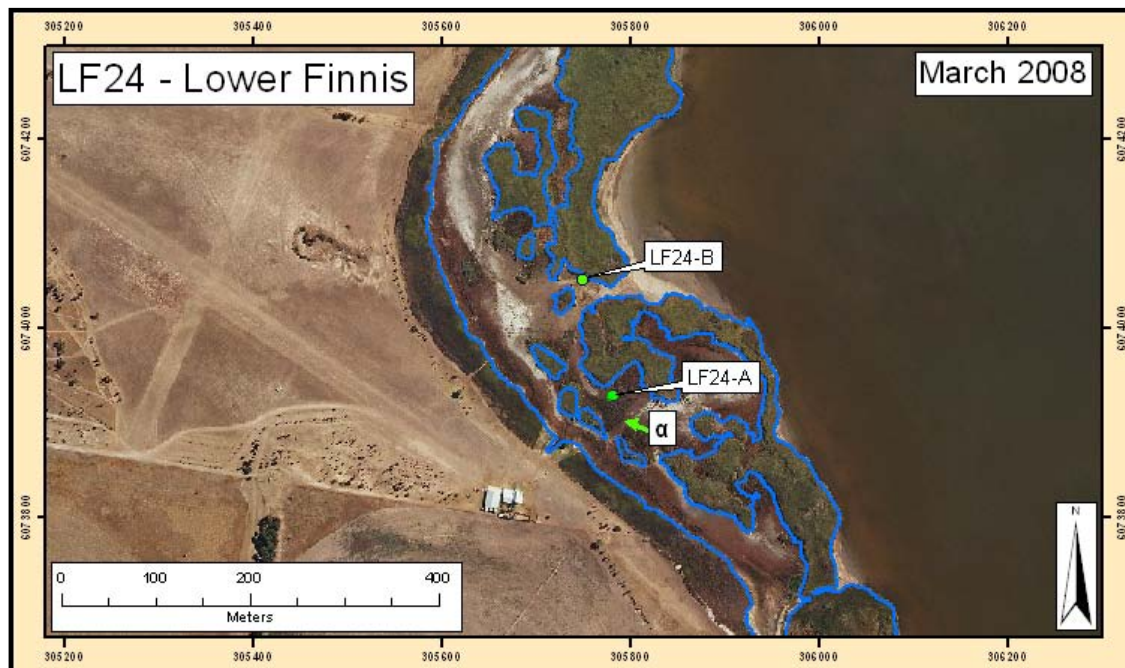
Figure 20-1 Sample location map. Aerial photograph taken in March 2008 (Blue line: sampling-c, d, e & f water level)

At the time of Samplings-c/d/e, the study area had been completely re-flooded (Figure 20-1: Figure 20-2). Prior to this, in November 2008 (Sampling-h_1), the study area was dry and the soil surface was cracked and desiccated (Figure 20-2). By December 2009 (Sampling-h_2), the water level had risen in the Finniss River (caused by the construction of the Clayton regulator) and the study area was subaqueous (Figure 20-2).
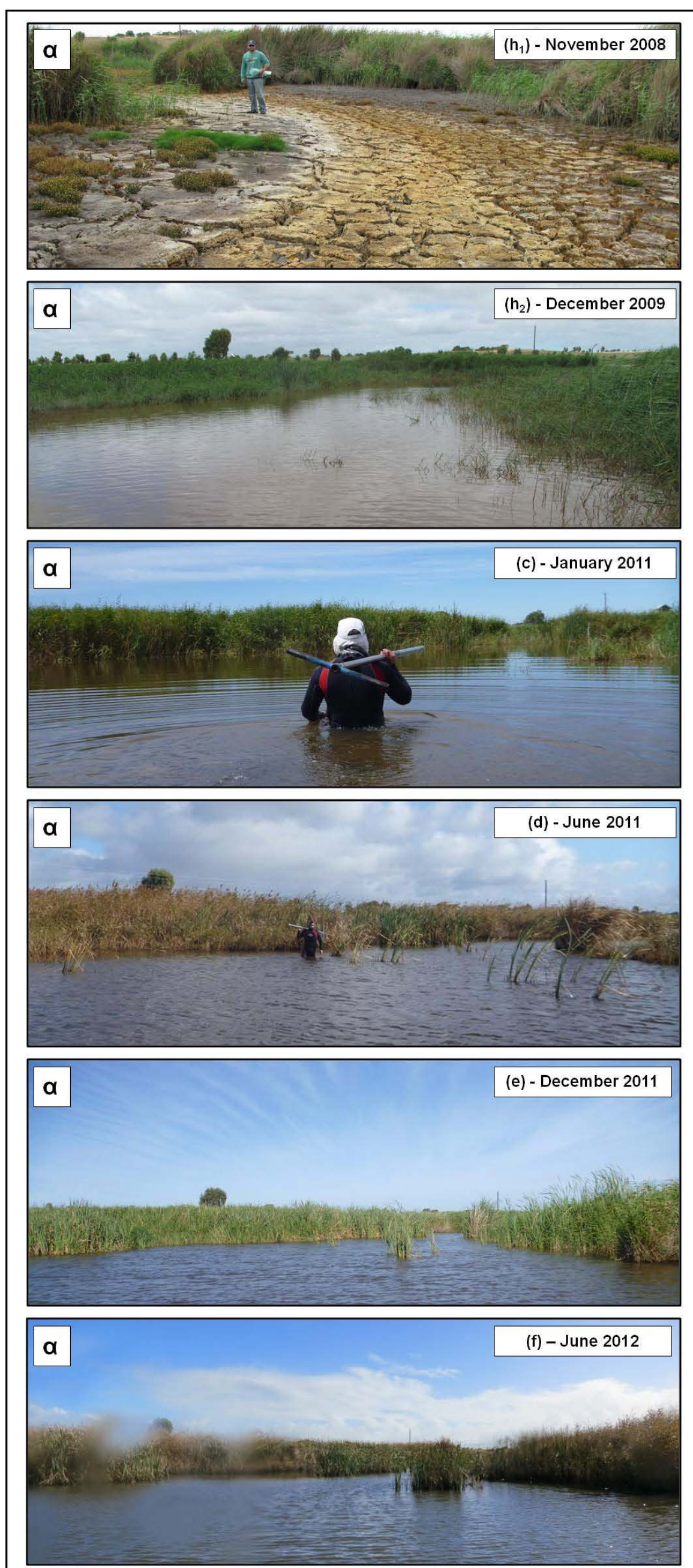
Figure 20-2 Site photographs. Refer to Figure 20-1 for the location and direction that photographs were taken, indicated by α (photographs were selected that best depicted the environmental conditions at the study area during each sampling)

20.2 Soils

Soils at the Lower Finniss site generally comprised sulfuric and hypersulfidic clay soil. A summary of encountered soils is provided below and site locations are presented in Figure 20-1. Detailed profile descriptions are presented in Appendix 4 and Appendix 8. Profile photographs are presented in Appendix 5.

LF24-A

During previous studies, profiles were collected at this site on two occasions (Sampling-h_1/h_2). Samplings encountered 6 cm of black clay with clayey gel with many dead roots. This was underlain, to a depth of 12 cm, by dark greyish brown heavy clay with common roots and distinct jarosite coatings (30 %) along root channels. Underlying this, to a depth of 25 cm, was grey heavy clay with common roots ad distinct jarosite coatings (30 %) along root channels. This was underlain, to the maximum extent of investigation (50 cm), by dark grey heavy clay.

When water levels rose and the study area became inundated (Samplings-c/d), a UWS was used to collect subaqueous soil profiles on two occasions. Sampling-c encountered 15 cm of black organic rich desiccated clay, which was underlain, to a depth of 30 cm, by reddish black slightly clayey fibric peat. Sampling-d encountered 27 cm of black sapric peat with fine rootlets and few shells. Underlying this, to depths of 55 and 46 cm, both samplings encountered dark grey clay with some roots and 5 to 10 % yellow mottles associated with root channels. Underlying this, to the maximum extent of investigation (70 cm), was dark bluish grey clay. Some jarosite mottles were noted in this layer during Sampling-d.

As part of this study, a UWS was used to collect subaqueous soil profiles (Samplings-e/f). The investigation encountered 28 cm of very dark brown sapric peat with very dark grey clayey material in the upper 5 cm. This was underlain, to depths of 37 to 42 cm, by dark grey heavy clay with 30 % jarosite mottles in the lower half in Sampling-e. Underlying this, to depths of 56 to 57 cm, was very dark grey heavy clay. This was underlain, to the maximum extent of investigation (76 to 87 cm), by dark grey heavy clay.

LF24-B

During previous studies, profiles were collected at this site on two occasions (Sampling-h_1/h_2). Samplings encountered 10 cm of black light clay with many dead roots. This was underlain, to a depth of 25 cm, by dark greyish brown heavy clay with common roots ad distinct jarosite coatings (15 %) along root channels. Underlying this, to the maximum extent of investigation (50 cm), by dark grey brown heavy clay.

When water levels rose and the study area became inundated (Samplings-c/d), a UWS was used to collect subaqueous soil profiles on two occasions. The investigations encountered dark grey sand with few medium roots. This was underlain, to depths of 33 and 28 cm, by light brownish grey sand. Distinct jarosite mottles were present during Sampling-c and faint remnant jarosite mottles were noted during Sampling-d. This was underlain, to the maximum extent of investigation (46 and 54 cm), by greyish brown loamy sand with dark grey bands.

As part of this study, a UWS was used to collect subaqueous soil profiles (Samplings-e/f). The investigation encountered 17 to 30 cm of very dark brown sapric peat. This was underlain, to depths of 42 to 50 cm, by dark grey heavy clay with common fine roots. Underlying this, to the maximum extent of investigation (69 and 74 cm), was dark grey heavy clay.

20.3 Soil acidity and acid-base accounting

Acid-base accounting was carried out according to the methods described in Section 2.3. Acid-base accounting and pH data (pH$_{OX}$, pH$_{INC}$ & pH$_W$), for each soil layer, are presented in Figure 20-2. These data were used to inform the acidification hazard assessment that is presented in Table 20-1.
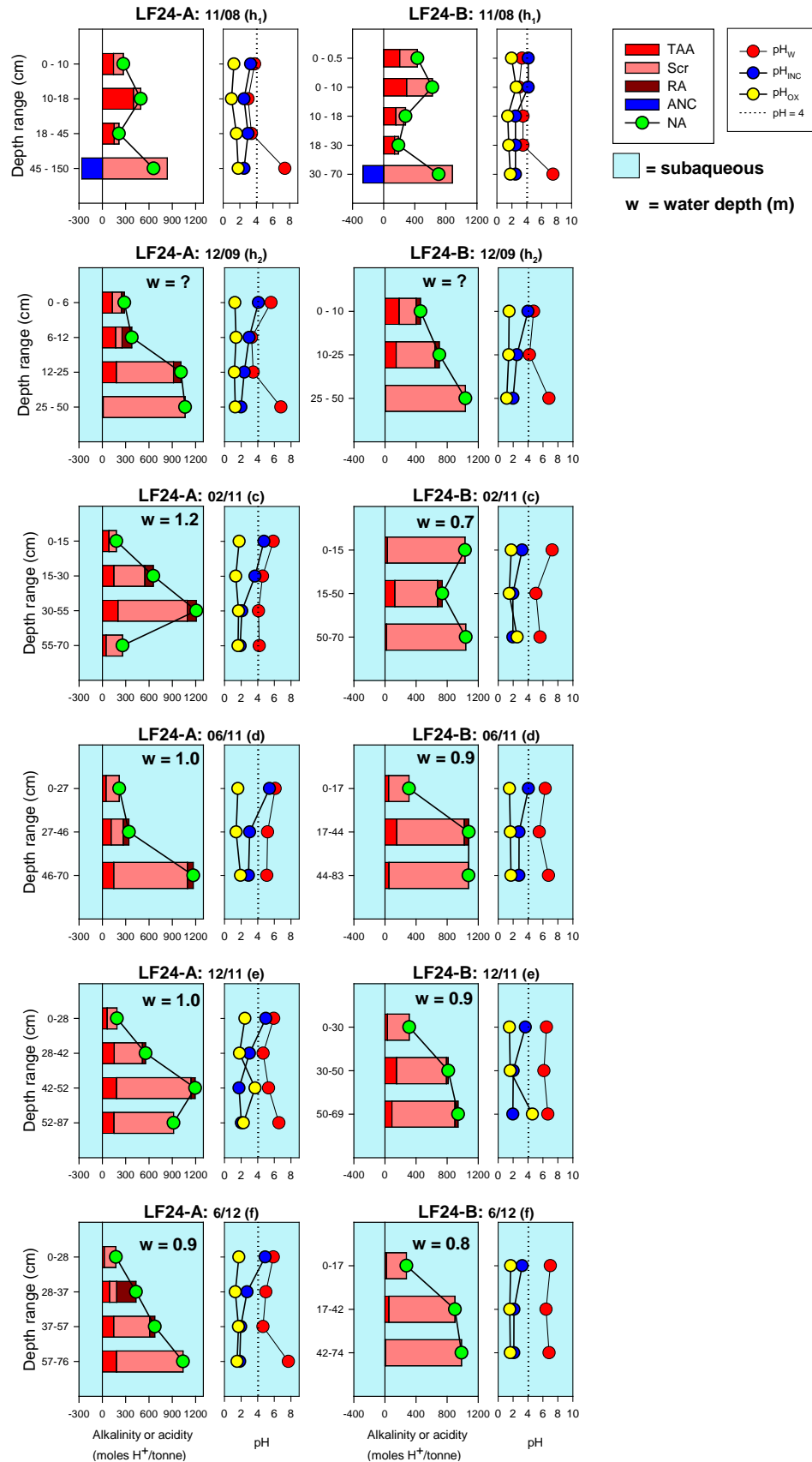
Figure 20-3 pH and acid-base accounting data plotted against depth for each profile collected

20.4 Summary and discussion

Acidification potential assessment and ASS material classification were carried out for each soil sample collected, according to the definitions and methods presented in Section 1.3 and Section 2.4 respectively. A summary of acidification potential and ASS material classification is presented in Table 20-1.

Acidification hazard assessment and ASS subtype classification were carried out for each soil profile collected. ASS subtype classification was achieved using the methods described in Appendix 2. Acidification hazard assessment was based on: (i) landscape position (Figure 20-2), (ii) soil morphology (Section 20.2), (iii) acid-base accounting (Figure 20-3), (iv) pH data (Figure 20-3), (v) acidification potential (Table 20-1) and (vi) ASS material and subtype classification (Table 20-1). Acidification hazard categories were: (i) very low, (ii) low, (iii) medium and (iv) high. A summary of ASS subtype classification and acidification hazard for each profile collected between November 2008 and June 2012 is presented in Table 20-1.

Soil profiles in the Lower Finniss comprised sulfuric and hypersulfidic soil with high acidification hazard ratings (Table 20-1). Under drought conditions and shortly after reflooding (Samplings-h_1/h_2), acidity within the profile comprised S_{CR}, TAA and RA (Figure 20-3). These profiles were classified as sulfuric and hypersulfidic with high acidification hazard ratings. By the time of Samplings-c/d, the sites had been inundated for 12 and 18 months yet TAA was still present throughout the profiles (Figure 20-3). At the time of Samplings-e/f, the sites had been inundated for approximately 2 and 2 ½ years respectively. No significant changes were noted between Samplings-d & e/f. Prolonged inundation most likely encouraged reducing conditions, leading to limited sulfate reduction and the transformation of previously sulfuric sediments to hypersulfidic subaqueous soil (Table 20-2).

Although soils converted from sulfuric to hypersulfidic subaqueous, net acidities remained very high and TAA and RA were still present in the profiles (Figure 20-3). Neutralisation was considered to be limited at this site and the soil material was considered to pose a high acidification hazard (Table 20-1). On drying, soil material is likely to re-acidify rapidly and may impact upon surface waters.

Overall, soil in the Lower Finniss was considered to pose a high acidification hazard.

Table 20-1 Summary of acidification potential, ASS material classification, ASS subtype classification and acidification hazard (* indicates sulfuric soil material). The soil texture in brackets following the ASS subtype classification indicates the dominant texture of the profile

Sample	Sampling	Depth (cm)	pH$_{OX}$ < 2.5	pH$_{INC}$ < 4.0	NA > 0	Acidification potential	ASS material classification	ASS subtype classification	Acidification hazard
LF24-A									
LFh(1)24-A.1	h$_1$	0 - 10	1	1	1	3*	Sulfuric clay	Sulfuric clay soil (clay)	High
LFh(1)24-A.2	h$_1$	10-18	1	1	1	3*	Sulfuric clay		
LFh(1)24-A.3	h$_1$	18 - 45	1	1	1	3*	Sulfuric clay		
LFh(1)24-A.4	h$_1$	45 - 150	1	1	1	3	Hypersulfidic clay		
LFh(2)24-A.1	h2	0 - 6	1	0	1	2	Hyposulfidic clay	Sulfuric clay soil (clay)	High
LFh(2)24-A.2	h2	6-12	1	1	1	3*	Sulfuric clay		
LFh(2)24-A.3	h2	12-25	1	1	1	3*	Sulfuric clay		
LFh(2)24-A.4	h2	25 - 50	1	1	1	3	Hypersulfidic clay		
LFc24-A.1	c	0-15	1	0	1	2	Hyposulfidic clay	Hypersulfidic subaqueous clay soil (clay)	High
LFc24-A.2	c	15-30	1	1	1	3	Hypersulfidic fibric peat		
LFc24-A.3	c	30-55	1	1	1	3	Hypersulfidic clay		
LFc24-A.4	c	55-70	1	1	1	3	Hypersulfidic clay		
LFd24-A.1	d	0-27	1	0	1	2	Hyposulfidic sapric peat	Hypersulfidic subaqueous clay soil (clay)	High
LFd24-A.2	d	27-46	1	1	1	3	Hypersulfidic clay		
LFd24-A.3	d	46-70	1	1	1	3	Hypersulfidic clay		
LFe24-A.1	e	0-28	1	0	1	2	Hyposulfidic peat	Hypersulfidic subaqueous clay soil (clay)	High
LFe24-A.2	e	28-42	1	1	1	3	Hypersufilidic heavy clay		
LFe24-A.3	e	42-52	0	1	1	2	Hypersufilidic heavy clay		
LFe24-A.4	e	52-87	1	1	1	3	Hypersufilidic heavy clay		
LFf24-A.1	f	0-28	1	0	1	2	Hyposulfidic sapric peat	Hypersulfidic subaqueous clay soil (clay)	High
LFf24-A.2	f	28-37	1	1	1	3	Hypersufilidic heavy clay		
LFf24-A.3	f	37-57	1	1	1	3	Hypersufilidic heavy clay		
LFf24-A.4	f	57-76	1	1	1	3	Hypersufilidic heavy clay		
LF24-B									
LFh(1)24-B.1	h$_1$	0 - 0.5	1	0	1	2*	Sulfuric clay	Sulfuric clay soil (clay)	High
LFh(1)24-B.2	h$_1$	0 - 10	0	0	1	1*	Sulfuric clay		
LFh(1)24-B.3	h$_1$	10 - 18	0	1	1	2	Hypersulfidic clay		
LFh(1)24-B.4	h$_1$	18 - 30	1	1	1	3*	Sulfuric clay		
LFh(1)24-B.5	h$_1$	30 - 70	1	1	1	3	Hypersulfidic clay		
LFh(2)24-B.1	h2	0 - 10	1	1	1	3	Hypersulfidic clay	Hypersulfidic clay soil (clay)	High
LFh(2)24-B.2	h2	10-25	1	1	1	3	Hypersulfidic clay		
LFh(2)24-B.3	h2	25 - 50	1	1	1	3	Hypersulfidic clay		
LFc24-B.1	c	0-15	1	1	1	3	Hypersulfidic clay	Hypersulfidic subaqueous clay soil (clay)	High
LFc24-B.2	c	15-50	1	1	1	3	Hypersulfidic clay		
LFc24-B.3	c	50-70	0	1	1	2	Hypersulfidic clay		
LFd24-B.1	d	0-17	1	0	1	2	Hyposulfidic sapric peat	Hypersulfidic subaqueous clay soil (clay)	High
LFd24-B.2	d	17-44	1	1	1	3	Hypersulfidic clay		
LFd24-B.3	d	44-83	1	1	1	3	Hypersulfidic clay		
LFe24-B.1	e	0-30	1	1	1	3	Hypersufilidic peat	Hypersulfidic subaqueous clay soil (clay)	High
LFe24-B.2	e	30-50	1	1	1	3	Hypersufilidic heavy clay		
LFe24-B.3	e	50-69	0	1	1	2	Hypersufilidic heavy clay		
LFf24-B.1	f	0-17	1	1	1	3	Hypersufilidic sapric peat	Hypersulfidic subaqueous clay soil (clay)	High
LFf24-B.2	f	17-42	1	1	1	3	Hypersufilidic heavy clay		
LFf24-B.3	f	42-74	1	1	1	3	Hypersufilidic heavy clay		

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Table 20-2 Summary of temporal and spatial variations and changes in ASS subtypes at each site (**A & B)**. Note: (i) Cells shaded orange summarise data presented within this report, (ii) all other cells are based on/extrapolated from data presented in Fitzpatrick *et al.* (2008a; 2008b; 2009b; 2008c) and (iii) cells bordered in blue indicate subaqueous

Lower Finniss		Drought: pre regulator Start summer 2008 (h₁)	Drought: post regulator Summer 2009 (h₂)	Post drought Summer 2011 (c)	Post drought Winter 2011 (d)	Post-drought start summer 2011/12 (e)	Post-drought start winter 2011/12 (f)	Summary
LF24-A	[1]Classification & [2]Acid hazard	**Sulfuric** clay **(H)**	**Sulfuric* subaqueous clay (H)**	**Hypersulfidic subaqueous clay (H)**	**Hypersulfidic subaqueous clay (H)**	**Hypersulfidic subaqueous clay (H)**	**Hypersulfidic subaqueous clay (H)**	During the extreme drought period (2007 to 2009) soil was hypersulfidic and Sulfuric. Inundation, following winter 2010, caused the formation of Hypersulfidic subaqueous soil.
	Dominant water and ASS process	**LW & Sulfuric**	**RW & Sulfuric**	**UW & Sulfide**	**UW & Sulfide**	**UW & Sulfide**	**UW & Sulfide**	
LF24-B	[1]Classification & [2]Acid hazard	**Sulfuric** clay **(H)**	**Hypersulfidic subaqueous clay (H)**	**Hypersulfidic subaqueous clay (H)**	**Hypersulfidic subaqueous clay (H)**	**Hypersulfidic subaqueous clay (H)**	**Hypersulfidic subaqueous clay (H)**	During the extreme drought period (2007 to 2009) soil was hypersulfidic and Sulfuric. Inundation, following winter 2010, caused the formation of Hypersulfidic subaqueous soil.
	Dominant water and ASS process	**LW & Sulfuric**	**RW & Sulfide**	**UW & Sulfide**	**UW & Sulfide**	**UW & Sulfide**	**UW & Sulfide**	

[1] **Classification – Acid Sulfate Soil subtype classification**
[2] **Acid hazard – Acidification hazard: H = High; M = medium; L = Low; VL = Very Low**
Dominant Water process
LW – Lowering water level regime to expose soil to air due to drought conditions and water evaporation
UW – Unchanged water regime, which had not yet evaporated to expose soil to air
RW – Rising water level regime to inundate and saturate soils by reflooding (e.g. due to pumping, regulator installation, river flow and groundwater)
RF – Rain fall rewetting and natural reflooding to inundate and saturate soils

Dominant ASS – process
Sulfuric – Sulfuricization - oxidation of pyrite in hypersulfidic material due to onset of aerobic conditions to form sulfuric material
Sulfuric* – As above with acidic minerals and/or salt efflorescences noted (i.e. measurable RA)
Sulfide – Sulfidization due to sulfide accumulation to form hypersulfidic material
Monosulfide – Monosulfidization due to monosulfide accumulation to form monosulfidic material
Leach – Leaching of acid from soil by winter rain fall
Sulfuric **subaqueous** with **overlying circa neutral water** pH >4: = font coloured blue or default
Sulfuric **subaqueous** soil with **overlying acid water** pH <4: = font coloured red
Where h₁ to h₃ = historical sampling; (a) – (b) sampling conducted in this project

21. Contaminant and Metalloid Dynamics

Summary

The contaminant and metalloid (CMD) dynamics data highlight a range of metal, metalloid and nutrient contaminants in the soils of the three selected study areas: Dog Lake, Boggy Lake and Point Sturt. These areas were selected because they had been impacted previously by oxidation and acidification of soils during the drought, hence likely to contain metal and metalloid hazards. There was significant variation between these sites, with Boggy Lake and Dog Lake soils displaying the highest hazards of acidity and metals. However, there was also a large variation within individual soil profiles. The dominant controls on metal and metalloid concentrations are pH and availability in the individual soil materials. Many of the soils have remained acidic, especially beneath the surface soil layer, and many contaminants were present at concentrations well above ANZECC Guideline values for freshwater ecosystems.

The more sandy surface soils at Point Sturt were very fresh and consistent with flushing of acidity and solutes downwards in the soil profile. The soils at Boggy Lake and Dog Lake were also relatively fresh but flushing was probably less, due to the more clayey nature of the soils. High SO_4/Cl ratios, however, attest to a retardation of many solutes in all soils, probably due to the presence of hydroxysulfate minerals which were identified in the soils during sampling. These have remained in the soils even after prolonged inundation, and are most likely responsible for the increase in metals and metalloids in soil samples during the dynamic tests.

There was generally very limited decrease in Eh in the experiments, most likely due to acid-generating buffering hydroxysulfate minerals. Alkalinity generation has, for most soil materials studied, remained negligible. The contaminants of concern highlighted in this section include ammonium and phosphate, and a range of metal species including Al, Co, Fe, Ni and Zn. Other metals identified in some samples include Be, Cr, Cu and Pb.

Comparisons of data from Sampling-e (November-December 2011) and Sampling-f (June 2012) indicate that there has been little change in the bioavailability of many metals during the intervening time period. The exception was at Dog Lake where the deeper soil layer increased in pH and as a consequence most metals were present at much lower concentrations than previously. In addition, the metalloid As was often lower in Sampling-f at all sites suggesting decreased bioavailability. During the tests, phosphate was commonly below the detection limit at the start of the tests, but increased over time indicating a potential hazard for nutrient release in these soils.

The CMD data provide a guide to the contaminant hazards present in the different soil layers. Furthermore, they provide an indication of the likely pH and Eh buffering effects within the soils that may control the pH and Eh condition of the soils, hence the speciation and mobility of metals, metalloids and other contaminants.

21.1 Introduction

The availability and mobilisation of metals is likely to change over time in response to physical factors (e.g. advective vs. diffusional flow) and chemical factors (e.g. changes in pH and Eh, mineralogy, sorption sites). A series of batch experiments were undertaken to help determine dynamic changes in metal and metalloid concentrations over time, based on a procedure used by the MDBA (2010) for selected metals.

One aim of these contaminant mobilisation and dynamics (CMD) tests was to determine how metal and metalloids change as dry oxidised wetland soils return to a more reducing environment following re-saturation. In the present context, some of the soils had been re-wet for a prolonged period and some

changes have already occurred. The CMD method was designed to determine the release of metals and metalloids in soils after 24 hours and then over longer time periods. The data represent the availability of metals and metalloids mobilised during a weak extraction (water, and thus easily bioavailable). The exercise was repeated in a batch process for longer time periods (7, 14, 35 and 56 days). The soil materials and the release/uptake of metals/metalloids are expected to change as the chemical environment changes from more oxidising to more reducing as the soils return to their previous condition prior to drying.

The tests were studied under closed system conditions in the laboratory. Therefore, the data serve only as a guide to the availability of contaminants, and care is needed when extrapolating potential impacts to open systems especially without knowledge of hydrological conditions and natural chemical barriers. The impact on surface waters will be governed by the upward chemical flux which is a function of soil type, water flow, diffusion and the chemistry of the soils near the sediment-water interface.

Redox potential (Eh) and pH were determined using calibrated electrodes linked to a TPS WP-80 meter; Eh measurements were undertaken in an anaerobic chamber to minimise the rapid changes encountered due to contact with the atmosphere, and are presented relative to the standard hydrogen electrode (SHE). Specific electrical conductance (SEC) was determined using a calibrated electrode linked to a TPS WP-81 meter. All parameters were measured on filtered (0.45 μm) water samples. Filtered samples were also collected for a wide range of major, minor and trace elements by Inductively Coupled Plasma Optical Emission Spectrometry (ICP OES), Inductively Coupled Plasma Mass Spectrometry (ICP MS) and ion chromatography using appropriately diluted calibration standards. The method was modified from MDBA (2010) only in that additional solutes (major, minor and trace elements and nutrients) were measured.

Four core samples were collected on two occasions (November-December 2011 and June 2012) and sample numbers and depths shown in Table 21-1. On both occasions, a single profile was collected from both Boggy Lake (LF 20) and Dog Lake (LF 19) in the north-west of Lake Alexandrina and two profiles from Point Sturt (LF 02) in the south west of Lake Alexandrina.

Table 21-1 Samples and sample depths for Contaminant and Metalloid Dynamics tests.

Location	Sample Number	Depth Interval (cm) Phase e	Depth Interval (cm) Phase f
Point Sturt	LF02-A.1	0 – 13	0 - 8
	LF02-A.2	13 - 25	8 - 23
	LF02-A.3	25 - 57	23 - 42
	LF02-A.4	57 - 69	42 - 67
	LF02-D.1	0 – 8	0 - 11
	LF02-D.2	8 - 19	11 - 25
	LF02-D.3	19 - 31	25 - 40
	LF02-D.4	31 - 47	40 - 72
Dog Lake	LF19-A.1	0 – 16	0 - 18
	LF19-A.2	16 – 24	18 - 32
	LF19-A.3	24 – 46	32 - 42
Boggy Lake	LF20-A.1	0 – 10	0 - 8
	LF20-A.2	10 – 17	8 - 18
	LF20-A.3	17 - 30	18 - 42
	LF20-A.4	30 – 55	42 - 57
	LF20-A.5	55 - 89	57 - 92

21.2 Boggy Lake

21.2.1 Hydrochemical characteristics

The shallow and intermediate soils at Boggy Lake remained largely acidic during Sampling-e and Sampling-f throughout the 56 day period (Figure 21-1), with only the deepest layer remaining circumneutral throughout. The pH of the surface layers were quite strongly acidic, with most displaying a decrease in pH to a minimum of pH 3.24. The acidity and alkalinity trends reflected the pH with moderate alkalinity in the deepest soil layer, and high acidity in the shallower layers. The pH of the surface layer during Sampling-e increased slightly with time, but the sample collected for Sampling-f decreased in a similar manner to the underlying soils. The decrease in pH during the tests was often accompanied by an increase in Eh to strongly oxidising conditions, but with the surface soil showing the opposite trend, especially in the sample from Sampling-f, where Eh was moderately reducing by day 56 (Figure 21-1).

The SEC showed little change over the 56 day period in both samplings and remained below ANZECC Guidelines for freshwater ecosystems. The SEC was lowest in the surface soil layer during both periods, typically being highest at intermediate depths before decreasing in the deepest soil layer samples.

21.2.2 Major elements

Selected major element data are shown on Figure 21-2. Chloride concentrations were relatively low, especially in the surface layers, and showed no clear trend over time in the tests. Lower Cl in the intermediate depth sample (8-18 cm depth) during Sampling-f is consistent with the lower SEC (Figure 21-1) compared with Sampling-e. Sulfate was the dominant anion, and concentrations were high in all samples, either increasing slightly over time or remaining stable. The SO_4/Cl ratios were very high (1.8 to 9.7) in comparison with seawater (0.142), most likely as a consequence of hydroxyl-sulfate mineral dissolution.

The major cation Na displayed a general increase in the deeper soil pore waters, whilst Ca increased until the deeper layer where it decreased significantly. The major element data suggest limited changes for most soil pore waters, with increases most likely due to mineral dissolution and/or exchange reactions.
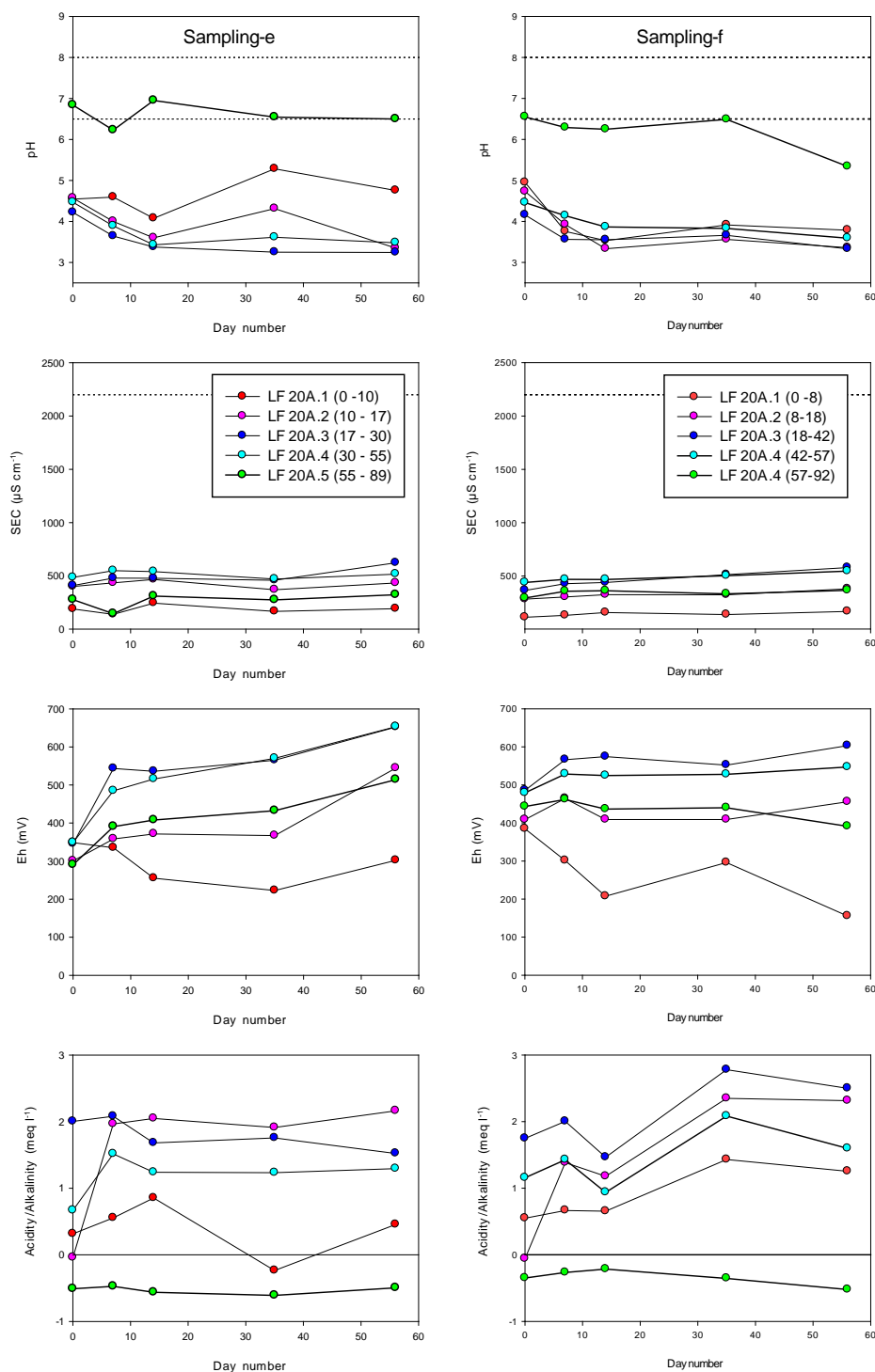
Figure 21-1 CMD data for pH, SEC, Eh and acidity/alkalinity in Boggy Lake soil waters for Sampling-e (left) and Sampling-f (right). Where alkalinity was present, it has been assigned a negative number for plotting purposes. Dotted lines show ANZECC Guideline values (see text for details).
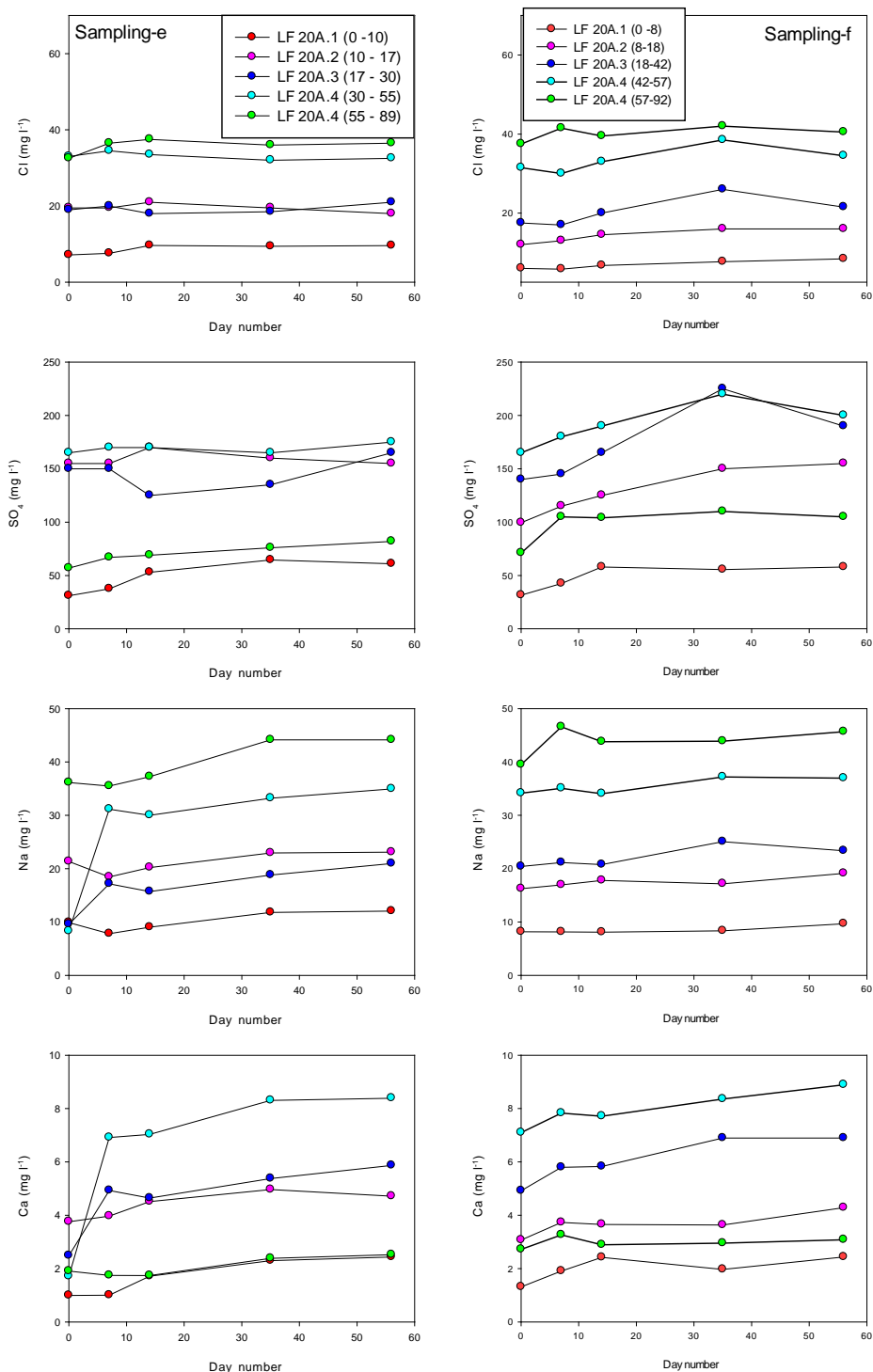
Figure 21-2 CMD data for selected major elements for Sampling-e (left) and Sampling-f (right) in Dog Lake samples. Dotted lines show ANZECC Guideline values (see text for details).

21.2.3 Nutrients

Selected nutrient data are shown on Figure 21-3. Total dissolved nitrogen concentrations were 0.3–0.9 mg l^{-1} N. Most samples showed little change over the 56 day period. Nitrate was below the limit of detection in all samples (<0.05 mg l^{-1}) in Sampling-e, but present up to 0.5 mg l^{-1} in the longer time period samples in Sampling-f. The dominant N-species was NH_4-N (Figure 21-3) and displayed similar behaviour in both sampling periods, with low concentrations at depth and the highest concentrations in the 10-17 cm soil layer. Nitrite was also present at below detection limit (<0.005 mg l^{-1}) in most samples, the exception being a deeper sample (30-55 cm) in both samplings, where NO_2-N was present up to 0.07 mg l^{-1}. Phosphate concentrations generally increased over time in Sampling-e, although maxima were observed in the shallow and deep layers (Figure 21-3).Concentrations were significantly lower in Sampling-f, suggesting that P was becoming less available over time. Dissolved organic carbon (DOC) concentrations were variable in the different soil layers in Sampling-e, displaying little change over time, but were less variable in Sampling-f. The nutrient data suggest that changes in species and release may be significant as the soils age, especially for phosphate and nitrate, but there was little change in ammonium and nitrite.

21.2.4 Trace elements

Selected trace elements for the CMD are shown on Figure 21-3 and Figure 21-4. The concentrations of a number of metals are high and above ANZECC Guideline values for freshwater ecosystems. In general, the highest concentrations were present in the intermediate soil layers, and lowest in the higher pH deep clay layer (Figure 21-1). Aluminium was high in all samples, consistent with acidic conditions, but the high concentrations in the deepest layer most likely reflects colloidal Al. Concentrations were lower in Sampling-f for some soil layers, despite similar pH, possibly indicating that Al has become less available or that it existed as colloids which have been modified over time.

For most metals, there has been little change between samplings, with solutes such as Co, Fe, Ni and Zn continuing to be released in the tests. Arsenic concentrations did show a slight decrease in Sampling-f when compared to Sampling-e in some soil layers suggesting that this metalloid may be coming more strongly bound over time. The Eh of the soils was too high for significant pyrite formation to be responsible for removal of As.

The dominant control on most metal and metalloid concentrations appears to be pH, with the highest solute concentrations present at low pH in the most acidic solutions (Figure 21-6). There is significant overlap between Sampling-e and Sampling-f, the exceptions being lower As and all metals and metalloids studied in the deeper soil layer. The clearest trends were for metal cations, with high concentrations of many metals, especially at pH<5. For Sampling-f, the maxima for Ni and Zn were slightly higher in sampling-f, but this may well be due to soil heterogeneity.
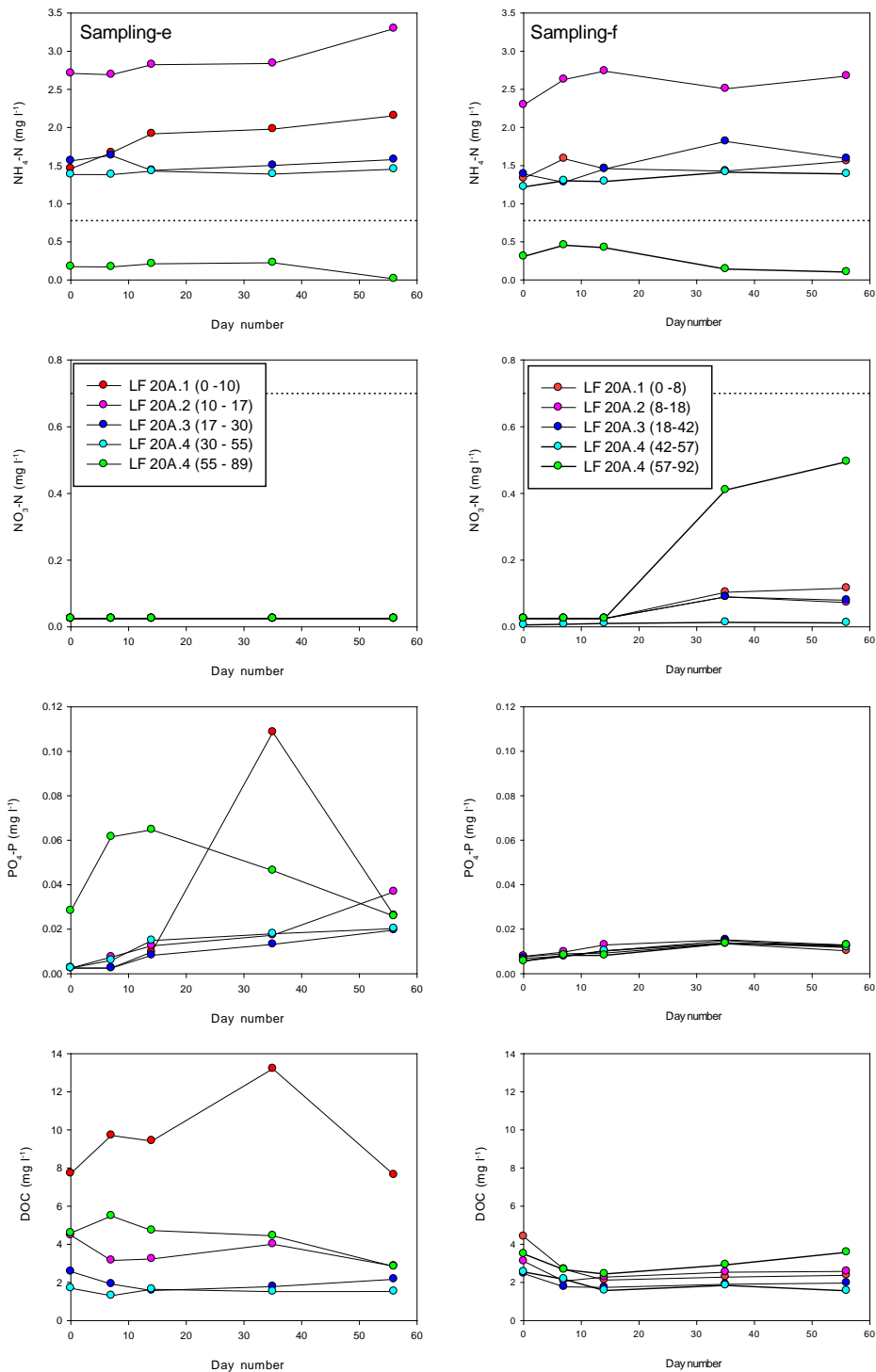
Figure 21-3 CMD data for selected nutrients in Boggy Lake for Sampling-e (left) and Sampling-f (right) in Dog Lake samples. Dotted lines show ANZECC Guideline values (see text for details).
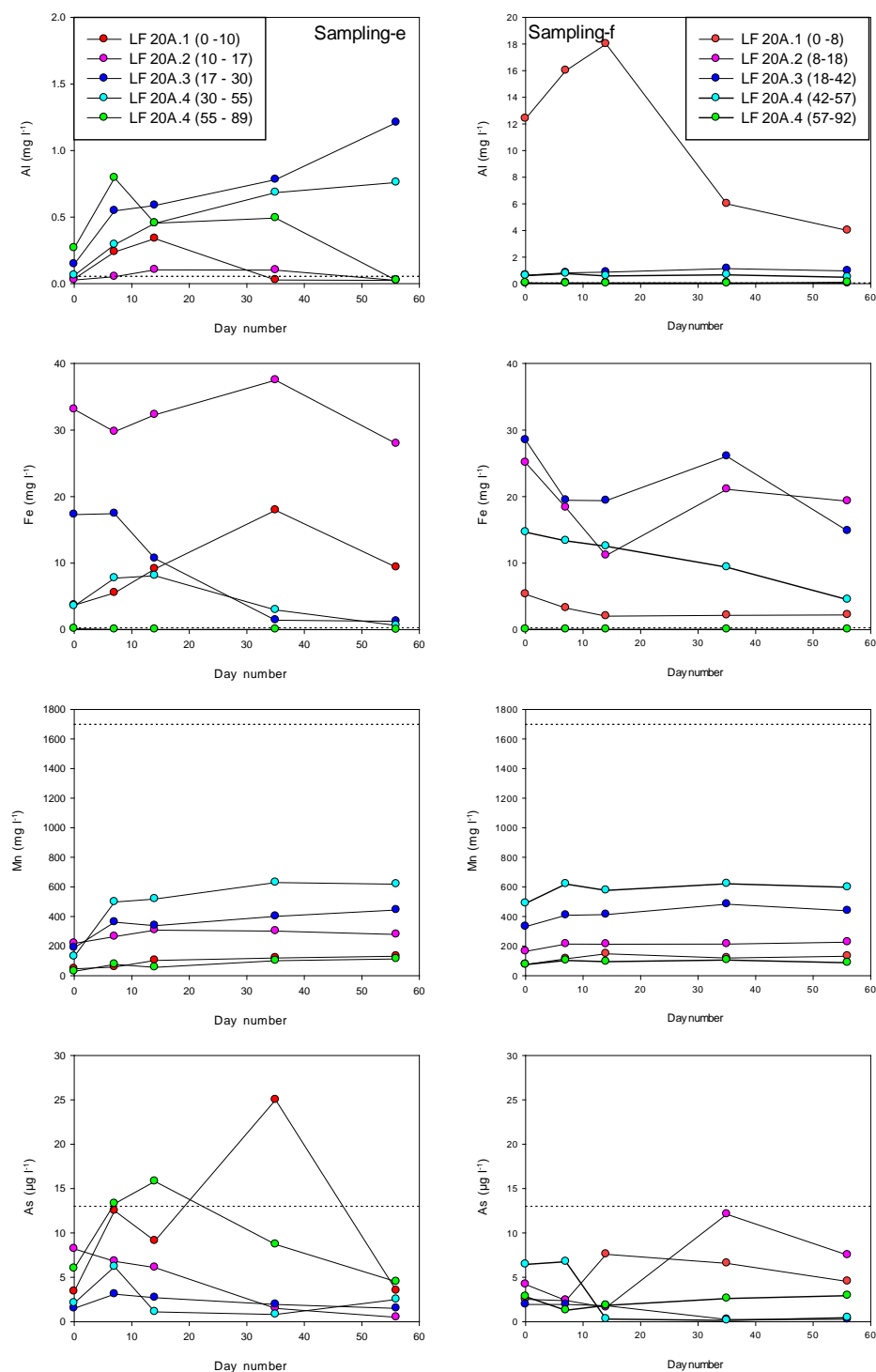
Figure 21-4 CMD data for selected trace elements in Boggy Lake for Sampling-e (left) and Sampling-f (right) in Dog Lake samples. Dotted lines show ANZECC Guideline values (see text for details).
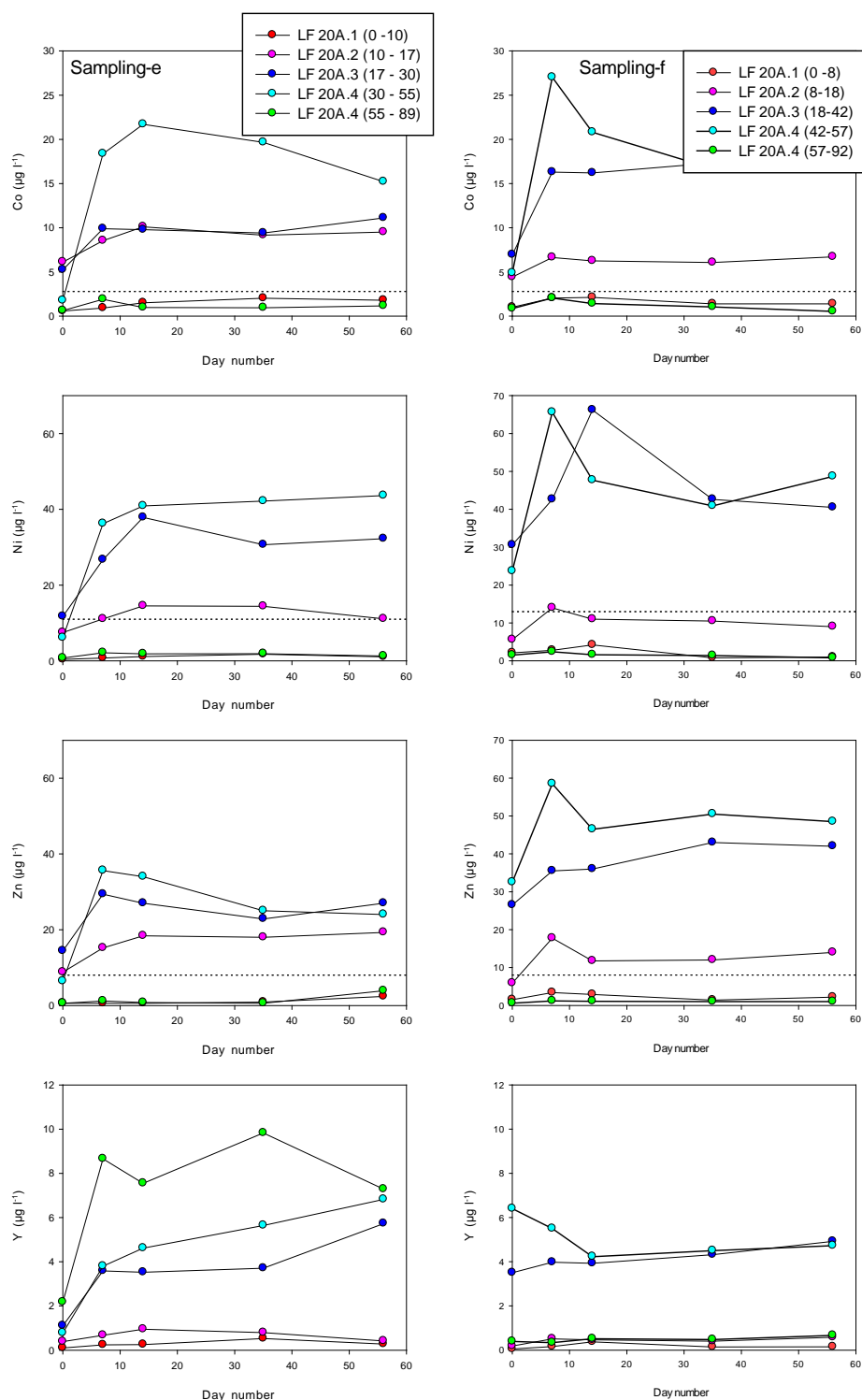
Figure 21-5 CMD data for selected trace elements in Boggy Lake for Sampling-e (left) and Sampling-f (right) in Dog Lake samples. Dotted lines show ANZECC Guideline values (see text for details).
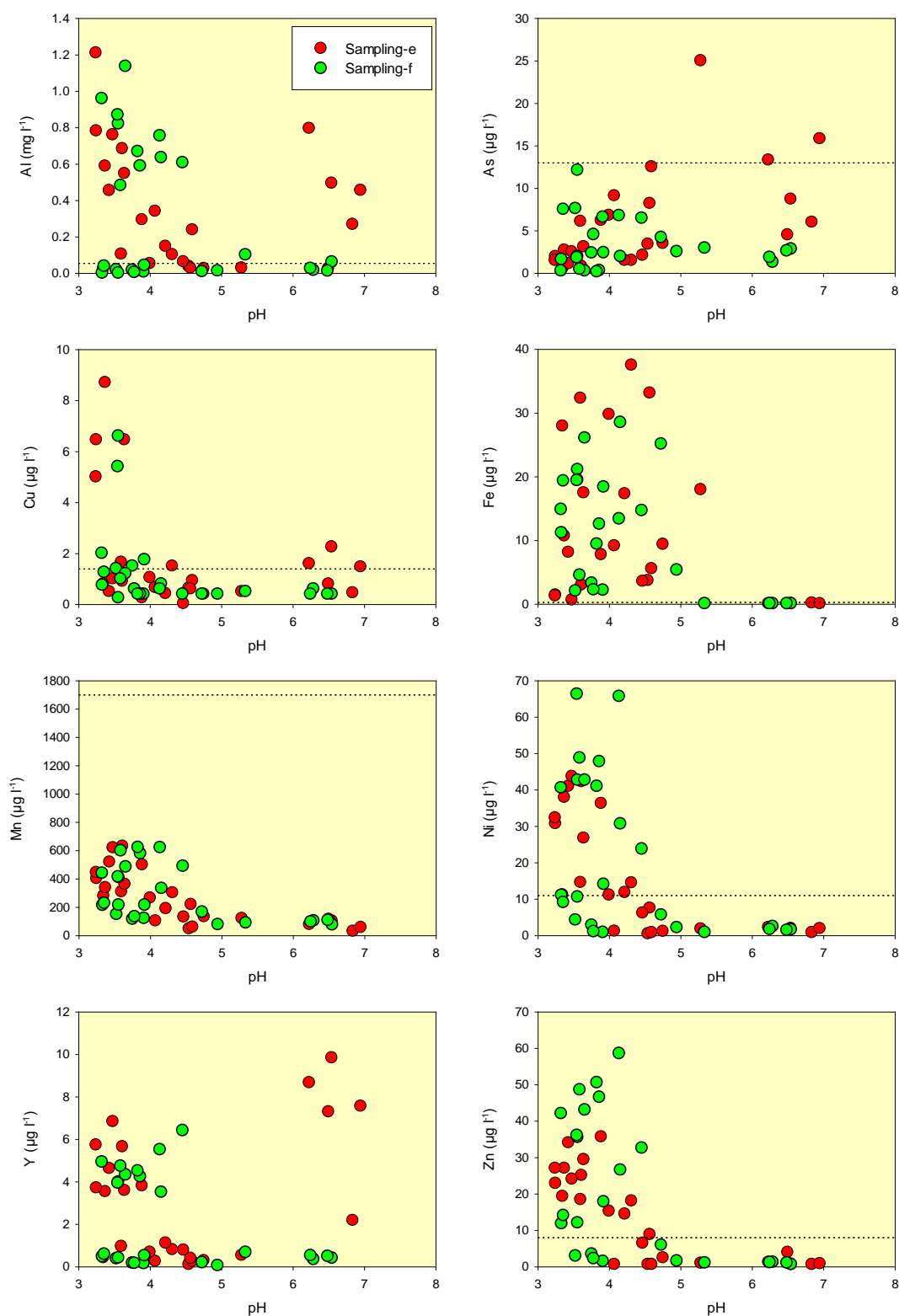
Figure 21-6 Selected solute concentrations for the CMD tests on Boggy Lake plotted against pH. Dotted lines show ANZECC Guideline values (see text for details).

21.2.5 Summary of Boggy Lake

The CMD data show that a number of contaminant hazards are present and likely to be mobilised in the soils. These include reduced and oxidised forms of N as well as PO_4. A number of metals were also high, particularly Al (up to 18 mg l^{-1}). Other metals of concern include As, Cu, Cr, Co and Ni. All soils remained oxidising, with the exception of the shallow soil layer in where Eh decreased in the tests over time. There was considerable overlap between Sampling-e and Sampling-f in the upper soil layers, the exception being lower concentrations of arsenic in the later sampling.

21.3 Dog Lake

21.3.1 Physicochemical characteristics

The profiles at Dog Lake remained acidic during Sampling-e throughout the 56 day period (Figure 21-7), but the deepest layer during Sampling-f was circumneutral throughout, indicating that this soil is well buffered. The pH of the surface layers was very acidic, with a minimum pH of 3.00. The acidity and alkalinity trends reflected the pH with the generation of significant alkalinity in the deepest soil layer during Sampling-f, and high acidity in the shallower layers and the deep layer during Sampling-e.

The SEC showed little change over the 56 day period in Sampling-e and remained below ANZECC Guidelines for freshwater ecosystems. For sampling-f, the SEC was lower in the 18-32 cm layer, possibly due to on-going infiltration of surface water. The deeper soil layer displayed an increase in SEC over time before levelling out on day 14. Although the samples were in sealed airtight containers, there was little change towards more reducing conditions; in contrast to what was expected, the Eh increased, especially in the acidic shallower layers, with a steeper gradient in the first 14 days. There would thus appear to be limited acid buffering in the shallow soils studied, and the timescales of recovery would appear to be significant. The Eh was lower in the deep sample in Sampling-f suggesting a trend towards more reducing conditions.

21.3.2 Major elements

Selected major element data are shown on Figure 21-8. Chloride concentrations were relatively low, especially in the surface layers, and there was no clear trend over time in the tests. Lower Cl in the intermediate depth sample during Sampling-f is consistent with the SEC. For SO_4, concentrations were high in all samples, either increasing slightly over time or remaining stable. The SO_4/Cl ratios were very high (16-31) in comparison with seawater (0.142), most likely as a consequence of hydroxyl-sulfate mineral dissolution. The major cations Na and Ca displayed an increase in the deeper soil pore waters. The increase in Ca was very significant in the deepest soil profile, and correlated with increased SO_4. Abundant gypsum was observed in the deeper clays elsewhere in Dog Lake, and gypsum dissolution is the most likely cause of this trend. The major element data suggest limited changes for most soil pore waters, with increases most likely due to mineral dissolution and/or exchange reactions.
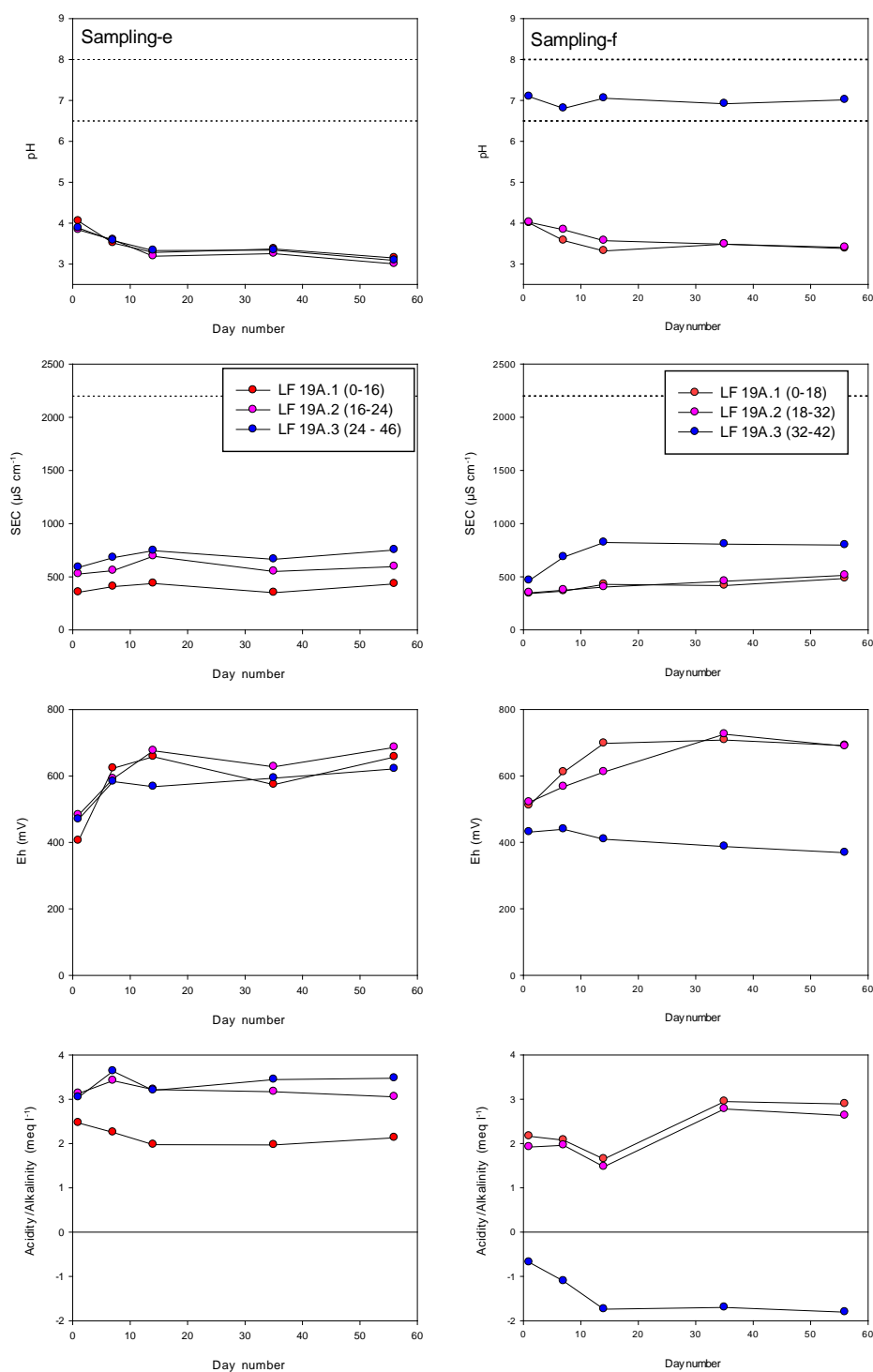
Figure 21-7 CMD data for pH, SEC, Eh and acidity/alkalinity in Dog Lake soil waters for Sampling-e (left) and Sampling-f (right). Where alkalinity was present, it has been assigned a negative number for plotting purposes. Dotted lines show ANZECC Guideline values (see text for details).
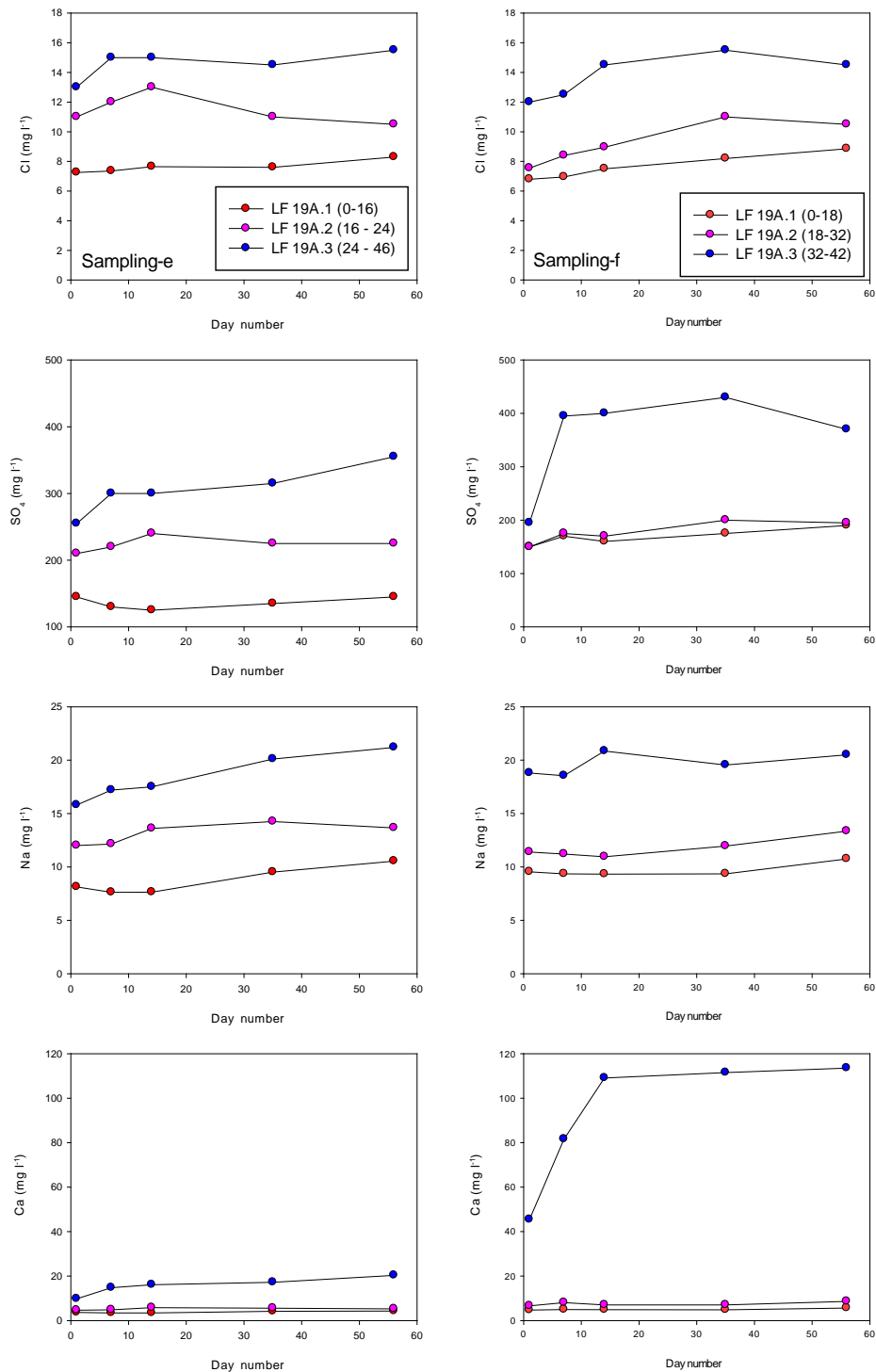
Figure 21-8 CMD data for selected major elements for Sampling-e (left) and Sampling-f (right) in Dog Lake samples. Dotted lines show ANZECC Guideline values (see text for details).

21.3.3 Nutrients

Selected nutrient data are shown on Figure 21-9. Total dissolved nitrogen concentrations were 0.3–3.4 mg l^{-1} N. Most samples showed little change over the 56 day period. Nitrate was below the limit of detection in all samples (<0.05 mg l^{-1}) in Sampling-e, but present up to 0.14 mg l^{-1} in deeper soil layers in Sampling-f. The dominant N-species was NH_4-N (Figure 21-9). In Sampling-e, the highest concentrations were at depth, but this was reversed in Sampling-f. Nitrite was also present at below detection limit (<0.005 mg l^{-1}) in most samples, the exception being the deeper sample in Sampling-f, where NO_2-N was present on days 35 and 56. This coincided with a decrease in NH_4-N, and may therefore be related to conversion of N-species. Phosphate concentrations increased over time in Sampling-e, being initially below the limit of detection (<0.005 mg l^{-1}) in all samples on day 1. Concentrations were significantly lower in Sampling-f, suggesting that P was becoming less available over time. Dissolved organic carbon (DOC) concentrations were generally low, displaying little change over time. The nutrient data suggest that changes in species and release may be significant as the soils age, especially for phosphate and the reduced N-species nitrite and ammonium.

21.3.4 Trace elements

Selected trace elements for the CMD are shown on Figure 21-10 and Figure 21-11. The concentrations of a number of metals are high and above ANZECC Guideline values for freshwater ecosystems. In general, the highest concentrations were present in the intermediate soil layers (depths 16-46 cm), and lowest in the higher pH deep clay layer (Figure 21-10) for Sampling-e. For the sandy upper soil layer waters, there is generally no consistent trend and concentrations remained high over the 56 days of testing. The major exception was Fe, which decreased in the acidic samples to relatively low concentrations by day 14, although the reasons for this are not yet clear: it may, for example, be due to an unusual Fe oxyhydroxide phase at the high Eh and low pH conditions of the sample. Manganese on the other hand remained moderately high over the duration of the tests and more closely follows the other metals. For Sampling-f, the trends were generally quite similar, the main exception being that concentrations in the deeper higher pH layer had decreased dramatically. Taking into account soil heterogeneity, the concentrations displayed a similar range in concentrations between the two samplings. The exception is for arsenic (As), where concentrations were lower in Sampling-f (Figure 21-10), suggesting a decrease in bioavailability over time.

The dominant control on most metal and metalloid concentrations appears to be pH, with the highest solute concentrations present at low pH in the most acidic solutions (Figure 21-12). There is significant overlap between Sampling-e and Sampling-f, the exceptions being lower As and all metals and metalloids studied in the deeper soil layer. The clearest trends were for metal cations. Iron, however, was very low in some of the most acidic samples as discussed previously, but appeared not to exert a major control on metal mobility in the latter stages of the tests. The reason for the decrease in Fe is not clear, but with the noted concomitant increase in Eh, it is likely that it is due to formation of a hydroxysulfate mineral. The change to higher pH and alkalinity in the deepest soil layer in Sampling-f led to a decrease in the solubility of most metals and metalloids, suggesting an improvement in the acidification potential of the deeper soils. The sample still contained jarosite mottling around the roots, but was dark grey in colour. It is possible that the increase in pH is due to sulfate reduction and/or the dissolution of oxidised Fe minerals generating alkalinity.
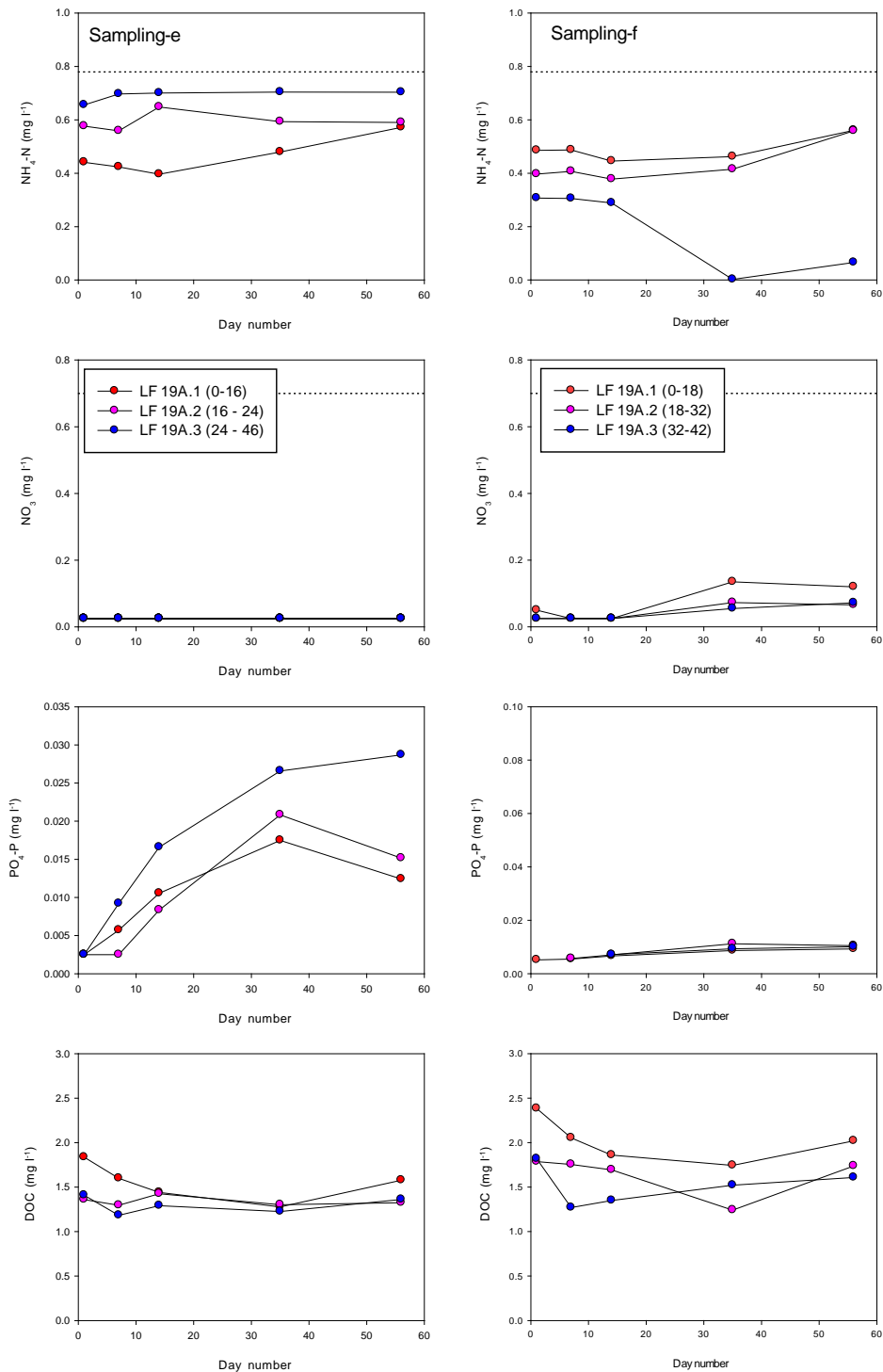
Figure 21-9 CMD data for selected nutrients in Dog Lake for Sampling-e (left) and Sampling-f (right) in Dog Lake samples. Dotted lines show ANZECC Guideline values (see text for details).
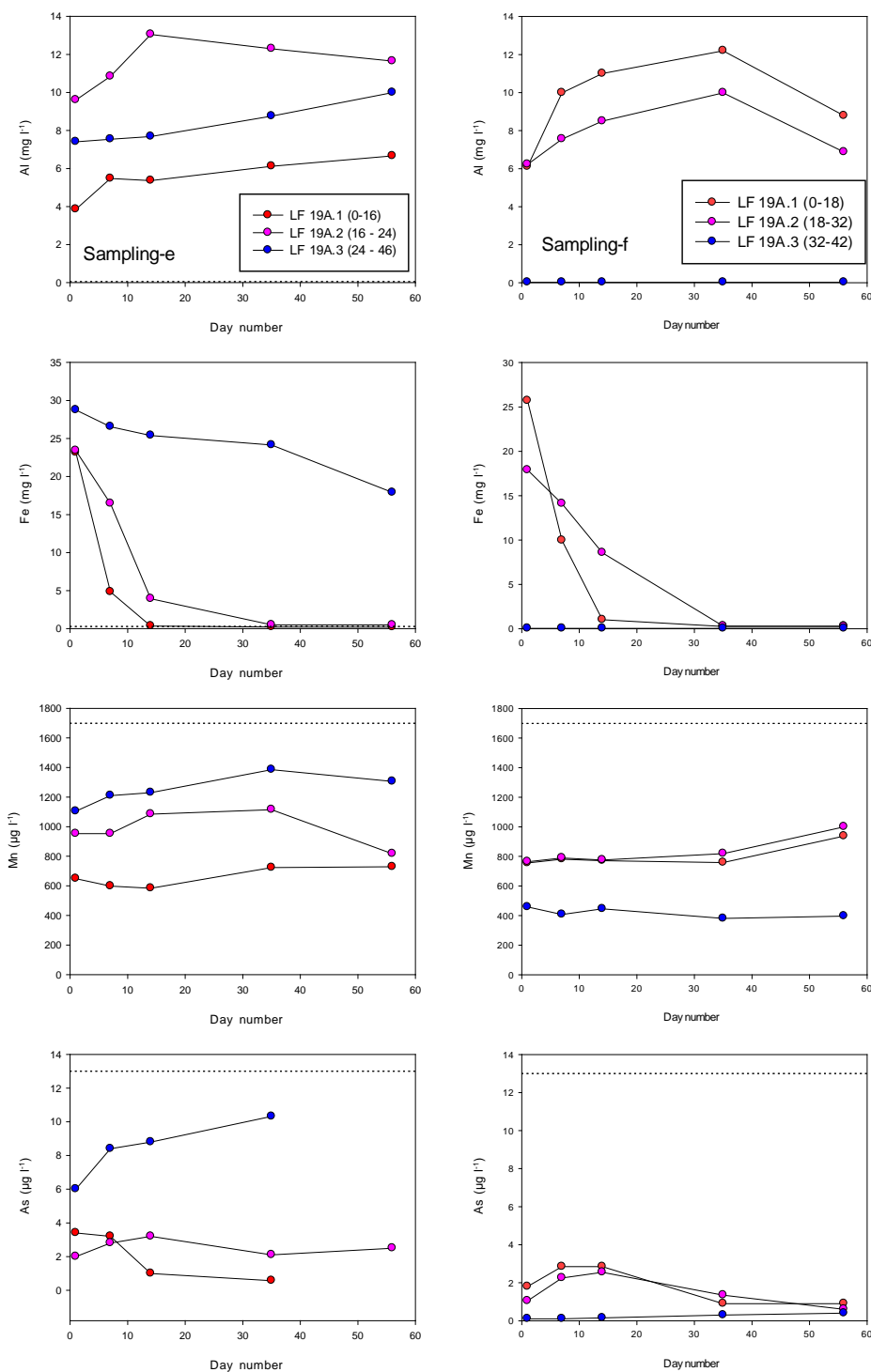
Figure 21-10 CMD data for selected trace elements in Dog Lake for Sampling-e (left) and Sampling-f (right) in Dog Lake samples. Dotted lines show ANZECC Guideline values (see text for details).
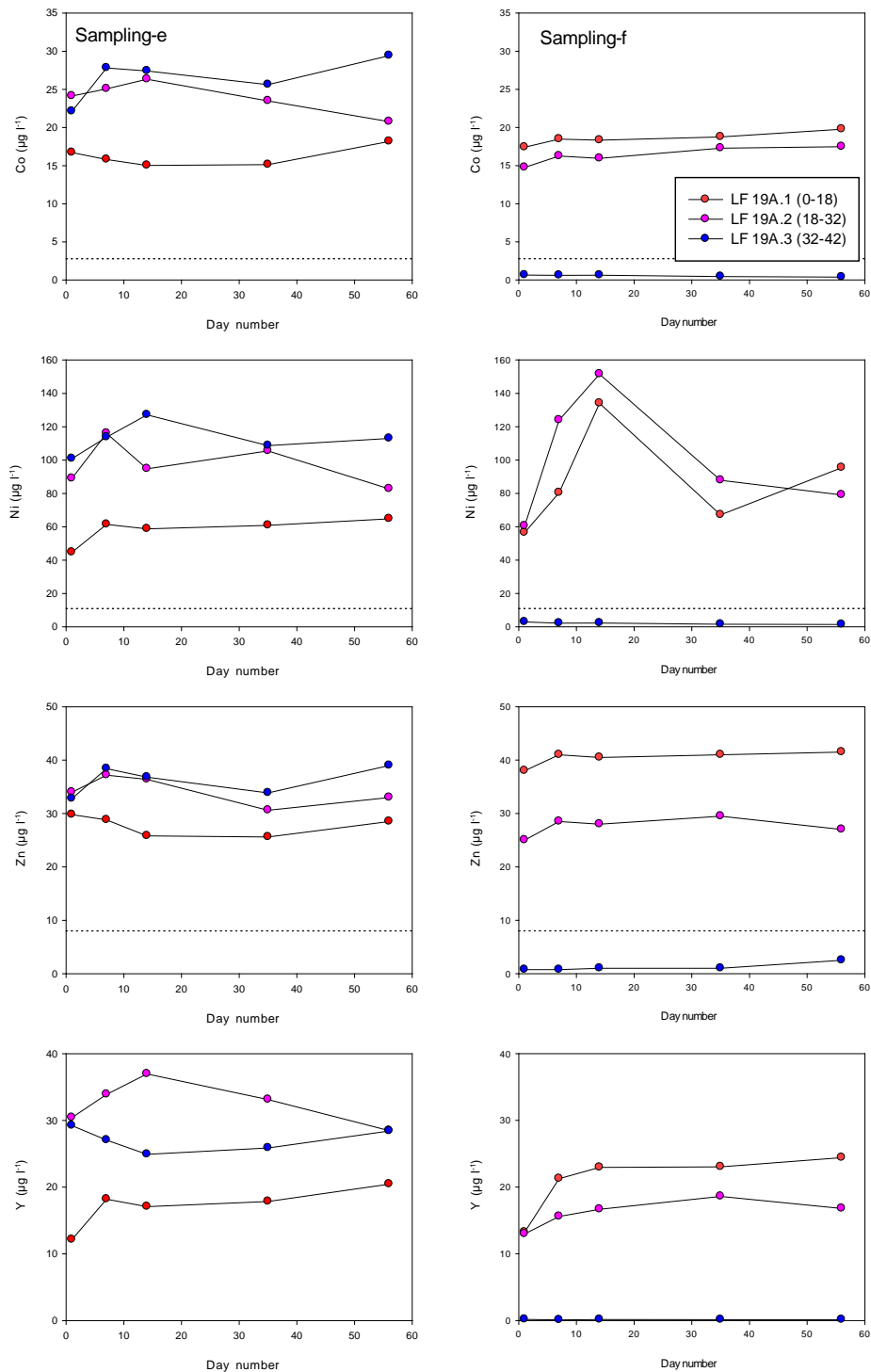
Figure 21-11 CMD data for selected trace elements in Dog Lake for Sampling-e (left) and Sampling-f (right) in Dog Lake samples. Dotted lines show ANZECC Guideline values (see text for details).
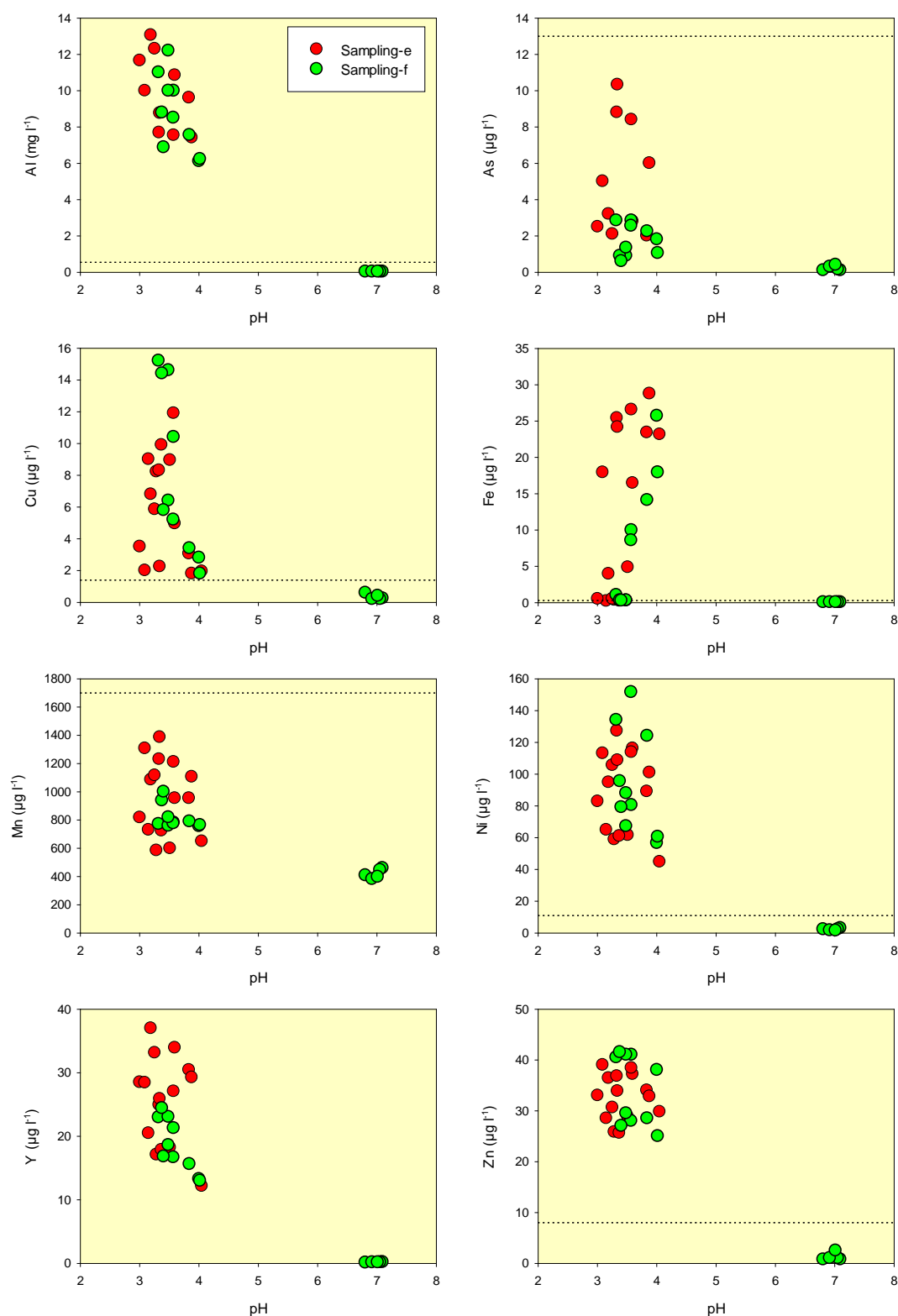
Figure 21-12 Selected solute concentrations for the CMD tests plotted against pH. Dotted lines show ANZECC Guideline values (see text for details).

21.3.5 Summary of Dog Lake

The CMD data show that a number of contaminant hazards are present and likely to be mobilised in the soils. These include reduced forms of N as well as PO_4. A number of metals were also high, particularly Al (up to 13 mg l^{-1}). Other metals of concern include As, Cu, Cr, Co and Ni. All soils remained oxidising, but some were dark grey in colour and appeared to be transitioning to more reduced soils (albeit with small patches of natrojarosite). There was considerable overlap between Sampling-e and Sampling-f in the upper soil layers, the exception being lower concentrations of arsenic in the later sampling. The deepest soil layer changed from acidic to neutral in terms of pH between samplings, and along with this increase in pH, much lower concentrations of metal and metalloid concentrations.

21.4 Point Sturt – Site 02a

21.4.1 Physicochemical characteristics

This site is one of two selected for CMD analyses. Site A (LF02A) is situated furthest from the shore, and site D (LF02D) data is presented in the next section (Section 21.5).

The profiles at site 02A remained acidic during Sampling-e throughout the 56 day period (Figure 21-7), with a slight decrease between day 1 and day 56 (Figure 21-13). In Sampling-f, the pH of the surface soil layer samples had increased significantly, suggesting some loss of acidity. The deeper layers remained moderately acidic, decreasing over time in both samplings, with a minimum pH of 3.81. The acidity and alkalinity trends reflected the pH with the significant alkalinity in the shallow soil layer during Sampling-f, and high acidity in the deeper layers.

The SEC was relatively low in all samples, and in most samples it increased over time, although all samples remained below ANZECC Guidelines for freshwater ecosystems. For sampling-f, the SEC was lower in the top three layers, possibly due to on-going infiltration of surface water. Although the samples were in sealed airtight containers, there was little change towards more reducing conditions; in contrast to what was expected, the Eh, with a steeper gradient in the first 14 days for Sampling-e. There would thus appear to be limited acid buffering in the shallow soils studied, and the timescales of recovery would appear to be significant. The Eh decreased initially in the surface soil layer in Sampling-f, but increased again by day 35 (Figure 21-13).

21.4.2 Major elements

Selected major element data are shown on Figure 21-14. Chloride concentrations were low, especially in the surface layers, and there was no clear trend over time in the tests. Concentrations were significantly lower in Sampling-f, especially in the shallower layers, consistent with the SEC. For SO_4, concentrations were high in all samples compared to Cl. For Sampling-e, concentrations increased consistently over time, whilst for Sampling-f they increased initially before plateauing after day 14. The SO_4/Cl ratios were very high (6-14) in comparison with seawater (0.142), most likely as a consequence of hydroxyl-sulfate mineral dissolution. The ratios were also higher in Sampling-f, likely due to dissolution of residual sulfate from the soils. The major cations Na and Ca displayed a slight increase over time in Sampling-e, but remained relatively flat in Sampling-f. The major element data suggest limited changes for most soil pore waters, with increases most likely due to mineral dissolution and/or exchange reactions.
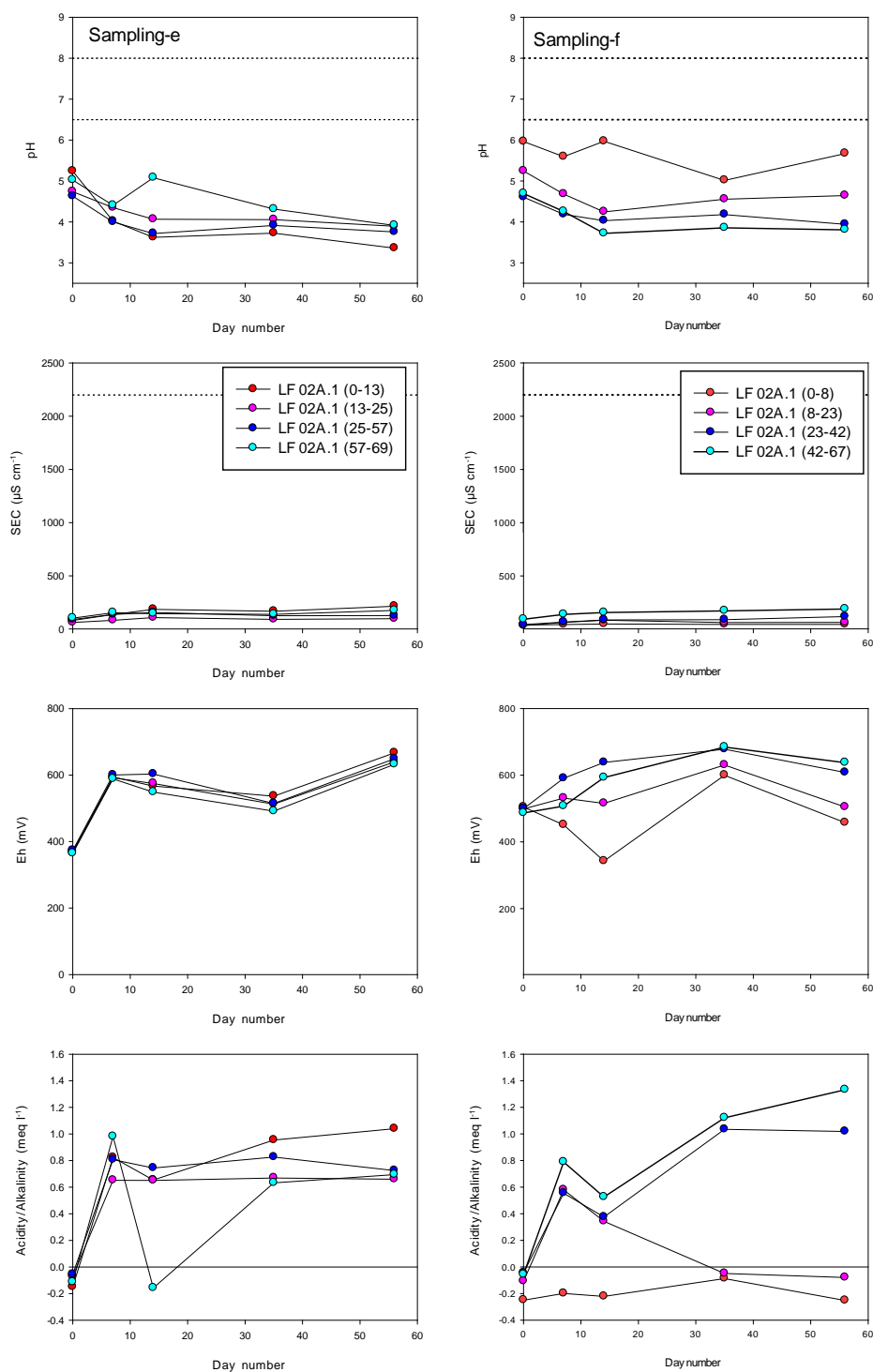
Figure 21-13 CMD data for pH, SEC, Eh and acidity/alkalinity in Point Sturt, site A soil waters for Sampling-e (left) and Sampling-f (right). Where alkalinity was present, it has been assigned a negative number for plotting purposes. Dotted lines show ANZECC Guideline values (see text for details).
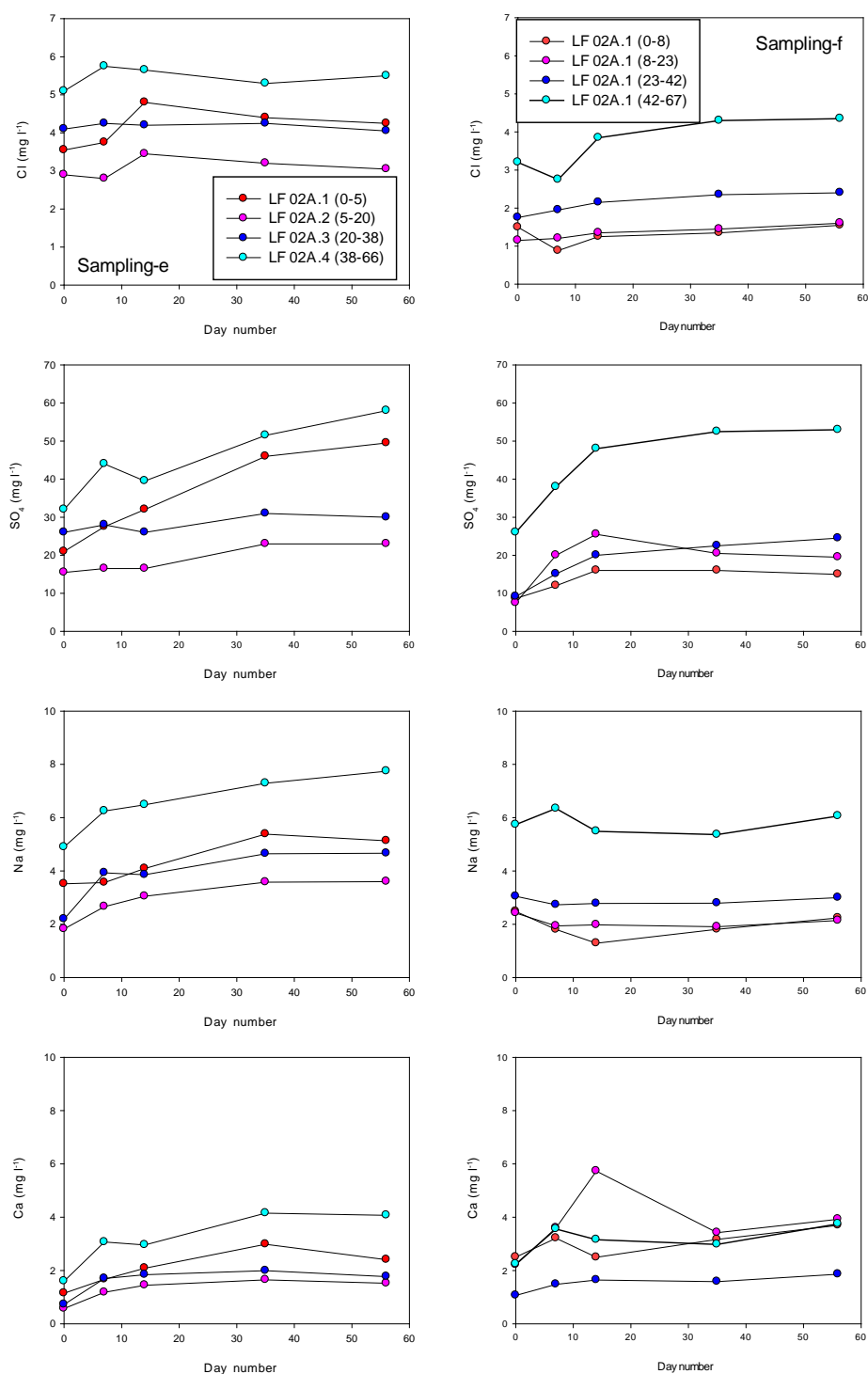
Figure 21-14 CMD data for selected major elements for Sampling-e (left) and Sampling-f (right) in Point Sturt 02a samples. Dotted lines show ANZECC Guideline values (see text for details).

21.4.3 Nutrients

Selected nutrient data are shown on Figure 21-15. Total dissolved nitrogen concentrations varied from 0.08–0.4 mg l^{-1} N. Most samples showed little change over the 56 day period. Nitrate was below the limit of detection in all samples (<0.05 mg l^{-1}) in Sampling-e, but present up to 0.22 mg l^{-1} in deeper soil layers in Sampling-f on day 56. The dominant N-species was NH_4-N (Figure 21-15). The highest concentrations were at depth, and concentrations were lower in the surface layers for Sampling-f. Nitrite was below detection limit (<0.005 mg l^{-1}) in all samples. Phosphate concentrations increased over time in Sampling-e, being initially below the limit of detection (<0.005 mg l^{-1}) in all samples on day 1. Concentrations were significantly higher in Sampling-f, suggesting that P was becoming more available over time. Dissolved organic carbon (DOC) concentrations were generally low, displaying little change over time. The nutrient data suggest that changes in species and release may be significant as the soils age, especially for phosphate and the N-species nitrate and ammonium.

21.4.4 Trace elements

Selected trace elements for the CMD are shown on Figure 21-16 and Figure 21-17. The concentrations of most metals were relatively low initially, but some increased to concentrations above ANZECC Guideline values for freshwater ecosystems with time. Aluminium increased above the ANZECC Guideline value in the surface sample during Sampling-e and Sampling-f, and the deep sample in Sampling-f. Manganese and Fe showed contrasting behaviour, with Mn increasing over time (but well below the ANZECC Guideline, and Fe decreasing (Figure 21-16). Arsenic was present at relatively low concentrations, with little difference between the two sampling periods.

The transition metals Co, Ni and Zn all increased in the initial stages of the tests, and in some cases went above the ANZECC Guideline. For the intermediate depth samples, there was little change between Sampling-e and Sampling-f, but the shallower layer typically displayed a much lower increase in concentrations in Sampling-f, and the deeper layer had higher concentrations (Figure 21-17).

The dominant control on most metal concentrations appears to be pH, with the highest solute concentrations present at pH<4.5 (Figure 21-18). The metalloid, As, showed no clear trend with pH. There is significant overlap between Sampling-e and Sampling-f. The clearest trends were for metal cations. Iron, however, was very low in some of the most acidic samples, but appeared not to exert a major control on metal mobility in the latter stages of the tests.

21.4.5 Summary of Point Sturt 02a

The CMD data show that the concentrations of most contaminants are relatively low, but increased over time. These include reduced forms of N as well as PO_4. A number of metals were also high, particularly Al (up to 13 mg l^{-1}). Other metals of concern include As, Cu, Cr, Co and Ni. This indicates that the these metals are bioavailable and can be mobilsed if current conditions change. All soils remained oxidising, and Eh typically increased with time, possibly buffered by hydroxysulfate miner dissolution. There was considerable overlap between Sampling-e and Sampling-f in the upper soil layers indicating little change in the bioavailability of contaminants during this period of time.
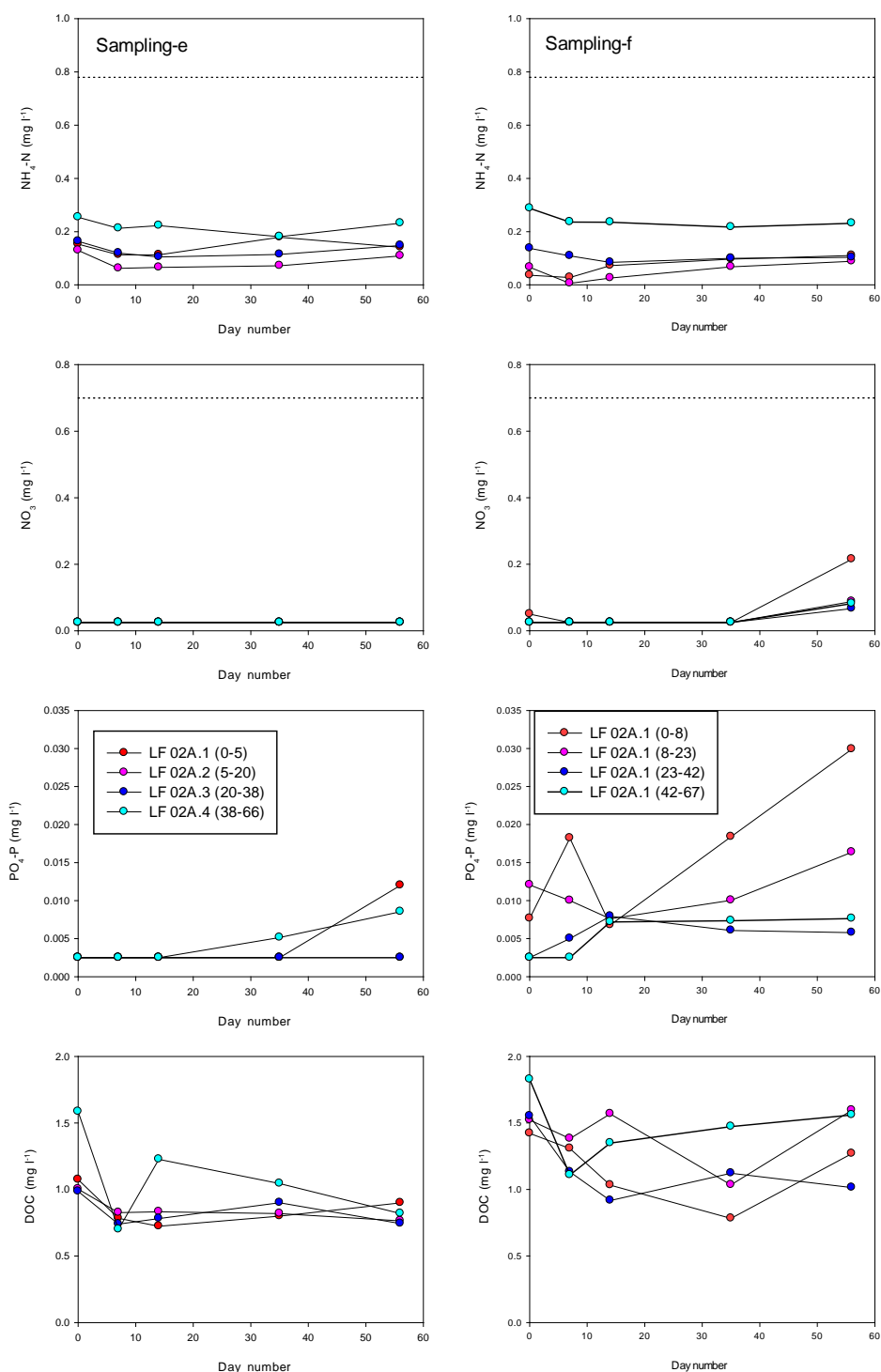
Figure 21-15 CMD data for selected nutrients in Point Sturt 02A samples for Sampling-e (left) and Sampling-f (right). Dotted lines show ANZECC Guideline values (see text for details).
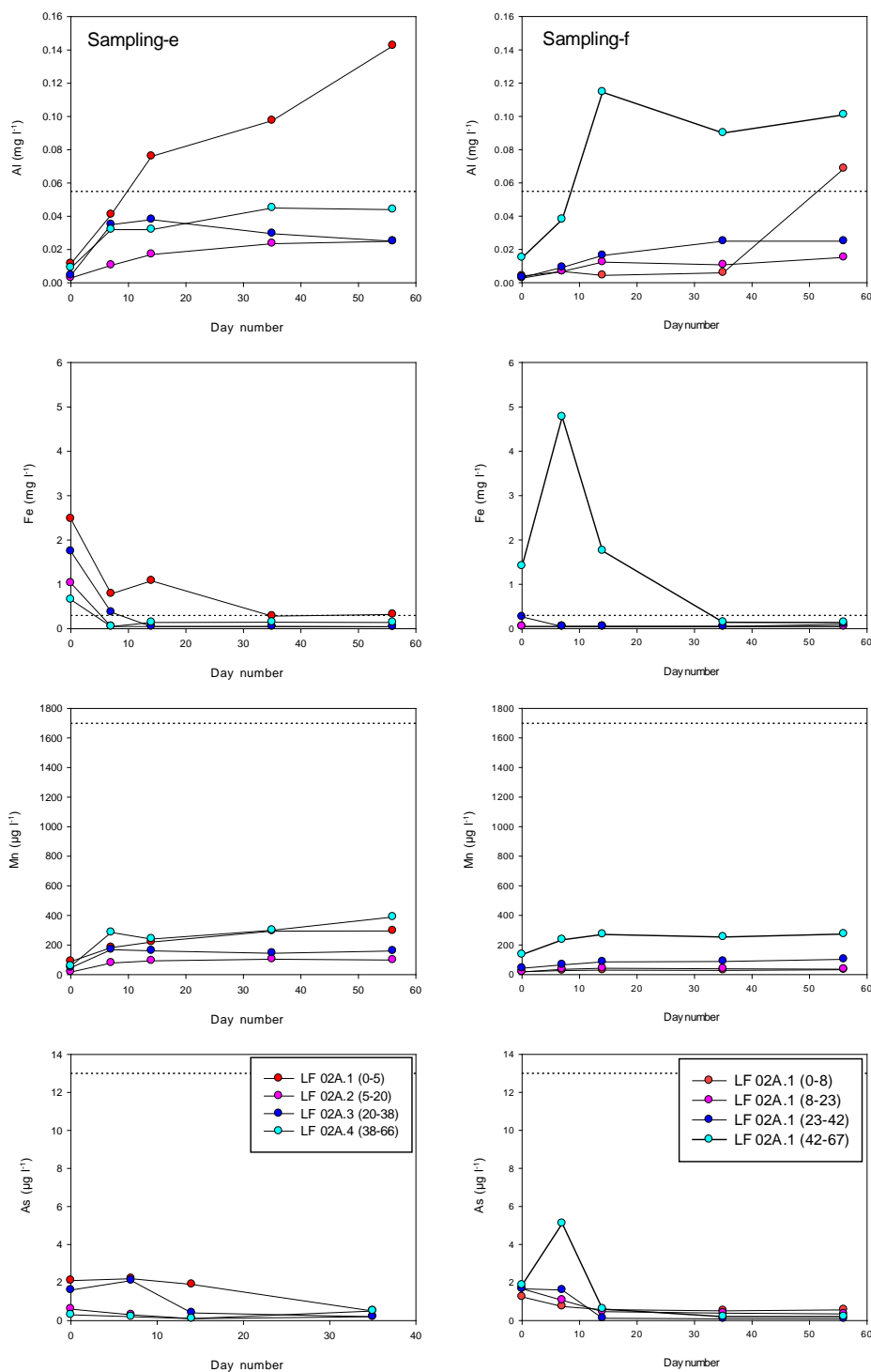
Figure 21-16 CMD data for selected trace elements in Point Sturt 02A for Sampling-e (left) and Sampling-f (right). Dotted lines show ANZECC Guideline values (see text for details).
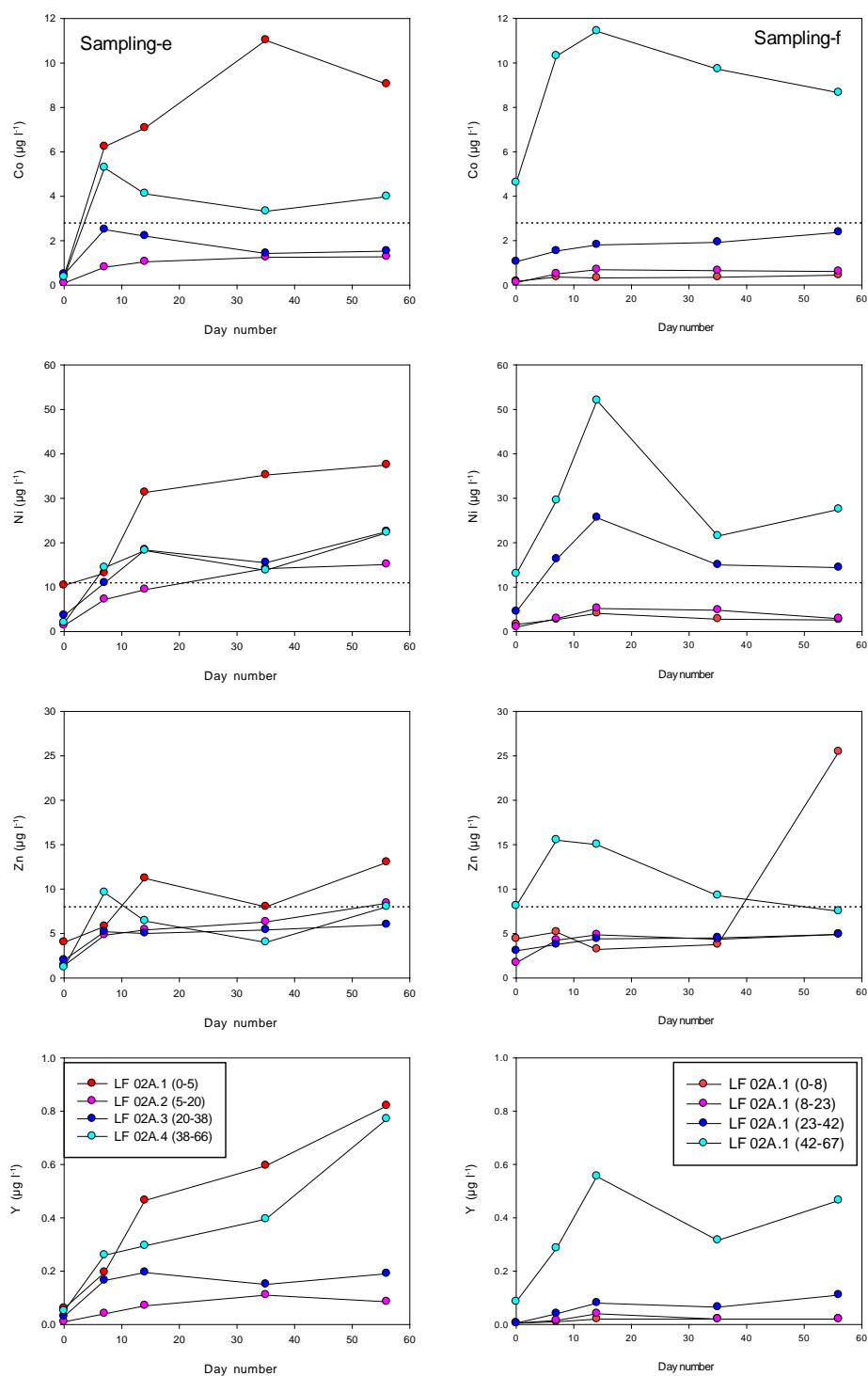
Figure 21-17 CMD data for selected trace elements in Point Sturt 02a for Sampling-e (left) and Sampling-f (right). Dotted lines show ANZECC Guideline values (see text for details).
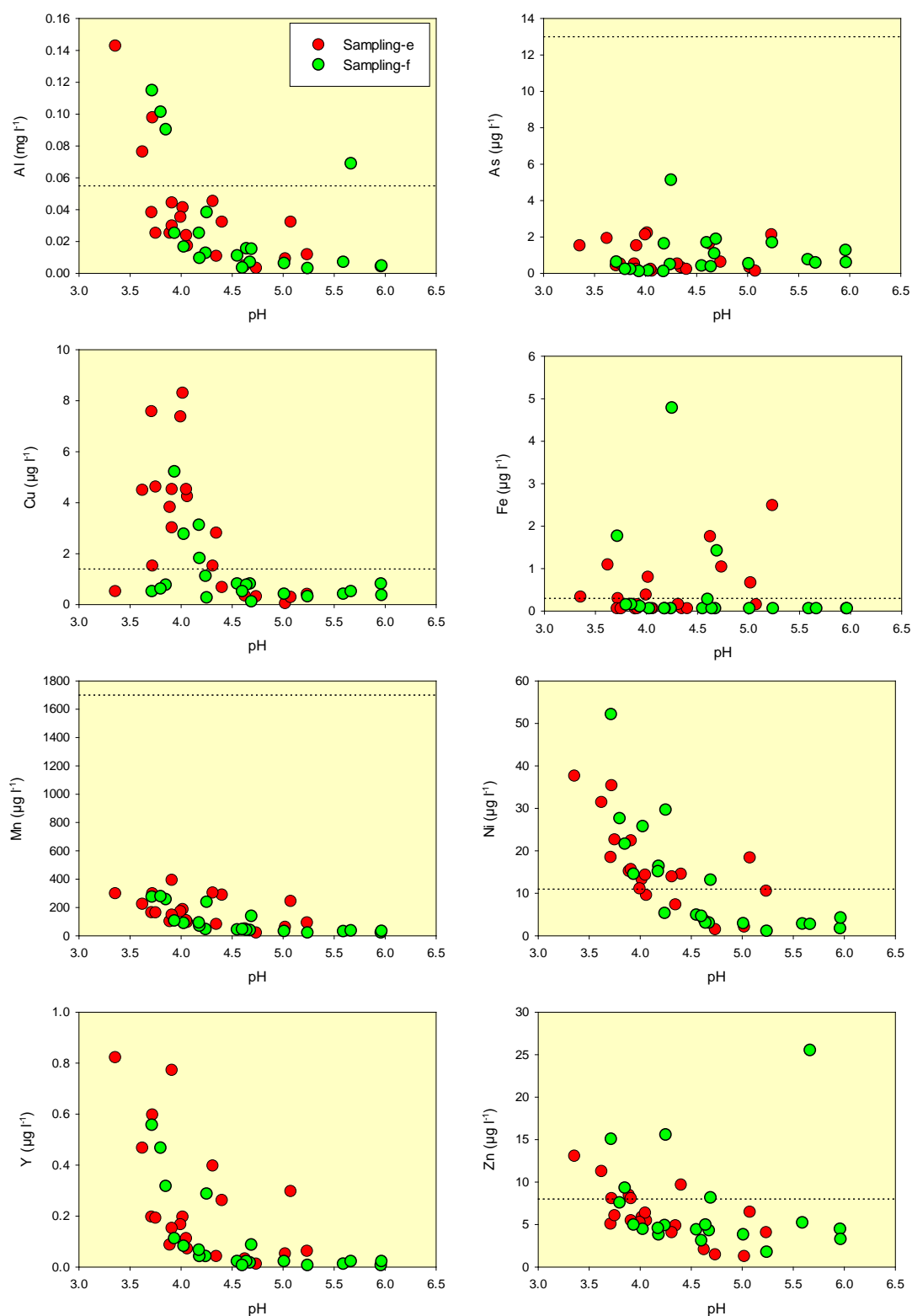
Figure 21-18 Selected solute concentrations for the CMD tests plotted against pH for Point Sturt 02a. Dotted lines show ANZECC Guideline values (see text for details).

21.5 Point Sturt – Site 02d

21.5.1 Physicochemical characteristics

This site is one of two selected for CMD analyses. Site D (LF02D) is situated closest to the shore, and site A (LF02D) data was presented in the previous section (Section 21.4).

There was a significant variation in pH in the profile for Sampling-e, with only slightly acidic water in the surface layer, and acidic waters in the intermediate layers (8-31 cm), with a slight decrease between day 1 and day 56 (Figure 21-19). The deepest soil layer was initially slightly acidic, but showed a significant decreased in pH over time, whilst the other layers showed little change. In Sampling-f, the pH of the surface and deep soil layers was slightly lower, and the pH at 56 days was similar to that observed in Sampling-e (Figure 21-19). The acidity and alkalinity trends reflected the pH with the significant alkalinity in the shallow and deep soil layers, however, for the two intermediate acidic soil layers, only one had high acidity. Over the period of the tests, the deeper soil layer showed a large increase in acidity suggesting strong acid generating processes. In Sampling-f, the final acidity in the top three layers was negative, possibly suggesting a loss of acidity or bioavailable acidity in the upper soil.

The SEC was relatively low in all samples, and little change over time, remaining well below ANZECC Guidelines for freshwater ecosystems. The SEC increased with depth for both samplings, but for sampling-f, it was lower in the top three layers, possibly due to on-going infiltration of surface water. Although the samples were in sealed airtight containers, there was little change towards more reducing conditions; in contrast to what was expected, the Eh, with a steeper gradient in the first 7 days (Figure 21-19). The highest Eh was initially in the intermediate acidic soil layers, however in both samplings, the Eh in the deepest layer increased to be the most oxidising of all layers. There would thus appear to be limited acid buffering in the shallow soils studied, and the timescales of recovery would appear to be significant.

21.5.2 Major elements

Selected major element data are shown on Figure 21-20. Chloride concentrations were low, especially in the surface layers, and increased with depth. There was no clear trend over time in the tests. Concentrations were significantly lower in Sampling-f, especially in the shallower layers, consistent with the SEC. For SO_4, concentrations increased with depth as with Cl, but were high compared to Cl. The SO_4/Cl ratios were very high (3.4-13) in comparison with seawater (0.142), most likely as a consequence of hydroxy-sulfate mineral dissolution. The ratios were also slightly higher in Sampling-f, likely due to dissolution of residual sulfate from the soils. The major cation Na was similar to Cl. Calcium also increased with depth, but in Sampling-e it was particularly high compared with Sampling-f. The major element data suggest limited changes for most soil pore waters between the two sampling periods, with decreases controlled by dilution and/or loss from the soils.
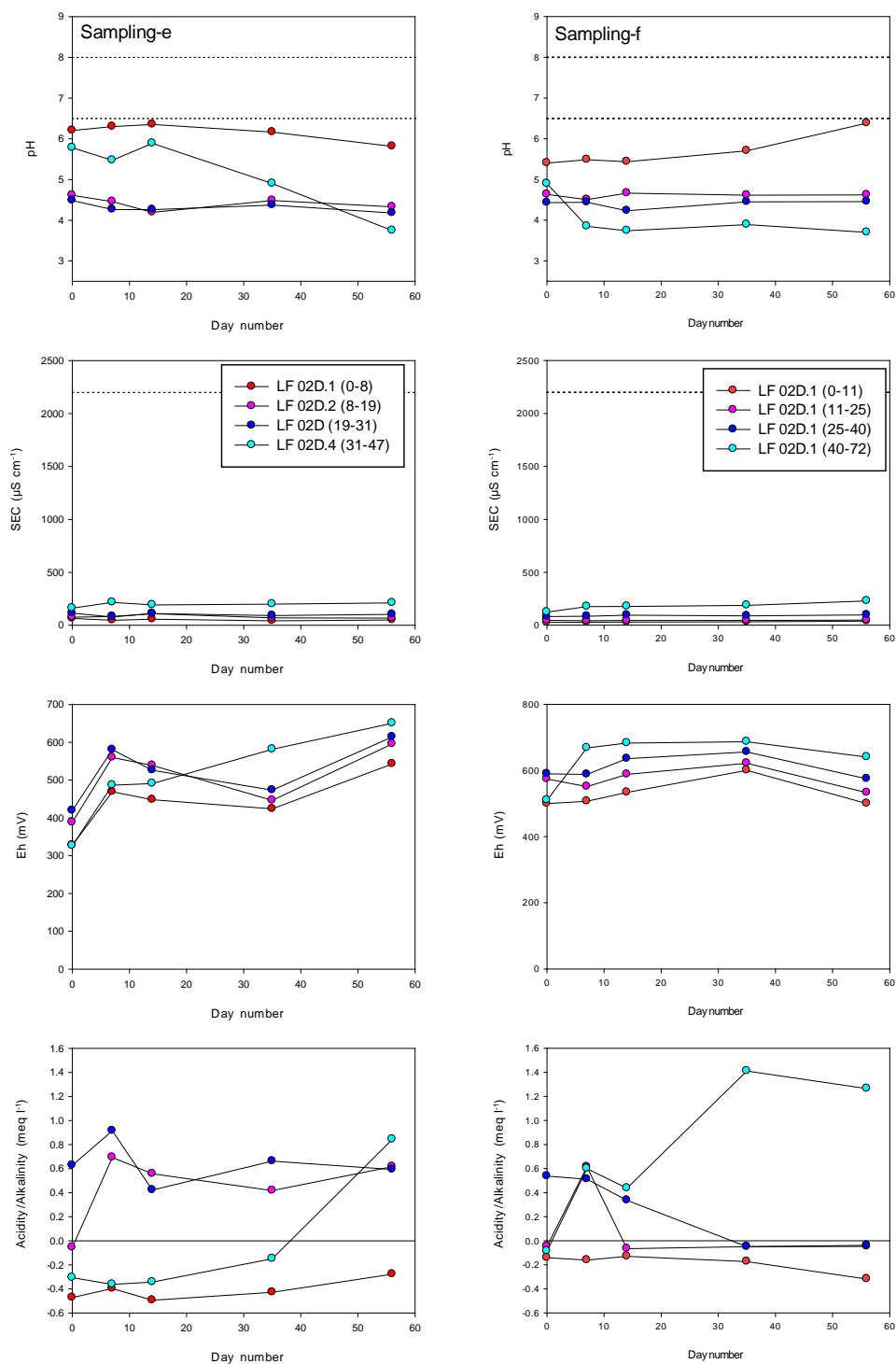
Figure 21-19 CMD data for pH, SEC, Eh and acidity/alkalinity in Point Sturt, LF02D waters for Sampling-e (left) and Sampling-f (right). Where alkalinity was present, it has been assigned a negative number for plotting purposes. Dotted lines show ANZECC Guideline values (see text for details).
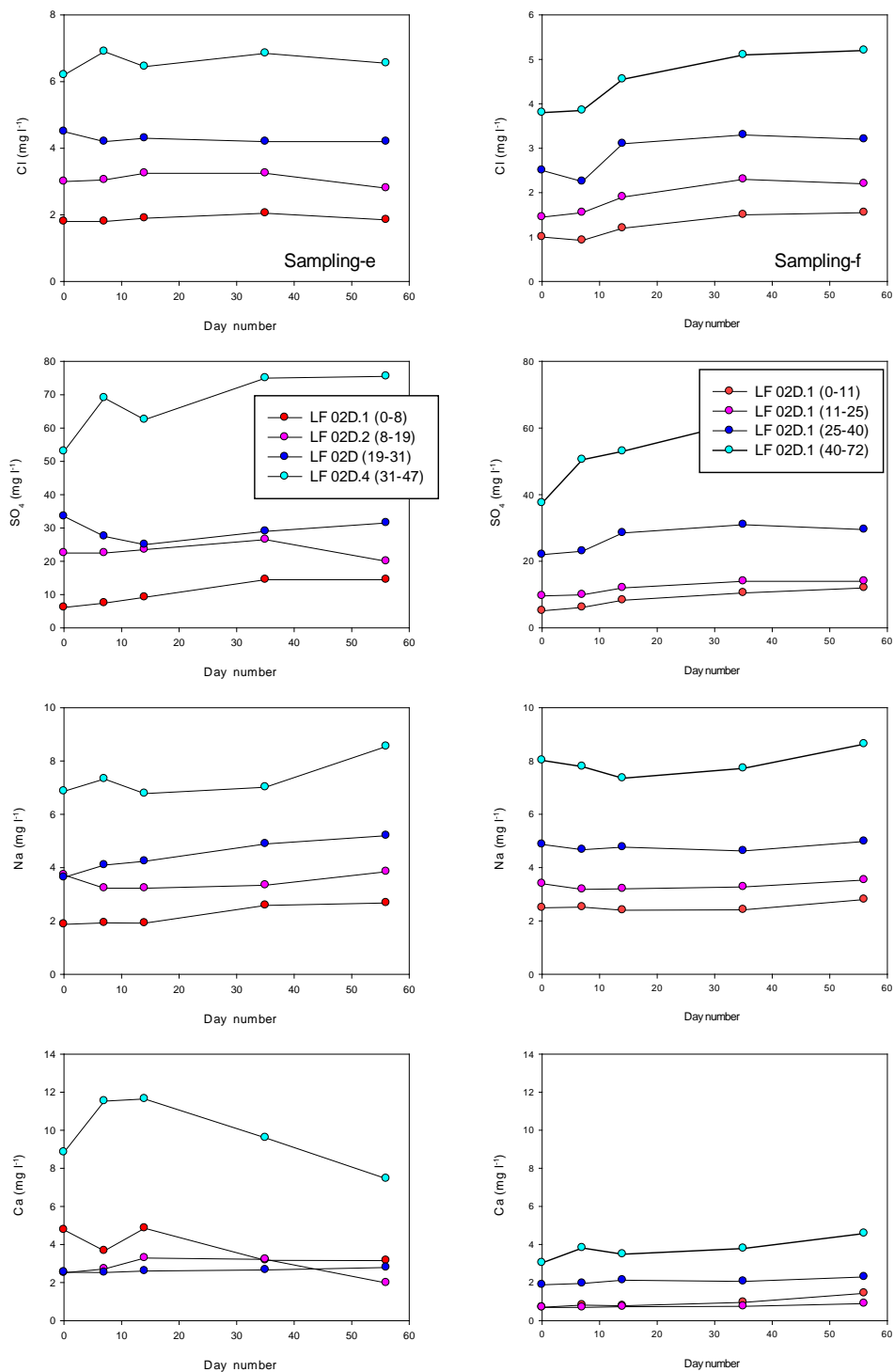
Figure 21-20 CMD data for selected major elements for Sampling-e (left) and Sampling-f (right) in Point Sturt 02D samples. Dotted lines show ANZECC Guideline values (see text for details).

21.5.3 Nutrients

Selected nutrient data are shown on Figure 21-21. Total dissolved nitrogen concentrations varied from 0.07–0.3 mg l^{-1} N. Most samples showed no clear trend over the 56 day period. Nitrate was below the limit of detection in all samples (<0.05 mg l^{-1}) in Sampling-e, but present up to 0.12 mg l^{-1} in deeper soil layers in Sampling-f on day 56. The dominant N-species was NH_4-N (Figure 21-21), but these were below the ANZECC Guideline value. Nitrite was below detection limit (<0.005 mg l^{-1}) in all samples. Phosphate concentrations increased over time in Sampling-e and Sampling-f, being initially below the limit of detection (<0.005 mg l^{-1}) in all samples on day 1. Maxima were similar in both samplings, suggesting that P availability was not changing over time. Dissolved organic carbon (DOC) concentrations were generally low in the deeper two soil layers, and moderate in the upper layers especially in Sampling-f, displaying a decrease over time. The nutrient data suggest that changes in species and release may be significant as the soils age, especially for phosphate. The increase in organic carbon may be significant, if not simply due to soil heterogeneity in the upper soil layers, and will help to enhance reductive processes in these sandy shallow soils.

21.5.4 Trace elements

Selected trace elements for the CMD are shown on Figure 21-22 and Figure 21-23. The concentrations of most metals and metalloids were relatively low compared to Dog Lake and Boggy Lake samples, but some were, or increased to, concentrations above ANZECC Guideline values for freshwater ecosystems. Aluminium was very high in one sample in Sampling-e, but this may be due to colloidal material as it was an isolated occurrence. Concentrations were highest in Sampling-e and Sampling-f in the highest pH samples, hence may also be due to the formation of colloids. Iron tended to be high at the beginning of the tests, decreasing over time, and again it is possible that it was present as colloidal material. Manganese was highest in the deeper soil layer for both samplings, and well below the ANZECC Guideline value. Arsenic was present at relatively low concentrations, being lower in Sampling-f suggesting less bioavailable As over time.

The transition metals Co, Ni and Zn had a tendency for higher concentrations in the two deeper soil layers. These typically increased over time, with the increases being greater in Sampling-f and occurring more rapidly (Figure 21-23). These all increased, or were initially, above the ANZECC Guideline value. Ytrrium and the rare earth elements are mobile under acidic conditions, and their low concentrations imply limited availability compared to Dog Lake and Boggy Lake soils (Figure 21-23).

The dominant control on most metal concentrations appears to be pH, with the highest solute metal concentrations typically being present at pH<4.5 (Figure 21-24). The metalloid, As, showed no clear trend with pH, and was well below ANZECC Guideline values. There is significant overlap between Sampling-e and Sampling-f. The clearest trends were for metal cations. Iron, however, was very low in some of the most acidic samples, but appeared not to exert a major control on metal mobility in the latter stages of the tests.

21.5.5 Summary of Point Sturt 02D

The CMD data show that the concentrations of most contaminants are relatively low, but increased over time for some solutes e.g. PO_4. A number of metals were also high, particularly in the more acidic intermediate depth soils including Co, Ni and Zn. This indicates that these metals are bioavailable and can be mobilsed if current conditions change. All soils remained oxidising, and Eh typically increased with time, possibly buffered by hydroxysulfate miner dissolution. There was considerable overlap between Sampling-e and Sampling-f suggesting limited major changes in bioavailability.
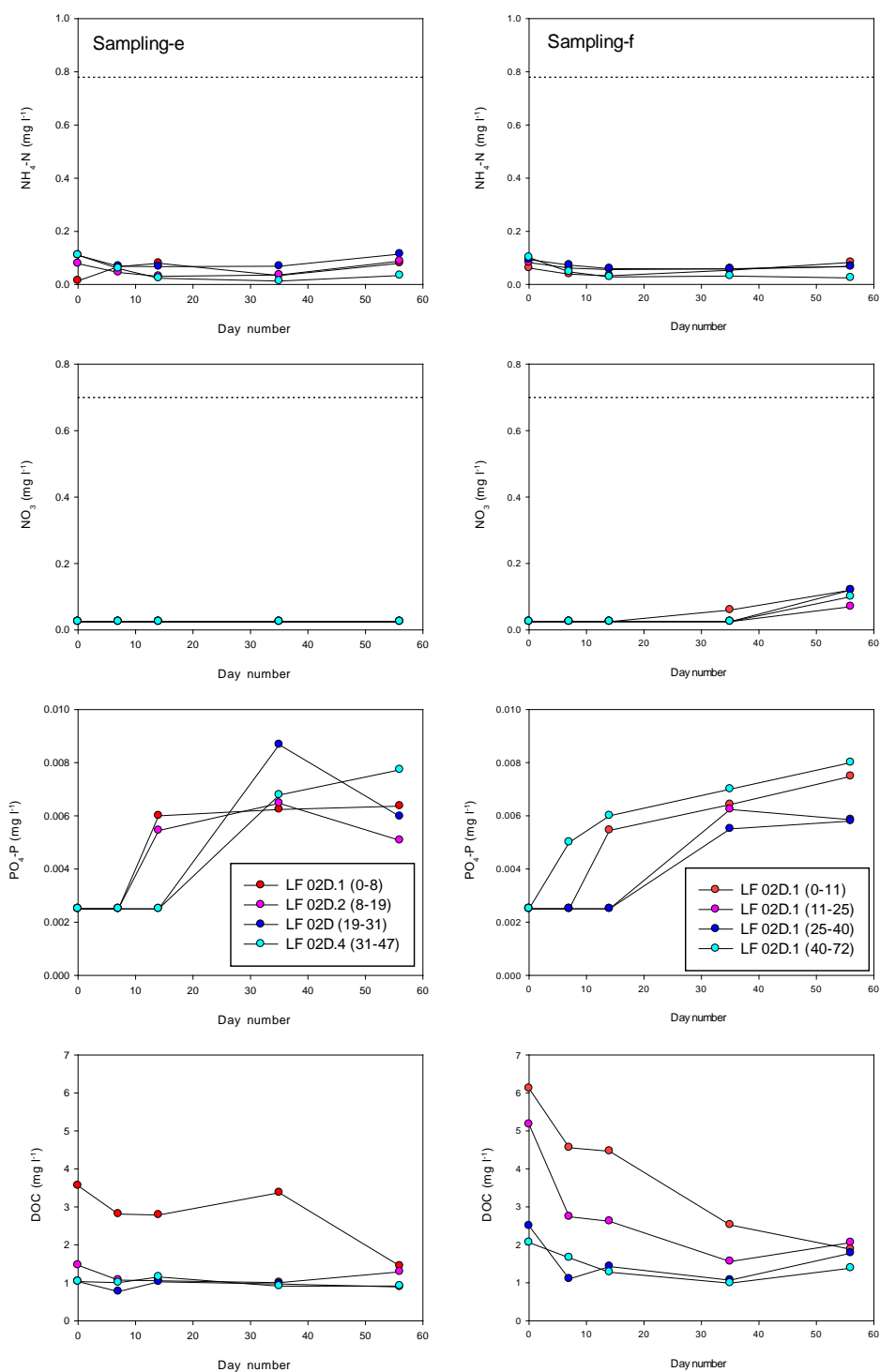
Figure 21-21 CMD data for selected nutrients in Point Sturt 02D samples for Sampling-e (left) and Sampling-f (right). Dotted lines show ANZECC Guideline values (see text for details).
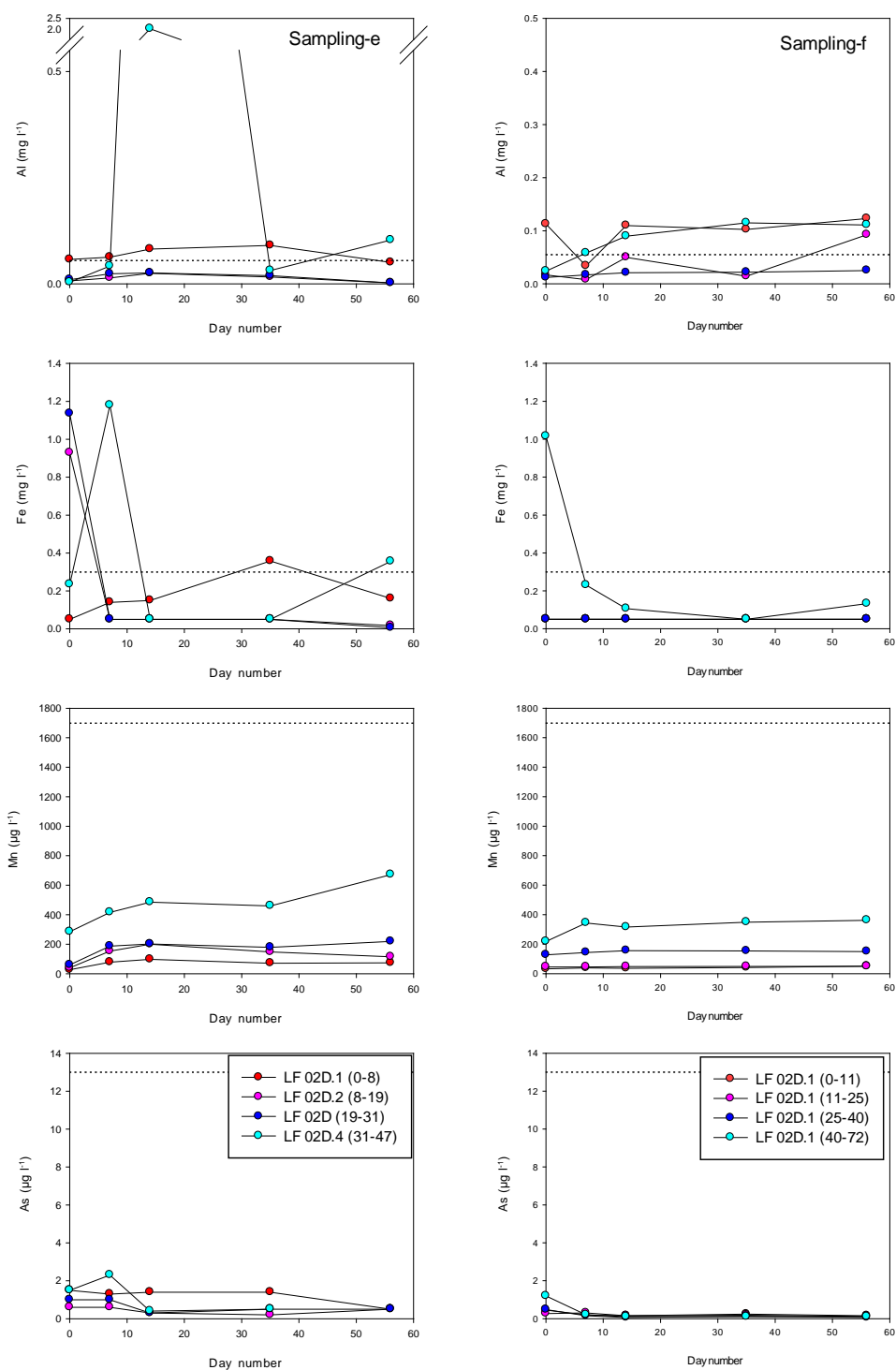
Figure 21-22 CMD data for selected trace elements in Point Sturt 02D for Sampling-e (left) and Sampling-f (right). Dotted lines show ANZECC Guideline values (see text for details).
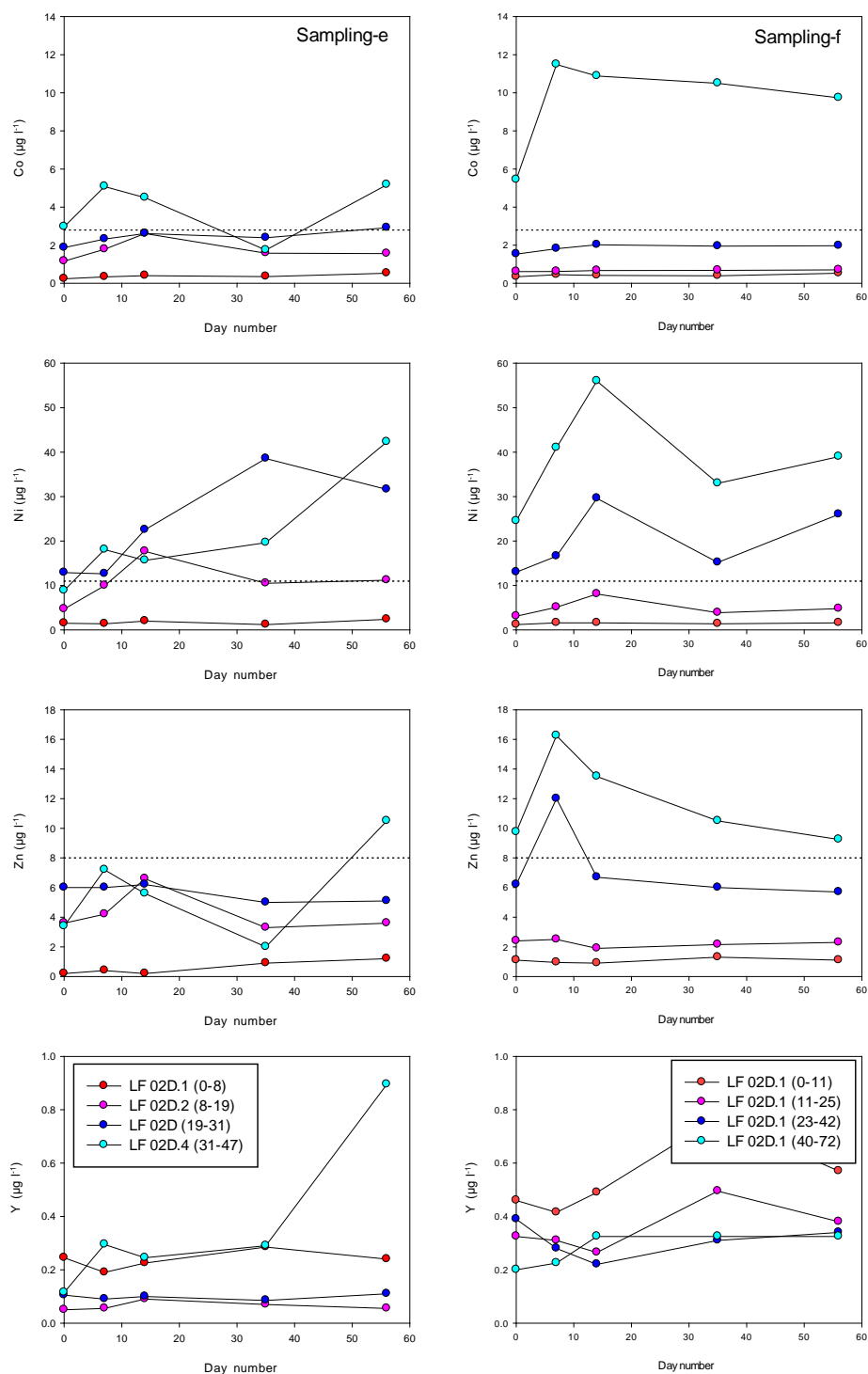
Figure 21-23 CMD data for selected trace elements in Point Sturt 02a for Sampling-e (left) and Sampling-f (right). Dotted lines show ANZECC Guideline values (see text for details).
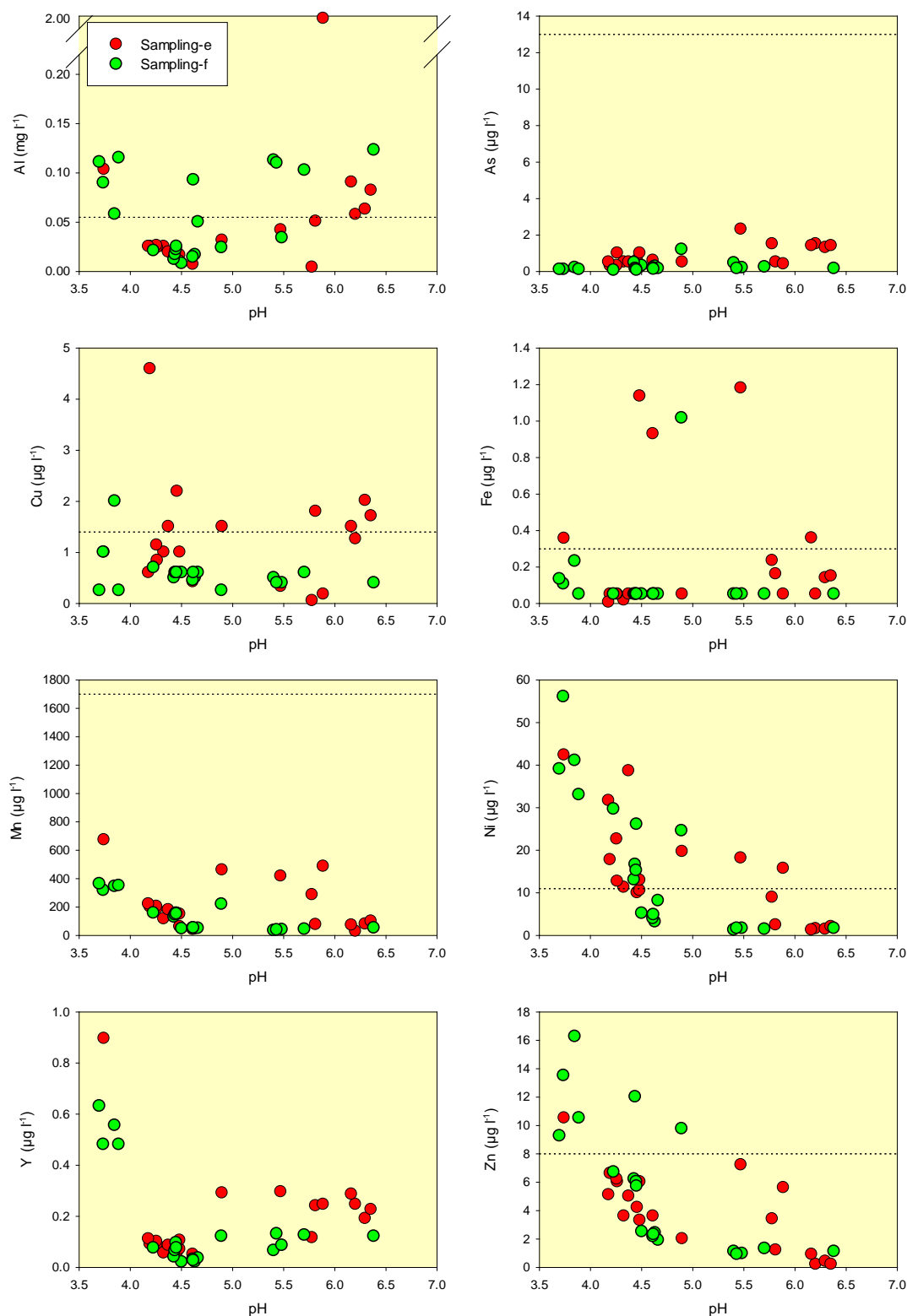
Figure 21-24 Selected solute concentrations for the CMD tests plotted against pH for Point Sturt 02a. Dotted lines show ANZECC Guideline values (see text for details).

22. Conceptual models of selected sites

Summary

This section provides a summary of how conceptual models are used to describe, explain and predict temporal and spatial heterogeneity of ASS properties and the main soil-regolith processes that may occur as a consequence of wide-ranging and fundamental shifts in the "environmental equilibrium" brought about by drying and re-wetting. The soil-regolith models provide a more detailed understanding of 2D, 3D and 4D (predictive) ASS soil-landscape features along representative transects, which illustrate vertical and lateral changes that occur across lake, river and creek hydro-toposequences. The ASS soil-regolith models are able to explain the complex sequential changes in soil, hydrological and biogeochemical interactions that have led to the formation of different types of ASS with time.

The 6 case studies were selected to illustrate the complexities and importance of understanding specific sites to assess the:

- time-related changes and soil evolution,

- detailed behaviour and implications of various ASS materials (e.g. sulfuric, hypersulfidic, hyposulfidic and monosulfidic),

- features in layers and horizons (e.g. cracks, salt efflorescences, algal mats),

- shallow regolith materials (e.g. layers of calcrete and Coorongite),

- degree of external and internal factors controlling pedogenic pathways and processes of soil evolution (i.e. extrinsic and intrinsic pedogenic thresholds, pedogenic rates and acid sulfate soil processes, such as sulfidization and sulfuricization),

- different management options (e.g. pumping from Lake Alexandrina to Lake Albert, revegetation and limestone application).

Case Studies

i)   Lake Albert on the northern side of Campbell Park Peninsula,

ii) Finniss River at Wallys Landing,

iii) Wetland adjacent to Finniss River near Wallys Landing,

iv) Lake Alexandrina and adjacent Loveday Bay,

v)   Boggy Creek on Hindmarsh Island near barrages / Lake Alexandrina,

vi) Waltowa Beach (protected embayment): north eastern side of Lake Albert

These 6 case studies were chosen to help visualise the results of several key ASS investigations performed at typical sites with complex surface and subsurface ASS features, including several regolith layers (e.g. Coorongite) and shallow surface water interface systems.

22.1 Time-related changes and soil evolution models

An understanding of the detailed behaviour of various ASS materials (e.g. sulfuric, hypersulfidic, hyposulfidic and monosulfidic) and features (e.g. cracks or salt efflorescences) in layers, horizons and deep regolith is fundamental to successful site or regional characterisation of ASS. This section provides a summary of how conceptual models are used to describe, explain and predict temporal and spatial heterogeneity of ASS properties and the main soil-regolith processes that may occur as a consequence of wide-ranging and fundamental shifts in the "environmental equilibrium" brought about by drying and re-wetting. These changes include not only the historical building of locks and barrages to contain water flow or from over-allocation of irrigation water (see Fitzpatrick *et al.* 2009b) but also by: (i) extreme

drought conditions from 2006 to 2009, which have lowered water levels in rivers, lakes and wetlands and (ii) re-wetting caused by winter rainfall events, upstream re-flooding and re-flooding from the installations of regulators and pumping (e.g. Narrung, Clayton and Currency Creek). The effects of these changes have led to an accelerated accumulation, then drying and oxidation of sulfides in ASS materials. The transformation of hypersulfidic materials in ASS to acidic by-products arise from this disequilibrium, which can be presented in various categories of conceptual soil-regolith process models in graphical and/or written form.

To aid in understanding the spatial and temporal heterogeneity of ASS properties, soil landscape cross-sections, in the form of conceptual soil-regolith toposequence models, are constructed from field and laboratory data and surveyor knowledge. Conceptual soil-regolith process models enable workers to develop and present a mechanistic understanding of complex spatial and temporal soil-regolith environments (e.g. Fritsch and Fitzpatrick 1994). The regolith is the unconsolidated earth material present above bedrock and includes the upper soil layers. These models are cross-sectional representations of soil-regolith-bedrock profiles that illustrate vertical and lateral changes that occur across wetland hydro-toposequences. They also tell a story explaining the complex soil, hydrological and biogeochemical interactions that have led to the development of an ASS problem (e.g. Fitzpatrick and Merry 2002). These models may also incorporate various management options linked to scenarios such as:

- The "minimum intervention' option such as permitting water levels to continue to: (i) lower due to extreme drought conditions resulting in the progressive exposure and oxidation of hypersulfidic materials at depth and formation of more sulfuric material and (ii) rise due to reflooding resulting in the progressive reduction of sulfuric material.
- Implementation of various management options such as: (i) the construction of water flow regulators, (ii) addition of limestone to raise alkalinity and (iii) revegetation.

Example models: The following sections describe **six** examples of soil-regolith models from: (i) Lake Albert on the northern side of Campbell Park Peninsula, (ii) the Finniss River at Wallys Landing, (iii) wetland adjacent to Finniss River near Wallys Landing, (iv) Lake Alexandrina and adjacent Loveday Bay, (v) Boggy Creek on Hindmarsh Island near barrages / Lake Alexandrina and (vi) north eastern side of Lake Albert on Waltowa Beach (protected embayment).

These six particular models were chosen to help visualise the results of key ASS investigations performed at typical / representative sites with complex surface and subsurface ASS features, including several regolith layers (e.g. Coorongite) and shallow surface water interface systems. Three categories of soil-regolith toposequence models have been found to be useful for ASS scenarios:

- Descriptive soil-regolith models (e.g. Figure 22-1 to Figure 22-5).
- Explanatory soil-regolith models (e.g. Figure 22-6).
- Predictive soil-regolith models (e.g. Figure 22-7).

In these soil-regolith model examples the spatial variation of all ASS materials identified are displayed in detail using a standard set of graphic symbols such as for sulfuric, hypersulfidic, hyposulfidic and monosulfidic materials. They also display other related features formed as a consequence of the formation ASS such as soil cracks and salt efflorescences caused as a consequence of receding water levels due to extreme drought conditions. However, in some soil-regolith models, symbols for "inferred" sulfuric and hypersulfidic materials were used because only sporadic soil morphology features were observed or logically extrapolated or occurrence was hypothesised).

Finally, these soil-regolith models can also be used as a framework or basis to explain some of the key intrinsic features and external drivers that render acid sulfate soils relatively stable or susceptible to rapid change (Fitzpatrick *et al.* 2012). To illustrate how this concept can be applied to determine the degree of external and internal factors, which control pedogenic pathways of evolution, the Wallys Landing site model was used as a case example in section 22.3.3 below).

22.2 LF10 – Campbell Park

22.2.1 Descriptive soil-regolith models

To aid in understanding the spatial heterogeneity of ASS property variation described in Table 11-2, soil landscape cross-sections have been constructed from the data and surveyor knowledge. Descriptive soil-regolith models are presented for Campbell Park in Lake Albert for: (i) pre-drought (winter 2007), (ii) Drought (Summer) 2008, (iii) Winter-Spring 2009) and finally dry summer of 2010 (see conditions in Figure 22-1, Figure 22-2, Figure 22-3, Figure 22-4 and Figure 22-5). They all show the location and transition of hypersulfidic, sulfuric and monosulfidic materials occurring in the unsaturated sands, hypersulfidic material on the water margins, and subaqueous sulfuric and hypersulfidic material occurring below water.

An important finding of this study was the temporal occurrence of shallow sulfuric subaqueous soils and that they occur over significant areas in winter to spring 2009. In the Lake Albert toposequence these soils occurred where there were isolated pools of water that formed in surface depressions.
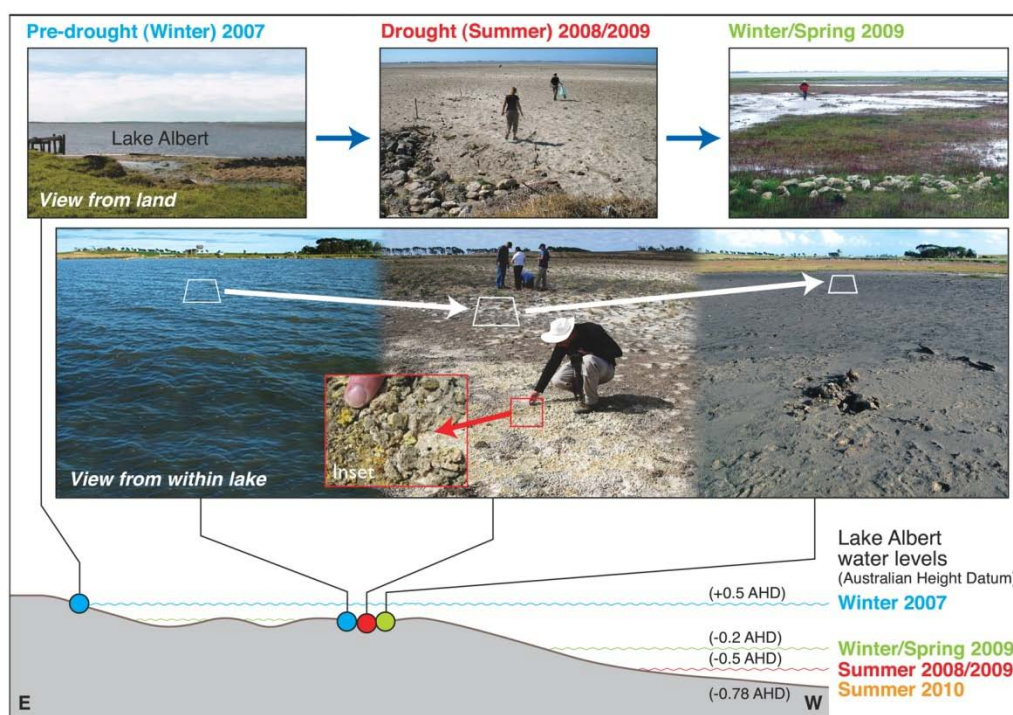
Figure 22-1 Descriptive toposequence model for an area near Campbell Park in Lake Albert showing variation of ASS features in Pre-drought (winter) 2007, Drought (Summer) 2008, Winter-Spring 2009) and after summer in March 2010 (estimated)
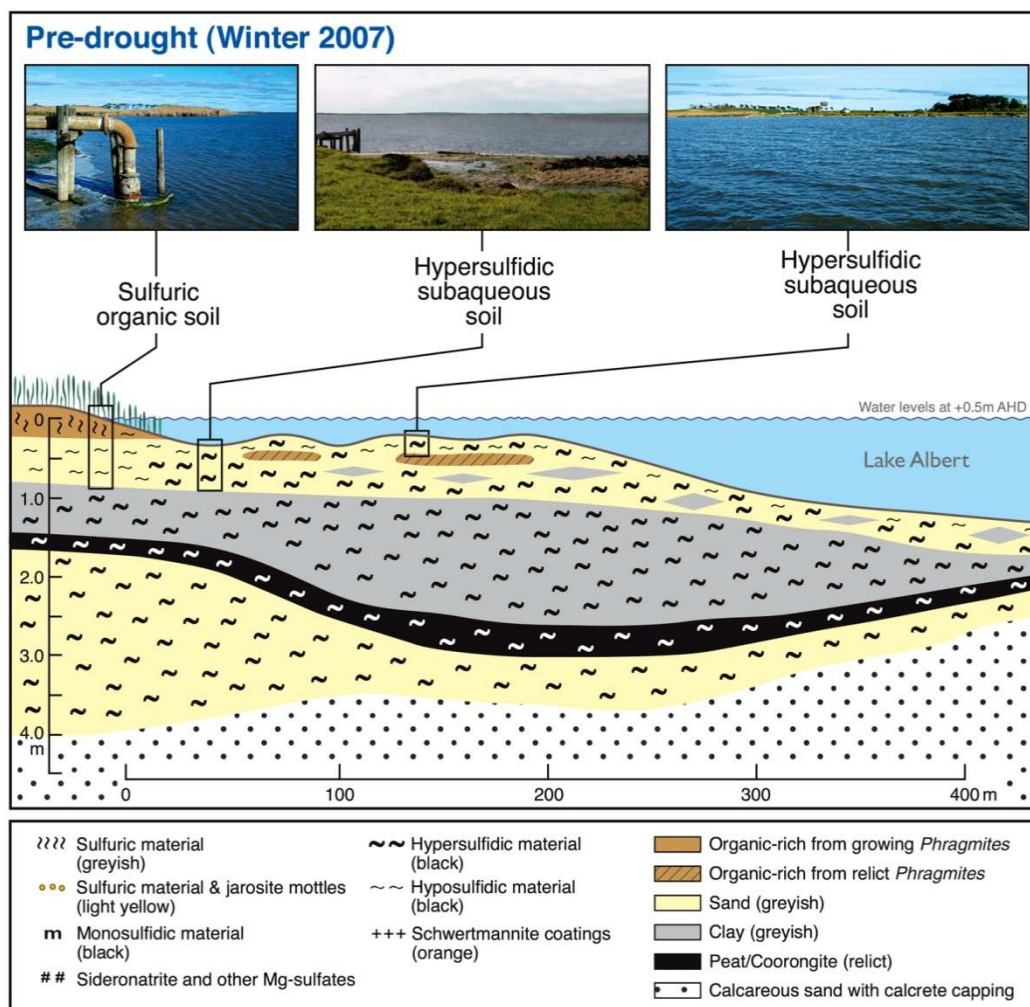
Figure 22-2 Descriptive toposequence model for an area near Campbell Park in Lake Albert showing spatial variation of ASS materials in pre-drought (winter 2007)
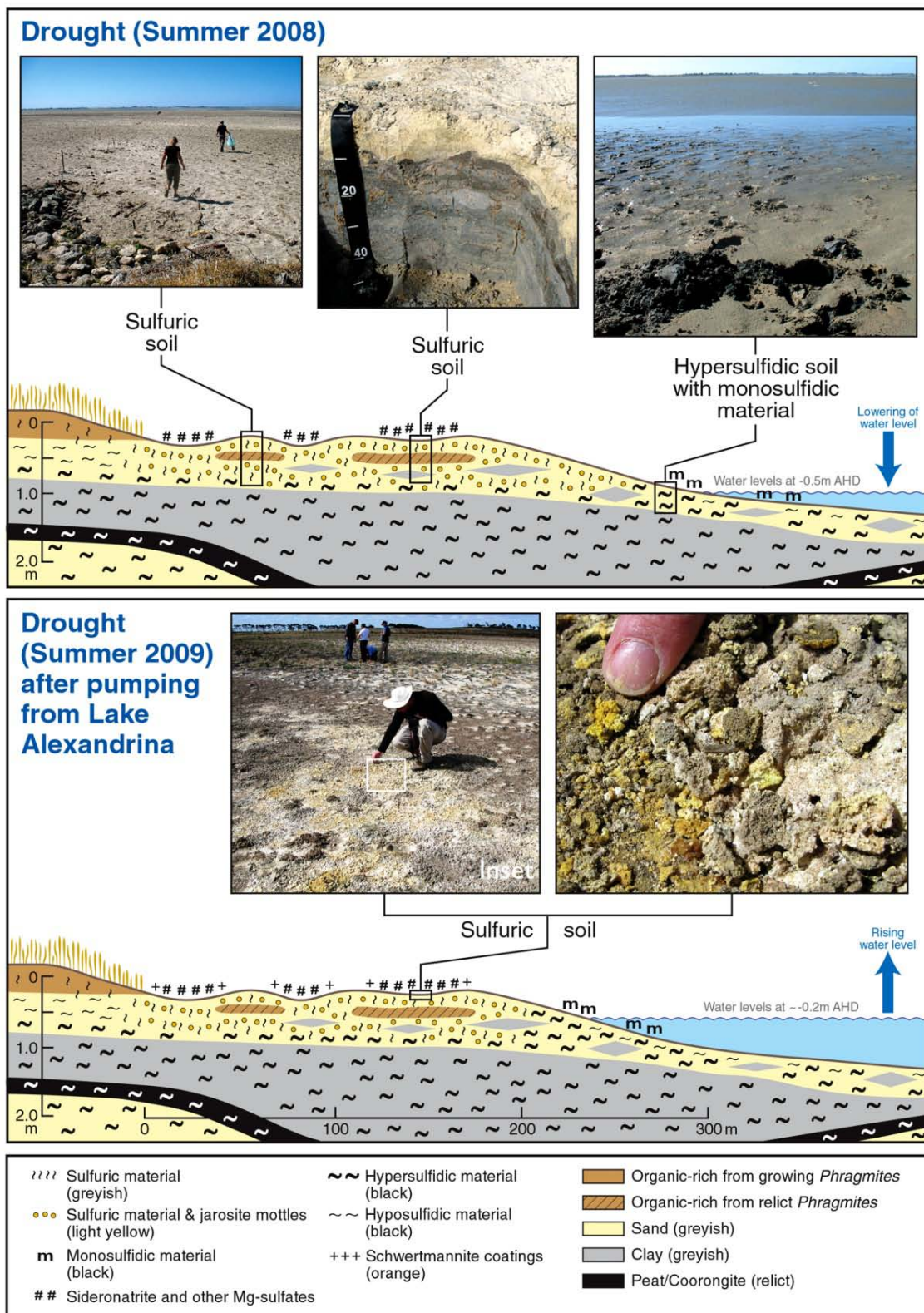
Figure 22-3 Descriptive toposequence model for an area near Campbell Park in Lake Albert showing spatial variation of ASS materials (summer 2008)
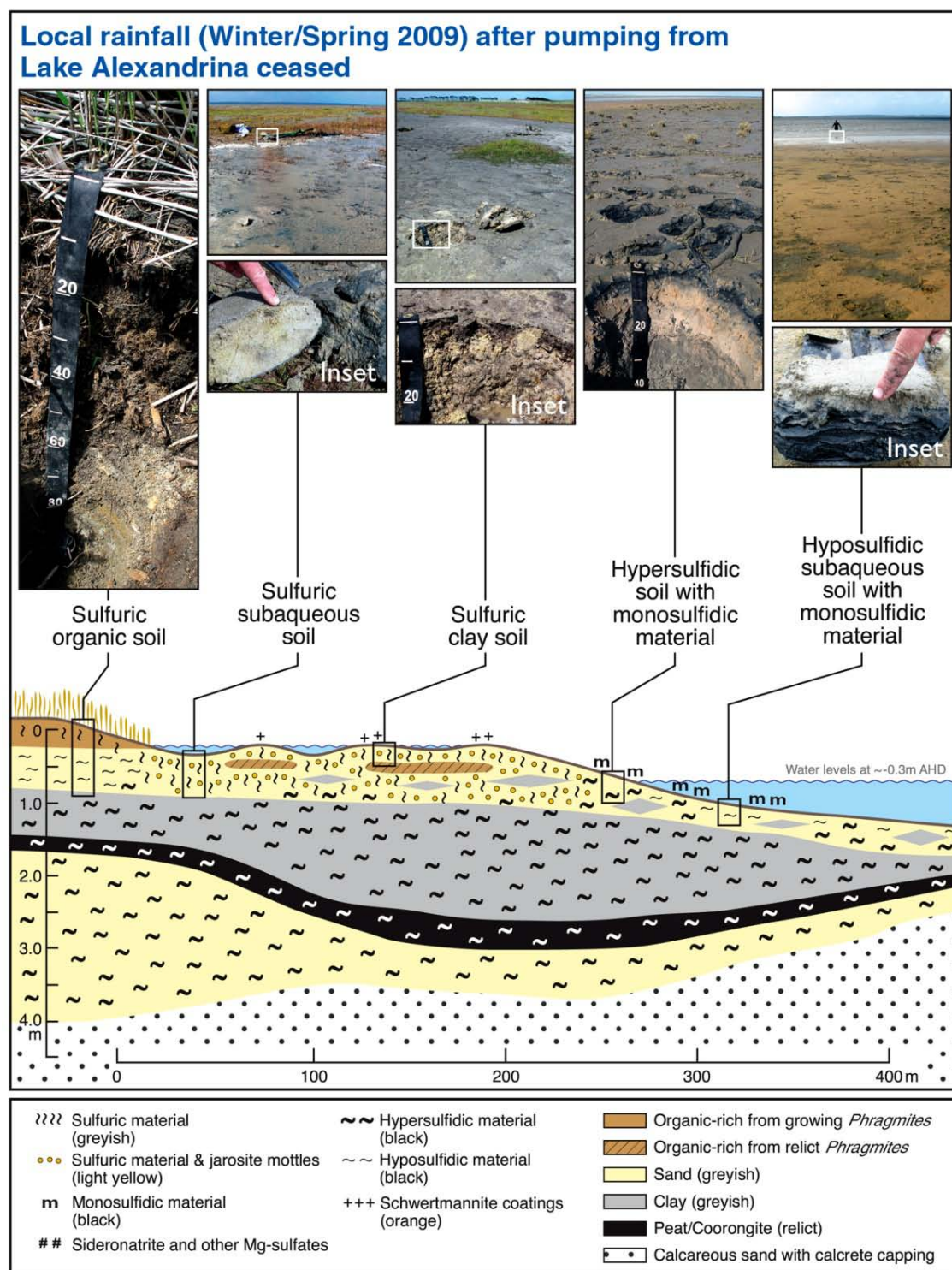
Figure 22-4 Descriptive toposequence model for an area near Campbell Park in Lake Albert showing spatial variation of ASS materials after several winter rainfall events (winter / spring 2009)
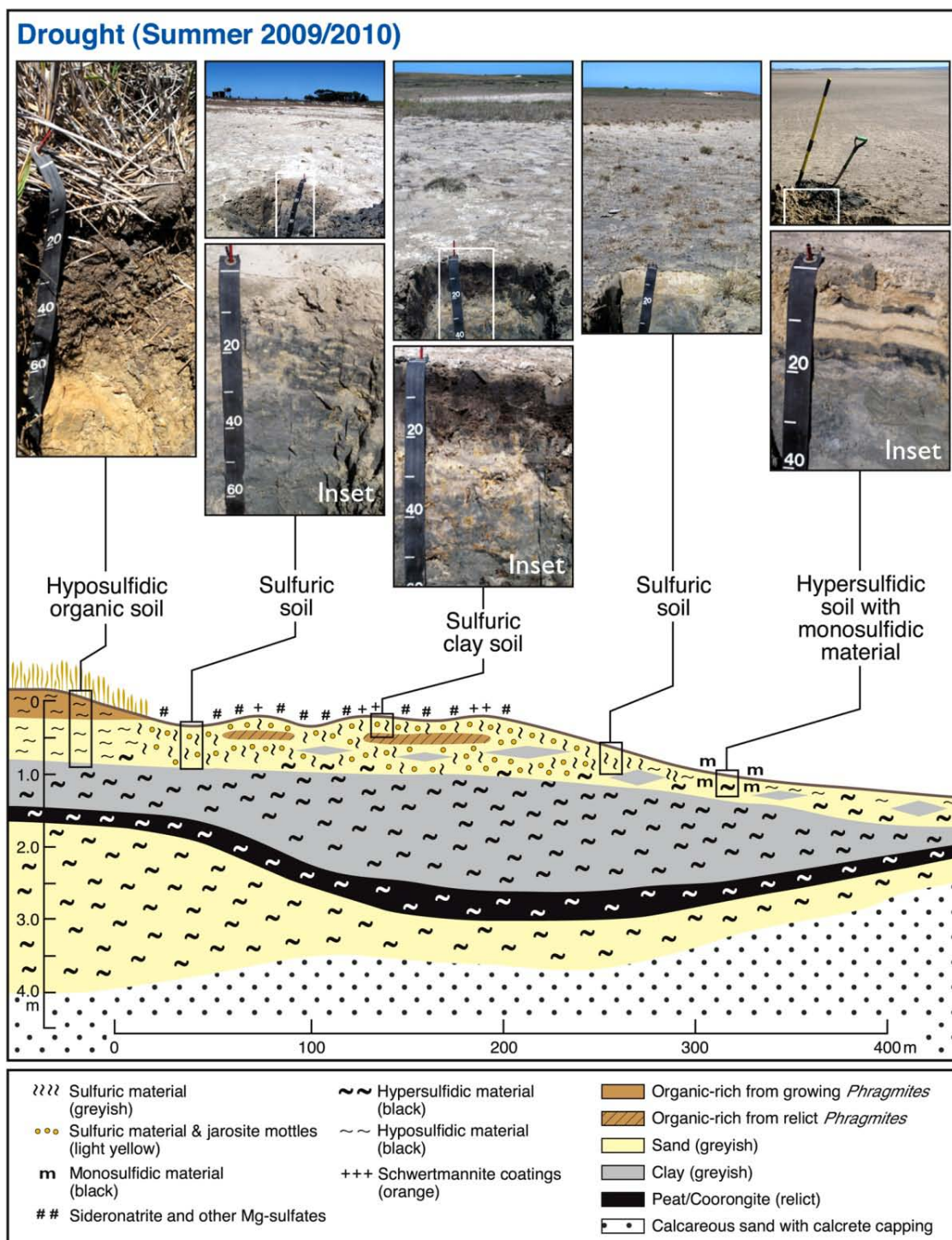
Figure 22-5 Descriptive toposequence model for an area near Campbell Park in Lake Albert showing spatial variation of ASS materials at the end of summer and after discontinuation of water pumping from Lake Alexandrina to Lake Albert (March 2010)

22.2.2 Explanatory and Predictive soil-regolith models

To aid in the understanding and explaining the location and spatial variation of ASS described above and in Table 11-2, the temporal variation due to fluctuating water levels is considered. Predictive "generalised' conceptual models based on knowledge from repeat site visits over time to the areas have been constructed for the same areas in Lake Albert at Campbell Park (Figure 22-6). In addition, the following eight "detailed" sequential soil-models are presented in Figure 22-7, based on the data presented in Chapter 11, especially in Table 11-2: (i) pre-drought (winter 2007), (ii) Drought (Summer) 2008, (iii) Summer 2009 after pumping from Lake Alexandrina, (iv) End winter 2010 after pumping ceased, (v) End summer following no pumping, (vi) Post drought flooding in summer/autumn 2011, (vii) Post drought flooding in winter 2011 and (viii) Post drought flooding to June 2012.

The management option for preventing more sulfidic material in Lake Albert oxidising to form sulfuric material was implemented by pumping water from Lake Alexandrina to Lake Albert to maintain water levels (Figure 22-6 and Figure 22-7). This option was based on:
(a) identification of abundant sulfuric and underlying hypersulfidic materials in Lake Albert when water levels were minus 0.3 m AHD (Figure 22-7),
(b) predicted formation of abundant sulfuric materials when water levels drop further if the extreme drought conditions in the Lower Lakes continued (see ASS maps in Fitzpatrick *et al.* 2008a; Fitzpatrick *et al.* 2008b; Fitzpatrick *et al.* 2008c) and
(c) the absence of satisfactory environmental flows resulting in restoration of water levels in the Lower Lakes. The South Australian and Australian Federal governments maintained water levels in Lake Albert at approximately -0.2 to -0.3 m AHD by pumping water at a rate of 400 ML/day from Lake Alexandrina to Albert to prevent the water level in Lake Albert dropping below -0.6 m AHD (Figure 22-6 and Figure 22-7), to minimise the risk of extreme soil and water acidification. Lake Albert was disconnected from Lake Alexandrina after the construction of an earthen bank (see photograph in Figure 22-6) before pumping commenced in early 2008. However, pumping ceased in winter 2009 [see (iv) in Figure 22-7].

To aid in the understanding and explaining the location and spatial variation of the various ASS materials described above, the temporal variation due to fluctuating water levels is considered. Explanatory and predictive soil-regolith models based on knowledge from repeat site visits over time to the areas have been constructed for the same areas in Lake Albert (Figure 22-1, Figure 22-2 and Figure 22-4).
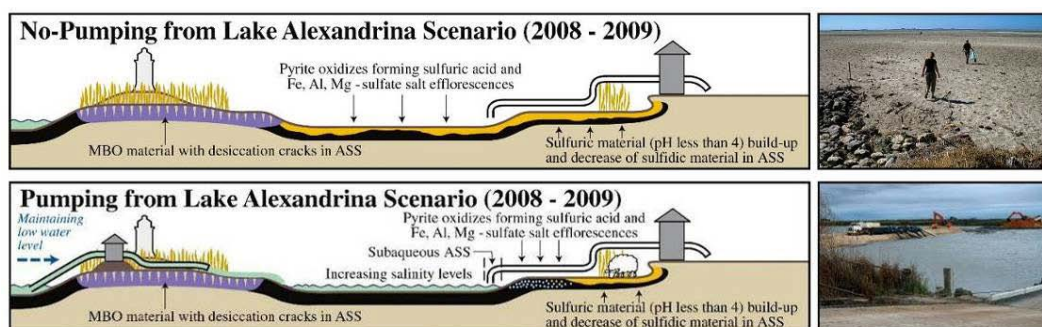
Figure 22-6 Explanatory schematic conceptual models for Lake Albert showing: (a) the formation of sulfuric materials on the edges of the lake – "no management or no pumping scenario" (upper panel) illustrating the widespread formation of: (i) sulfuric material (pH <4) by oxidation of sulfides in sulfidic material, (ii) sulfate-rich salt efflorescences and (iii) deep desiccation cracks: due to continued lowering of water levels under persistent extreme drought conditions during 2008–2009, and (b) management by protecting sulfidic materials from oxidation using partial water inundation – "pumping of water from Lake Alexandrina scenario" (lower panel) where an earthen bank between Lake Albert and Lake Alexandrina was constructed in early 2008,which disconnected Lake Albert from Lake Alexandrina (modified from Fitzpatrick *et al.* 2009b)

(i)   Pre-drought, modified by barrages from the 1920s to July 2007. Since the 1930s water levels in Lake Albert and Lake Alexandrina and adjacent wetlands have been managed using locks and barrages and this continues to the present, with seawater exclusion being their main function. The installation of locks and barrages has allowed considerable build-up of hypersulfidic and monosulfidic material in Lake Albert due to: firstly the evaporative concentration of sulfate from river nutrient/salt loads during periods of stable pool levels and from groundwater sources, and secondly, the lack of scouring and seasonal flooding. This has led to the formation of subaqueous ASS (i.e. hypersulfidic subaqueous clayey soils) [see panel (i) in Figure 22-7].

These soil-regolith models show that pre-drought [panel (a) in Figure 22-6] water levels were higher and connected to the main lake water body: the soils were covered with water and were classified as Hypersulfidic subaqueous soils.

(ii)   Drought with drying from 2006 to February 2008. During this drought period, due to lowering water levels, areas became disconnected from the main lake water body, surface water evaporated and the saturated hypersulfidic soils became unsaturated (dried) and oxidised to form Sulfuric soils [see panel (ii) in Figure 22-7].

(iii)   Pumping - -Drought with extreme drying from February 2008 to March 2009.
During this extreme drought period, despite pumping from Lake Alexandrina, water levels remained low and surface water evaporated and the saturated hypersulfidic soils became unsaturated (dried) and oxidised to form Sulfuric soils [see panel (iii) in Figure 22-7].

(iv)   Winter rains causing rewetting in May 2009. Water levels remained low enough to keep a high proportion of the areas disconnected from the main lake water body, and with winter rains, water flowed over and through the sulfuric soils and collected in small depression areas as shown in panel (iv) in Figure 22-7. The consequence of this was observed during the August 2009 mapping survey (Fitzpatrick *et al.* 2010a), which was areas of very acidic water (pH 2.5 to 2.8) and soils below this water remaining sulfuric material and not reducing to hypersulfidic material. Note the location of the hypersulfidic soils that are adjacent to the main lake water bodies and how their position shifts with time due to the fluctuating water conditions. This confirms that mapping of these soil locations is highly dependent on the water level at the time of field survey.

In contrast, in 2011 (5 later) as a consequence of post drought reflooding the previously exposed areas include both Sulfuric subaqueous soils and hypersulfidic subaqueous soils [see panels (vi) and (vii) in Figure 22-7].

(v)   Post drought no pumping from end winter, 2009 to summer 2010. During this period of rewetting the wetlands remained exposed with the sulfuric clay soils that were coated in jarosite and infilled with medium sand with some sideronatrite [see panels (v) in Figure 22-7].

(vi)   Post drought reflooding from summer 2010 to summer 2011. During this extensive period of rewetting the lake remained submerged with the sulfuric subaqueous clayey soils containing vertical cracks that were coated in jarosite and infilled with medium sand [see panels (vi) in Figure 22-7].

(vii)   Post drought continued reflooding from Summer 2011 to December 2011. In sampling jarosite mottling was observed, leaving most of this area comprising predominantly Sulfuric / hypersulfidic subaqueous clay soils [see panel (vii) in Figure 22-7].

(viii)   Post drought continued reflooding from December 2011 to June 2012. In sampling fewer jarosite mottling was observed, leaving most of this area comprising predominantly hypersulfidic subaqueous clay soils [see panel (viii) in Figure 22-7].

The above demonstrates that ASS vary both spatially and temporally, and as this knowledge and understanding improves predictive conceptual models can be prepared to illustrate future changes. These conceptual soil-regolith models can be used to predict ASS changes and also help to generate "interpretive maps" (e.g. Fitzpatrick *et al.* 2010a) and data sets to support management planning.

(i) Pre-drought (h₁): July 2007

(ii) Drought (h₂): February 2008

(iii) Pumping from Lake Alexandrina (h₃): Summer 2009

(iv) Pumping ceased from Lake Alexandrina/Local rainfall (a): End of Winter 2009

(v) No pumping (b): End of Summer 2010

(vi) Post drought reflooding (c): Summer 2011

(vii) Post drought continued reflooding (d & e): Winter 2011 to December 2011

(viii) Post drought continued reflooding (f): June 2012

Figure 22-7 Predictive soil-regolith model for an area near Campbell Park in Lake Albert that shows the changes of ASS materials with time due to fluctuating water conditions from winter 2007 through to winter 2011.

22.3 LF01 – Wallys Landing Wetlands

To aid in understanding the spatial heterogeneity of ASS property variation in the Finniss River and adjacent wetlands near Wallys Landing (jetty), soil landscape cross-sections have been constructed from the data described in Table 4-2 and surveyor knowledge. The locality map shown in Figure 4-1 of upper Finniss River area shows localities of the two cross- sections (A–B and A – B') and for water and soil profile sites monitored during the drought (i.e. drying phases between 2007 and 2009 as shown Figure 22-8) and rewetting from winter rainfall events and reflooding between 2010 and 2012 (see Figure 22-10 and Figure 22-11).

The August 2007 photograph shows the Finniss River with benign hypersulfidic subaqueous clay under 80 cm of water at the end of the jetty (Figure 22-8). Benign hypersulfidic organic clay was sampled in the Phragmites reeds four metres from the bank/water's edge. The November 2008 photograph shows substantial lowering of water levels to produce mainly waterlogged benign hypersulfidic cracking clay (Figure 22-8; end of jetty). The February 2009 photograph shows further lowering of water levels to expose a dry clay river-bed with cracks and salt efflorescences (sulfuric cracking clay) (Figure 22-8). The red square shown in the February 2009 photograph in Figure 22-8 indicates the location of white fluffy acidic salts adjacent to Phragmites reeds. This is shown in close-up on the lower right hand side photograph.
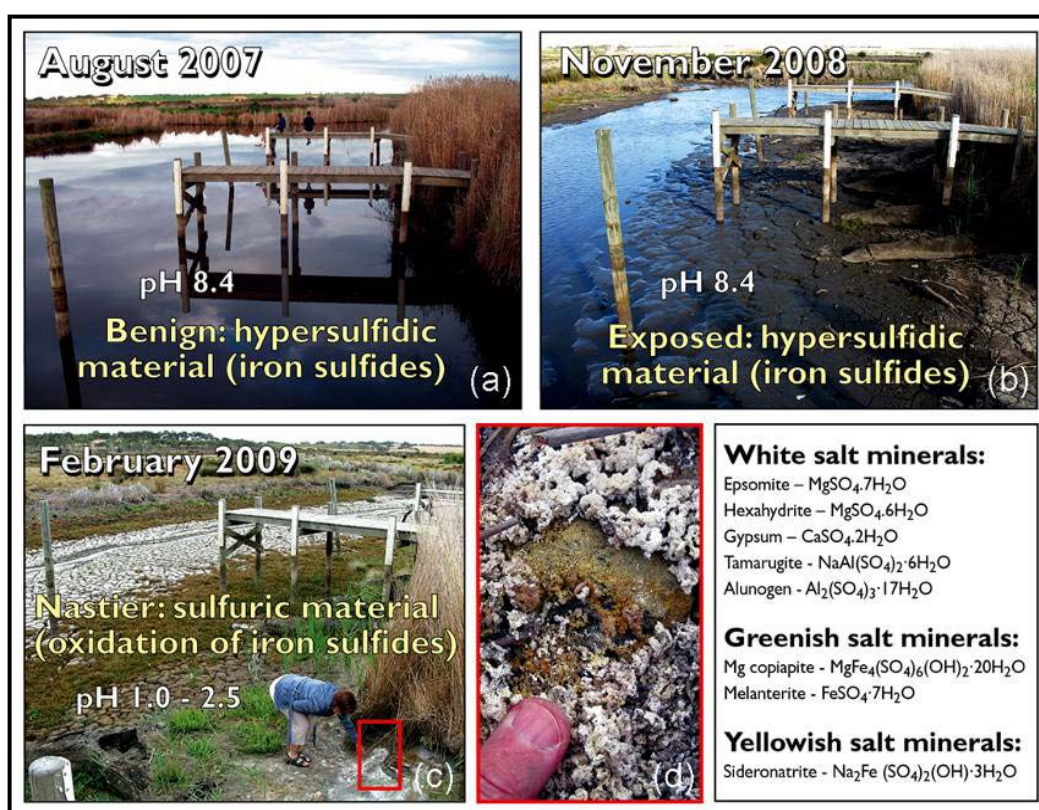
Figure 22-8 Wallys Landing showing changes in water level and soil pH during August 2007, November 2008 and February 2009 (modified from Fitzpatrick *et al.* 2009a).

More than 91% of the representative sites assessed in November 2008 had a high, very high, or extra high ASS hazard classification. It was found that 37 of the 39 sites (94%) investigated had sufficient net acidity that, if disturbed, would be a major concern (Fitzpatrick *et al.* 2009a).

22.3.1 Mineralogy

At several sites, abundant minerals were recorded in salt efflorescences and sub-surface horizons by Fitzpatrick *et al.* (2009a). In the bright yellowish green and orange surface salts (e.g. Figure 22-8), and pale yellow mottles in subsoils, X-ray diffraction analyses identified sideronatrite, schwertmannite and jarosite/natrojarosite minerals, respectively. The pH values of the bright yellowish green surface efflorescences was very acidic (pH < 2) and the orange and pale yellow minerals were acidic (pH < 3 to 4). The presence of all these minerals indicates high contents of iron sulfides (principally pyrite) in the original materials. Where winter rainfall has rewet previously identified sandy sulfuric soils with pH values of 1.6 to 2.5, the mineral tamarugite [$NaAl(SO_4)2.6H_2O$], with traces of sideronatrite were subsequently identified with extremely acidic pH values ranging from 0.5 to 0.8 during slight rewetting of the mineral surfaces.

22.3.2 Hydrogeochemistry

While still connected, the alkalinity of Lake Alexandrina (> 250 mg/L) has helped to maintain the alkalinity of the remnant Currency Creek and Finniss River waters, along with local contributions from alkaline ground waters and evaporation. ASS impacts are most likely to have an effect where net acidities are high and surface water alkalinities are low, such as in Currency Creek, where alkalinities are lower than in Lake Alexandrina (200 to 250 mg/L).

The data from Wallys Landing in May 2009 showed that the pH in the flowing river was circumneutral following rewetting from winter rainfall. However, water in cattle pugs close to the river was found to be very acidic (pH 3.2). In a major anabranch of the Finniss River, the flowing stream water was found to produce acidic pulses (pH 3.3. to 4.0) with relatively high specific electrical conductance (SEC) of 13300 $\mu S\ cm^{-1}$ (reflecting the presence acidic sulfate salts).

Finniss River predictive soil-regolith models

Predictive soil-regolith models illustrating the formation and transformation of hypersulfidic material were constructed for the Finniss River and adjacent wetlands in the area near Wallys Landing (Figure 22-9 and Figure 22-10). These models provide an additional understanding of how and why the nature of soil materials has changed over time, especially in describing the spatial heterogeneity of ASS property variation described in Table 4-2. Based on field investigations and historical/soil knowledge of the Finniss River wetlands, a sequence of seven conceptual soil-regolith models (Fitzpatrick *et al.* 2009a) have been reconstructed in Figure 22-9, Figure 22-10 and Figure 22-11. This is elaborated in the following text.

5,500 BC to 1920s. Following stabilisation of sea level to about its present position 5,500BC, the lower Finniss River cycled between natural wetting and flushing, and partial drying conditions in response to seasonal and climatic cycles occurring in the upper Murray-Darling Basin and its own catchment. During wetter periods, the river accumulated sulfidic materials from sulfate contained in surface waters and groundwaters. However, during periods when river flows were lower (Figure 22-9 - middle panel), the river and adjacent wetlands partially dried causing oxidation of hypersulfidic material, especially on the dry margins with the potential formation of sulfuric material. In wetter times and during floods, the acidic material was resubmerged causing dilution or neutralisation of acidity, entrainment of soluble materials in the river waters or the reformation of sulfidic material. The build-up of hypersulfidic material in the Finniss River was thus regularly kept in check by oxidation and removal during scouring floods.
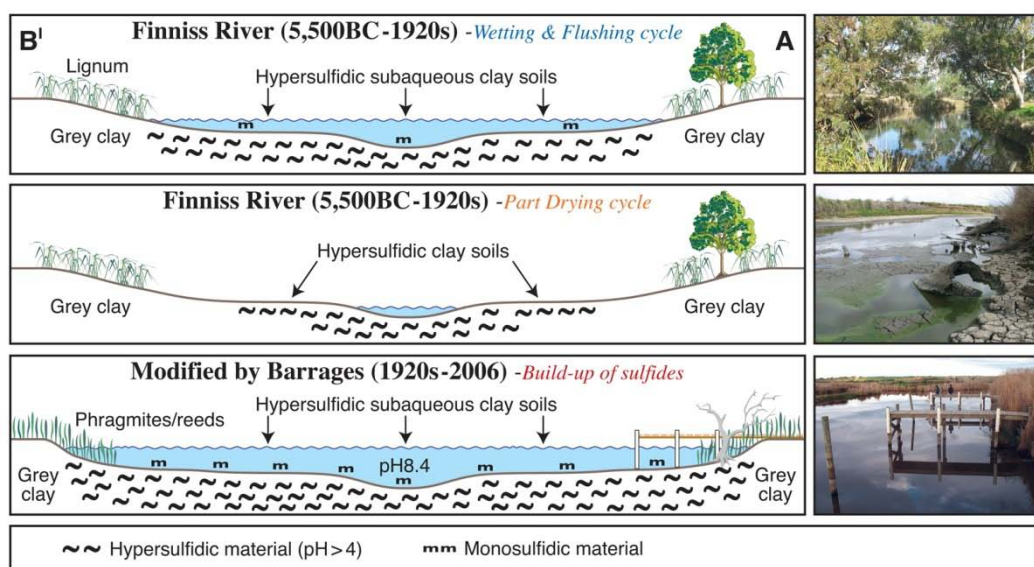
Figure 22-9 Predictive soil-regolith models for Finniss River (A – B' transect in Figure 4-1) illustrating natural wetting and flushing (upper panel), and partial drying (lower panel) cycles during the time prior to major pre-European development (5,000 BC to 1880s). The first picture taken upstream of Wallys Landing to represent its possible original condition (modified from Fitzpatrick *et al.* 2009a).

(i) **Pre-drought, modified by barrages from the 1920s to 2006.** Since the 1920s water levels in Lake Alexandrina, The Finniss River and adjacent wetlands have been managed using locks and barrages and this continues to the present, with seawater exclusion being their main function. The installation of locks and barrages has allowed considerable build-up of sulfidic, hypersulfidic and monosulfidic material in the lower lakes and tributaries due to: firstly the evaporative concentration of sulfate from river nutrient/salt loads during periods of stable pool levels and from groundwater sources, and secondly, the lack of scouring and seasonal flooding. This has led to the formation of subaqueous ASS (i.e. hypersulfidic subaqueous clay soils) with ultra-fine monosulfidic material accumulating in low-flow backwaters and along the vegetated edges of the wetlands [see panel (i) in Figure 22-10].

(ii) **Drought with drying from 2006 to November 2008.** During this drought period, partial drying of the river [panel (ii) in Figure 22-10] and adjacent wetlands [panel (ii) in Figure 22-11] took place and the river and lake levels continued to decrease. The subaqueous ASS (hypersulfidic subaqueous clayey soils) transformed to waterlogged ASS (hypersulfidic clayey soils).

(iii) **Drought with extreme drying from November 2008 to February 2009.** During the November 2008 to February 2009 period, extreme drying of Lake Alexandrina and adjacent wetlands took place because of the extended drought conditions and lower lake levels (Lake Alexandrina had almost lowered to minus 1.0m AHD). Most wetlands adjacent to Lake Alexandrina effectively became hydraulically disconnected from the lake. These conditions also permitted oxidation of sulfides due to increased soil aeration from deepening of desiccation cracks (> 50cm), especially in areas that are organic-rich (> 10 % organic carbon) and clayey (> 35 % clay). This resulted in the formation of sulfuric material up to 75 cm into the subsoil (sulfuric clayey soils). Under these low pH conditions, acid dissolution of the layer silicate soil minerals caused the release of substantial soluble Fe, Al, Mg, Si (and other elements). The continued drying of the Finniss River and the adjacent wetlands caused further desiccation and the precipitation of sulfate-rich salt efflorescences in desiccation cracks and on the sandy edges of the river [see panel (iii) in Figure 22-10 and Figure 22-11]. Areas with monosulfidic material continued to dry out, with the formation of desiccation cracks in the fine textured material.

(iv) **Winter rains causing rewetting in May 2009.** During May 2009, the river and adjacent wetlands (cracks and areas pugged by cattle) were rewet [see panel (iv) in Figure 22-10 and Figure 22-11]. This caused sulfate-rich salt efflorescences to dissolve and wash into cracks and cattle pugs (pH 1.3 to 2.5). Rewetted soil surfaces with extremely low pH values (pH 0.5 to 0.8) were also recorded, especially in the adjacent wetlands (Figure 22-11). Strongly flowing extremely acidic water (pH 3.3) was observed in the adjacent anabranches and wetlands draining former channels of the lower alluvial plain [see panel (iv) in Figure 22-11]. In contrast, at the same time the adjacent river channel water had a pH of 7.0 to 7.5. The higher river pH values on the southern side were likely partly maintained by the discharge of alkaline ground water. The submerged sulfuric subaqueous clay soil in the wetlands contained vertical cracks that were coated in jarosite and infilled with medium sand.

(v) and (vi) **Post drought flooding from end winter, 2009 to autumn 2010.** During this extensive period of rewetting both the river and adjacent wetlands remained submerged with the sulfuric subaqueous clay soils containing vertical cracks that were coated in jarosite and infilled with medium sand [see panel (v) & (vi) in Figure 22-10 and Figure 22-11].

(vii) **Post drought continued flooding from February 2011 to June 2012.** In sampling no jarosite mottling was observed, leaving most of this area comprising predominantly hypersulfidic subaqueous clay soils [see panel (vii) in Figure 22-10 and Figure 22-11].

22.3.3 Degree of external and internal factors controlling pedogenic pathways and processes of soil evolution

The soil-regolith models displayed in Figure 22-9 and Figure 22-10 were used as a framework or basis to illustrate some of the key intrinsic features and external drivers that render the various subtypes of acid sulfate soils relatively stable or susceptible to rapid change (Fitzpatrick *et al.* 2012). Fitzpatrick *et al. (2012)* define Extrinsic and Intrinsic pedogenic thresholds (Muhs 1984) rather loosely as a circumstance by which a "relatively modest change" in an environmental driver can cause a major change in soil subtype alteration (i.e. soil evolution) and soil properties (Figure 22-12). The degree of external and internal factors, which control pedogenic pathways of soil evolution at Wallys Landing are shown in Figure 22-12.

The dominant pedogenic processes are assigned to: (i) each sequential hydro-toposequence model in Figure 22-12 and (ii) the summary table (see Figure 2 in (see Figure 2 in Fitzpatrick *et al.* 2012), which is based on Table 4-2 for Wallys Landing using the following 3 pedogenic concepts:
(a) Extrinsic and intrinsic pedogenic thresholds (Muhs 1984). The pedogenic threshold is a value, unique to a particular soil system, beyond which the system adjusts or changes, not just in rate but also in soil type. In an extrinsic pedogenic threshold, an external factor changes progressively, which triggers abrupt, fast or slow pedogenic changes. This is usually caused by climatic, geomorphic or human-made changes. In contrast intrinsic pedogenic thresholds occur when a system changes without a change in external variable.
(b) Pedogenic rates [e.g. dynamic balance of thickness (Johnson and Watson-Stegner 1987)].
(c) Acid sulfate soil processes (e.g. sulfidization and sulfuricization).
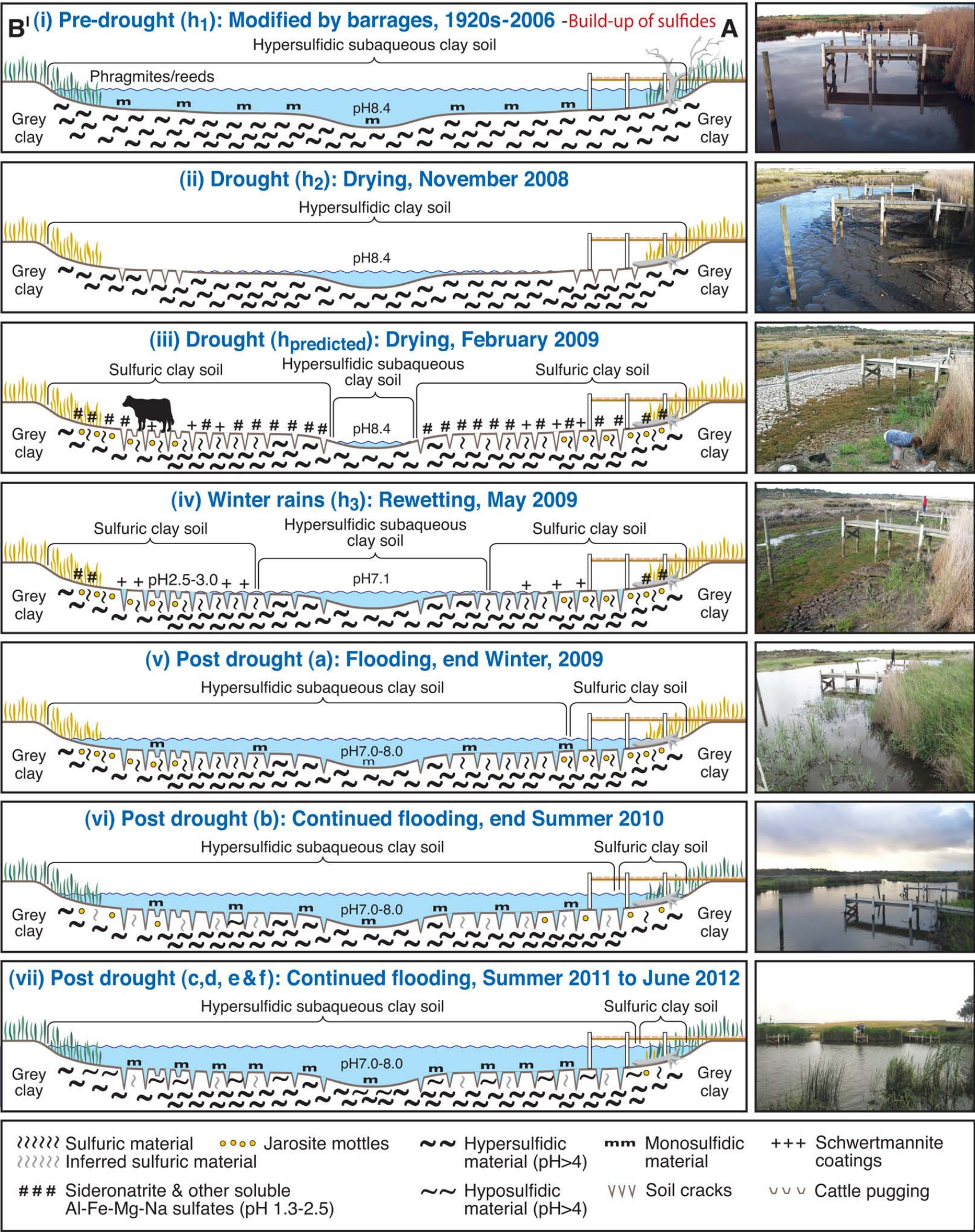
Figure 22-10 Predictive soil-regolith models for the Finniss River at Wallys Landing (A – B' transect in Figure 4-1) illustrating modification of water levels by barrage installations causing the build up of sulfides under continuous subaqueous ASS conditions from 1920s-2006 followed by progressive drying [panels (ii) and (iiii)] and a rewetting phase in May 2009 [panel (iv)], which resulted in acidic pools and flowing water (pH 3.3. to 4) in the cracks and cattle pugs (pH 0.5 to 0.8); and finally post drought flooding resulting in the sequential transformation of jarosite to sulfide under subaqueous conditions after at least 3 years (modified from Fitzpatrick *et al.* 2009a)
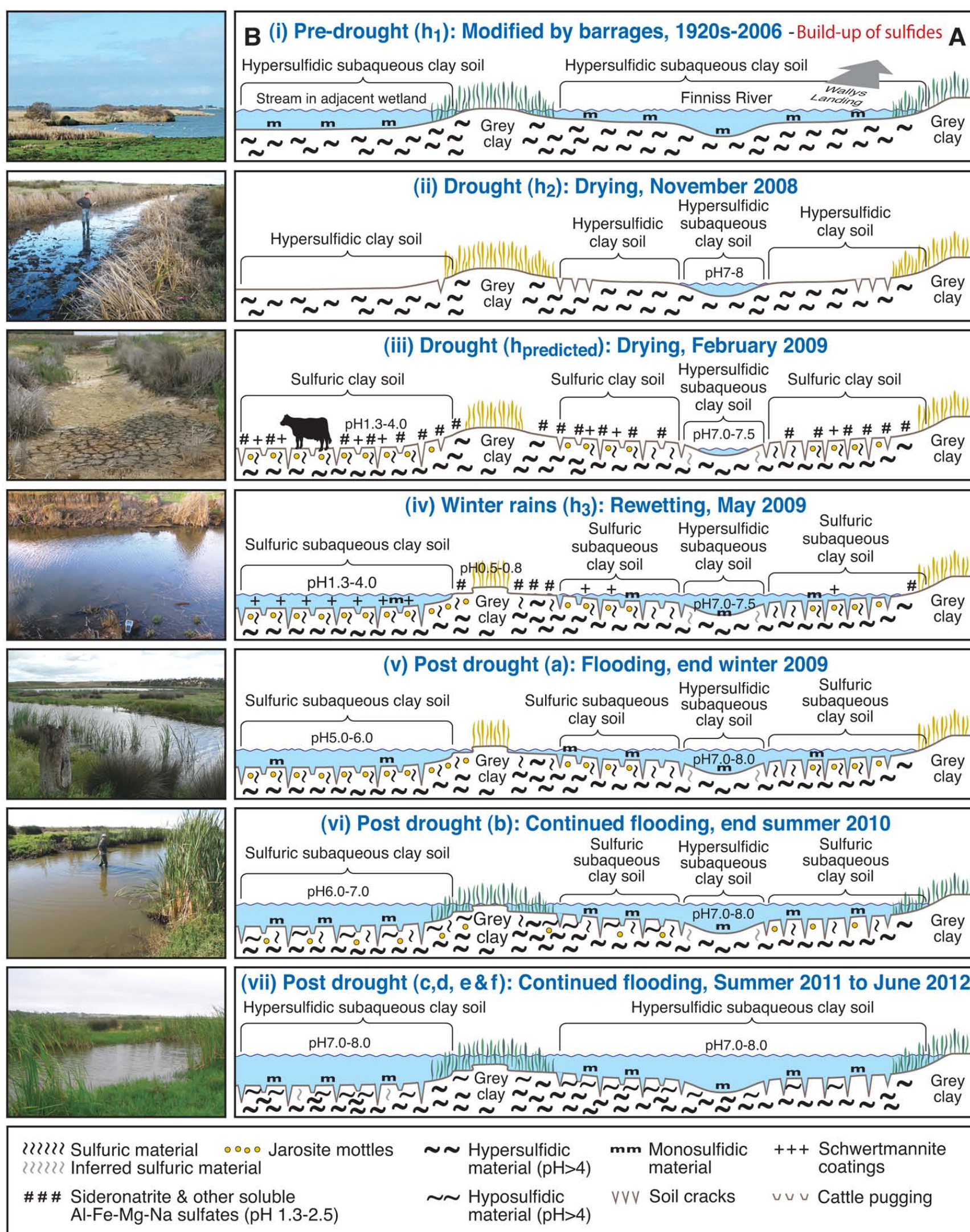
Figure 22-11 Predictive soil-regolith models across the Finniss River and adjacent wetland (A– B transect in Figure 4-1) illustrating modification of water levels by barrage installations causing the build up of sulfides under continuous subaqueous ASS conditions from 1920s-2006 followed by progressive drying [panels (ii) and (iiii)] and a rewetting phase in May 2009 [panel (iv)], which resulted in acidic pools and flowing water (pH 3.3. to 4) in the cracks and cattle pugs (pH 0.5 to 0.8); and finally post drought flooding resulting in the sequential transformation of jarosite to sulfide under subaqueous conditions after at least 3 years (modified from Fitzpatrick *et al.* 2009a)

Soil-regolith hydro-toposequence models and ASS subtypes	Dominant pedogenic processes
Finniss River (5,500BC-1930s) - *Wetting & Flushing cycle*	Extrinsic pedogenic threshold (**Ex**), caused by climatic & geomorphic changes Progressive slow pedogenesis [**Pr(s)**] Upbuilding of sulfides (**Up**) Dynamic balance of thickness (**Dy**)
Finniss River (5,500BC-1930s) - *Part Drying cycle*	Extrinsic pedogenic threshold (**En**) caused by climatic & geomorphic changes Progressive slow pedogenesis [**Pr(s)**] Removal of sulfides (**Rv**) Dynamic balance of thickness (**Dy**)
(i) Pre-drought (h₁): Modified by barrages, 1930s-2006 - *Build-up of sulfides*	Extrinsic pedogenic threshold (**Ex**) caused by human-made changes. Progressive fast pedogenesis [**Pr(s)**] Upbuilding of sulfides and monosulfides (**Up**)
(ii) Drought (h₂): Drying, November 2008	Extrinsic pedogenic threshold (**Ex**) caused by human-made & climatic changes Progressive fast pedogenesis [**Pr(f)**] Removals of water & monosulfides (**Rv**)
(iii) Drought (h_predicted): Drying, February 2009	Extrinsic pedogenic threshold (**Ex**) caused by human-made & climatic changes Progressive fast pedogenesis [**Pr(f)**] Abrupt pedogenesis (**Ab**) Upbuilding of sulfuric acid, sideronatrite, schwertmannite & soluble sulfates (**Up**)
(iv) Winter rains (h₃): Rewetting, May 2009	Extrinsic pedogenic threshold (**Ex**) caused by human-made & climatic changes Progressive fast pedogenesis [**Pr(f)**] Removals of sideronatrite, schwertmannite & soluble sulfates (**Rv**) Upbuilding of schwertmannite **Up**
(v) Post drought (a): Flooding, end Winter, 2009	Extrinsic pedogenic threshold (**Ex**) caused by human-made & climatic changes Progressive fast pedogenesis [**Pr(f)**] Removals of acid & schwertmannite (**Rv**) Upbuilding of monosulfides (**Up**)

Figure 22-12 Predictive soil-regolith models for the Finniss River system illustrating the dominant pedogenic pathways and processes following: (a) wetting and flushing (upper panel) and partial drying (second panel) cycles during pre-European development (5,000 BC to 1880s); (b) modification of water levels by barrage installations causing the build up of sulfides under continuous subaqueous ASS conditions from 1930s/1920's -2006 [panel (i)] followed by progressive drying [panels (ii) and (iii)] and a rewetting phase in May 2009 [panel (iv)], which resulted in acidic pools and flowing water (pH 3.3. to 4) in the cracks and cattle pugs (pH 0.5 to 0.8); and finally post drought flooding resulting in the sequential transformation of jarosite to sulfide under subaqueous conditions after at least 3 years. Where:
Ex- Extrinsic pedogenic threshold; **In** - Intrinsic pedogenic threshold; **Dy** - Dynamic balance of thickness; **Dp** – deepening; **Rv** – removals; **Up** – upbuilding; **Pr(s)** - Progressive pedogenesis (slow: relative to previous window); **Pr(f)** - Progressive pedogenesis (fast relative to previous window);
Ab - Abrupt pedogenesis (relative to previous window); **Re** - Regressive pedogenesis;
St - Static pedogenesis (Fitzpatrick *et al.* 2012)

22.4 LF12– Loveday Bay

In September 2009, CSIRO (Fitzpatrick *et al.* 2010a) identified an area of more than 200 ha of acidic surface water (pH 2.5 to 2.8) in Loveday Bay (Figure 22-13). Due to lowering water levels, this area became disconnected from the main lake water body, surface water evaporated and the saturated hypersulfidic soils became unsaturated and oxidised to form sulfuric soils as shown in the A-B cross section in Figure 12-1 for panels (i), (ii) and (iii) in Figure 22-15. Water levels remained low enough to keep the areas disconnected from the main lake water body, and with winter rains, water flowed over and through the sulfuric soils and collected in the depression areas (more than 200ha) adjacent to Lake Alexandrina known as Loveday Bay (Figure 22-13). The consequence of this was observed during the August 2009 mapping survey described in Fitzpatrick *et al.* (2010a) as shown in panel (iii) in Figure 22-15, which was areas of very acidic water (pH 2.5 to 2.8) and soils below this water remaining sulfuric and not reducing to hypersulfidic material (i.e. soils remained as "sulfuric subaqueous soils"). Interestingly, the ASS subtype on the edge of the acidic water has a high amount of monosulfidic material (i.e. hypersulfidic soil with monosulfidic material) while most of the exposed beach areas comprise sulfuric soil with abundant highly acidic salt efflorescences (comprising mostly sideronatrite).
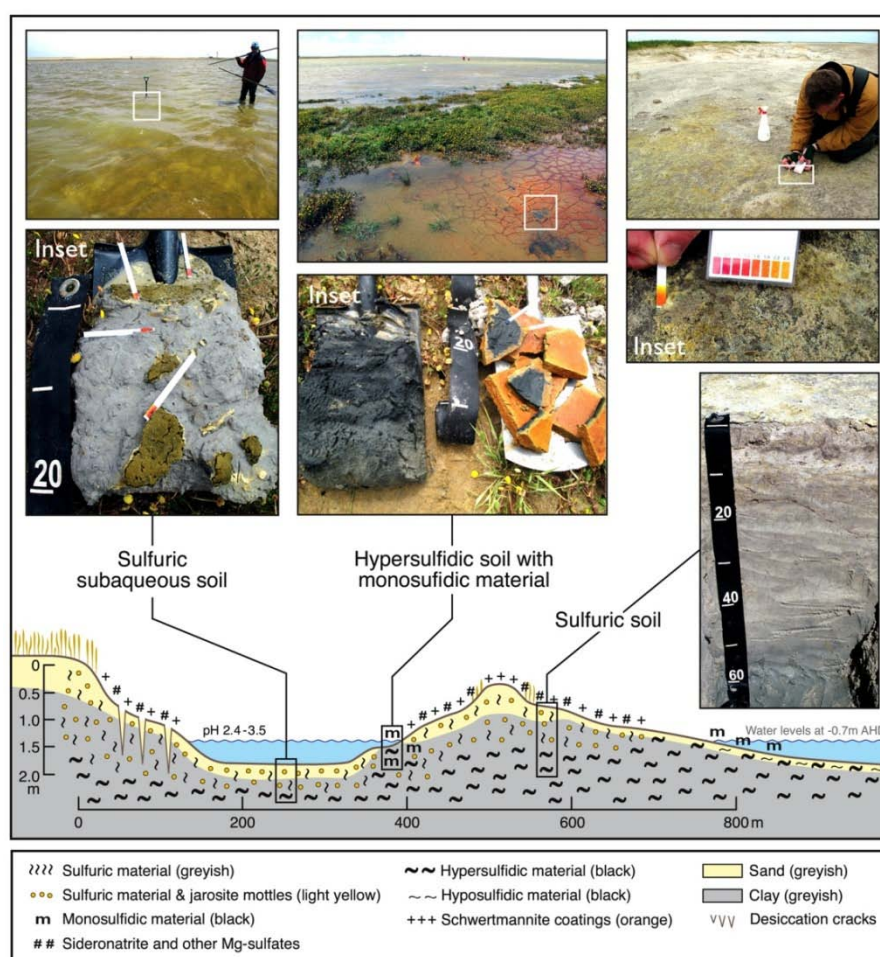
Figure 22-13 Descriptive soil-regolith model, for Loveday Bay at the end of winter/spring 2009 with strongly acid water (pH 2.4 to 3.5).

A second period of drying, in summer/spring 2010, resulted in Loveday Bay drying out completely leaving a vast area comprising predominantly sulfuric soil [Figure 22-14; see also panel (iv) in Figure 22-15].
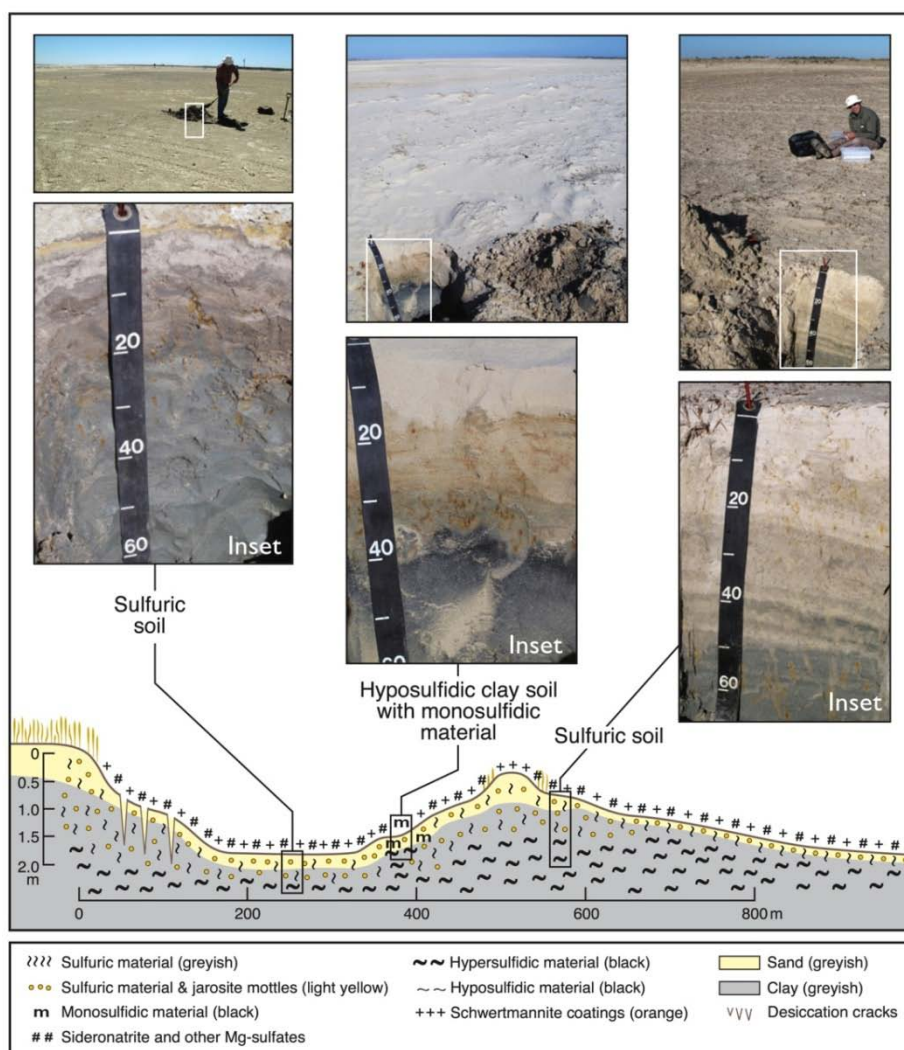
Figure 22-14 Descriptive soil-regolith model, for Loveday Bay in Summer 2010.

22.4.1 Post drought reflooding and management options

Inundation, following post drought flooding in winter 2010, caused the formation of dominantly Hypersulfidic subaqueous soil (with minor occurrences of sulfuric materials and jarosite mottles), which remained when sampled in June 2012 [see panels (v) & (vi) in Figure 22-15]. Consequently, no management options were implemented, such as limestone application to remediate the strongly acid standing water and soils in Loveday Bay. However, water and soils were monitored over this period by EPA and CSIRO. This so-called "do-nothing" approach has been adopted to this site because Loveday Bay has no apparent major risk to adjacent water bodies, wetlands, agricultural lands, stock or humans – due its remote location. However, monitoring of water (i.e. monthly during the re-wetting phases when acidity and metal mobilisation are likely to occur) and ASS (three monthly) was an essential strategy applied.

These models are based on the summary data presented in Section 12, especially in Table 12-2.

(i) Pre-drought (h₁): Winter 2007
Hypersulfidic subaqueous

(ii) Drought (h_postulated): Summer 2008

(iii) Drought end (a): Winter/Spring 2009

(iv) Drought end (b): Summer 2010

(v) Post drought (c): Reflooding February 2011

(vi) Post drought (d, e & f): Continued reflooding winter 2011 to June 2012
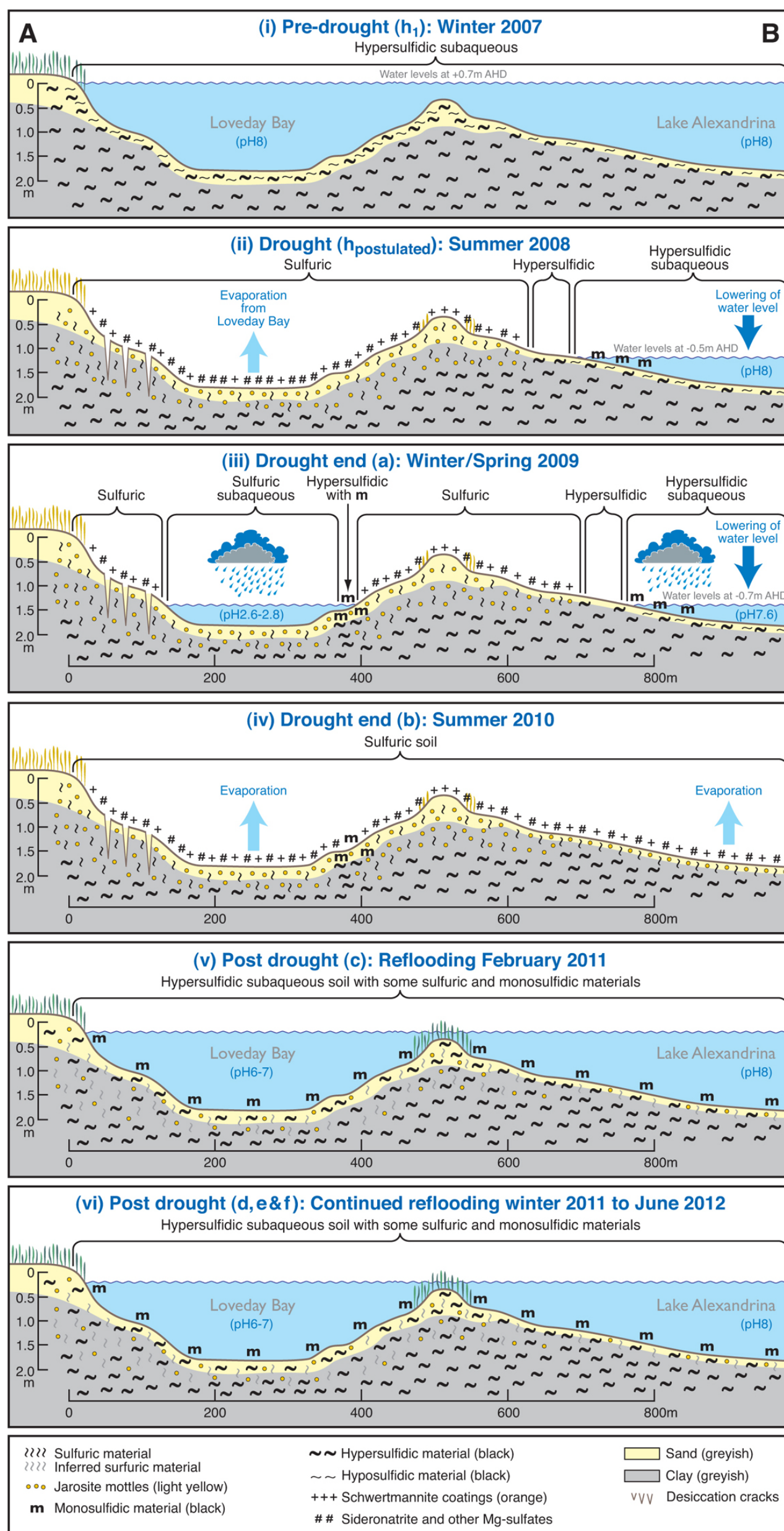
Figure 22-15 Predictive soil-regolith model for Loveday Bay

22.5 LF15– Boggy Creek

To aid in understanding the spatial heterogeneity of ASS property variation across Boggy Creek on Hindmarsh Island (see Section 14), one descriptive and four predictive soil-regolith models in the form of cross-sections have been constructed from data presented in Table 14-2, profile descriptions and surveyor knowledge.

In September 2009, when Boggy Creek was completely dry, CSIRO (Fitzpatrick *et al.* 2010a) identified sulfuric soils with prominent jarosite mottling and coatings as shown in the descriptive soil-regolith model in Figure 22-16. Due to lowering water levels, Boggy Creek became disconnected from the main lake water body (Lake Alexandrina), surface water evaporated and the saturated hypersulfidic clay soils became unsaturated and oxidised to form sulfuric clay soils as shown in the cross section A-B (Figure 14-1) for panel (i) (Figure 22-17 indicating pre-drought in 2006) and panel (ii) (Figure 22-17 indicating extreme drought conditions from July 2009 to March 2010).

However, in post drought flooding and inundation following winter 2010, summer/autumn 2011 to winter 2011 reducing conditions were re-established, which promoted sulfate reduction as indicated in panels (iii) & (iv) in Figure 22-17. As a result, the two profiles in the main creek area transformed from sulfuric clay soils to hypersulfidic subaqueous clay soils with abundant presence of a thin layer (0-5 cm) of monosulfidic material. As a consequence, an important finding of this study was the somewhat rapid temporal occurrence and transformation of "sulfuric subaqueous clay soils" (not shown in Figure 22-17), especially where there was widespread deep cracking. Deep cracking will permit flowing alkaline stream water in Boggy Creek to more effectively penetrate the sulfuric material to neutralise soil acidity.

The soil-regolith models in panels (iii) & (iv) in Figure 22-17, show the complex location and transition of hyposulfidic, hypersulfidic, sulfuric and monosulfidic materials and shell fragments occurring in various distinct layers (i.e. saturated sands, sandy clays and clays). For example, the two profiles collected in the middle of the creek were classified as hypersulfidic subaqueous clay soils but nevertheless have many "remanent" features of sulfuric material present (e.g. jarosite mottles and coatings) [see panels (iii) & (iv) in Figure 22-17]. The adjacent profile on the creek bank (LF15-A – Figure 22-16.) is classified as a hyposulfidic or hyposulfidic subaqueous soil with low and medium acidification hazard ratings.

These models are based on the summary data presented in Section 14, especially in Table 14-2. Overall, soil at Boggy Creek was considered to pose a high acidification hazard.
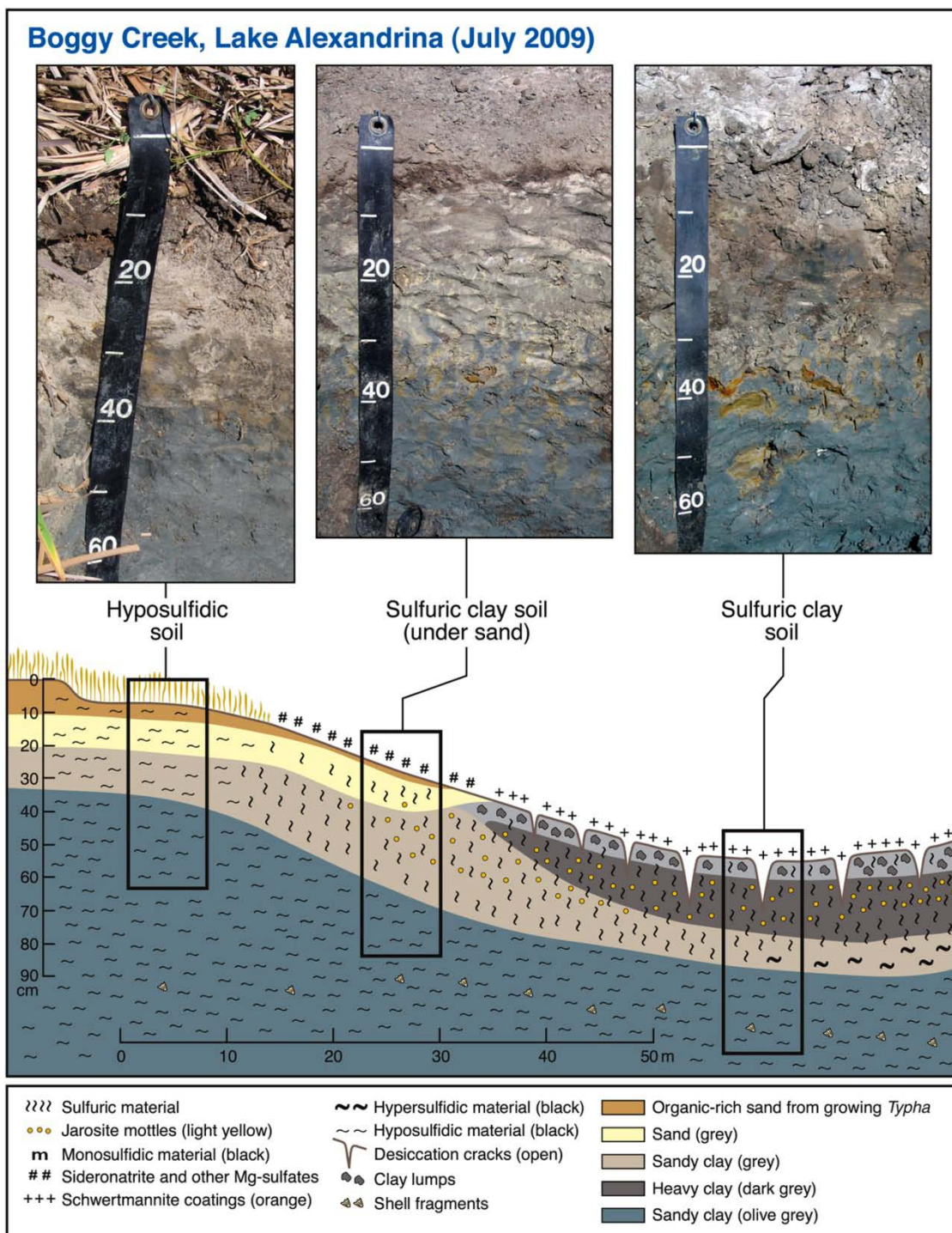
Figure 22-16 Descriptive soil-regolith model, for Boggy Creek in Winter 2010.
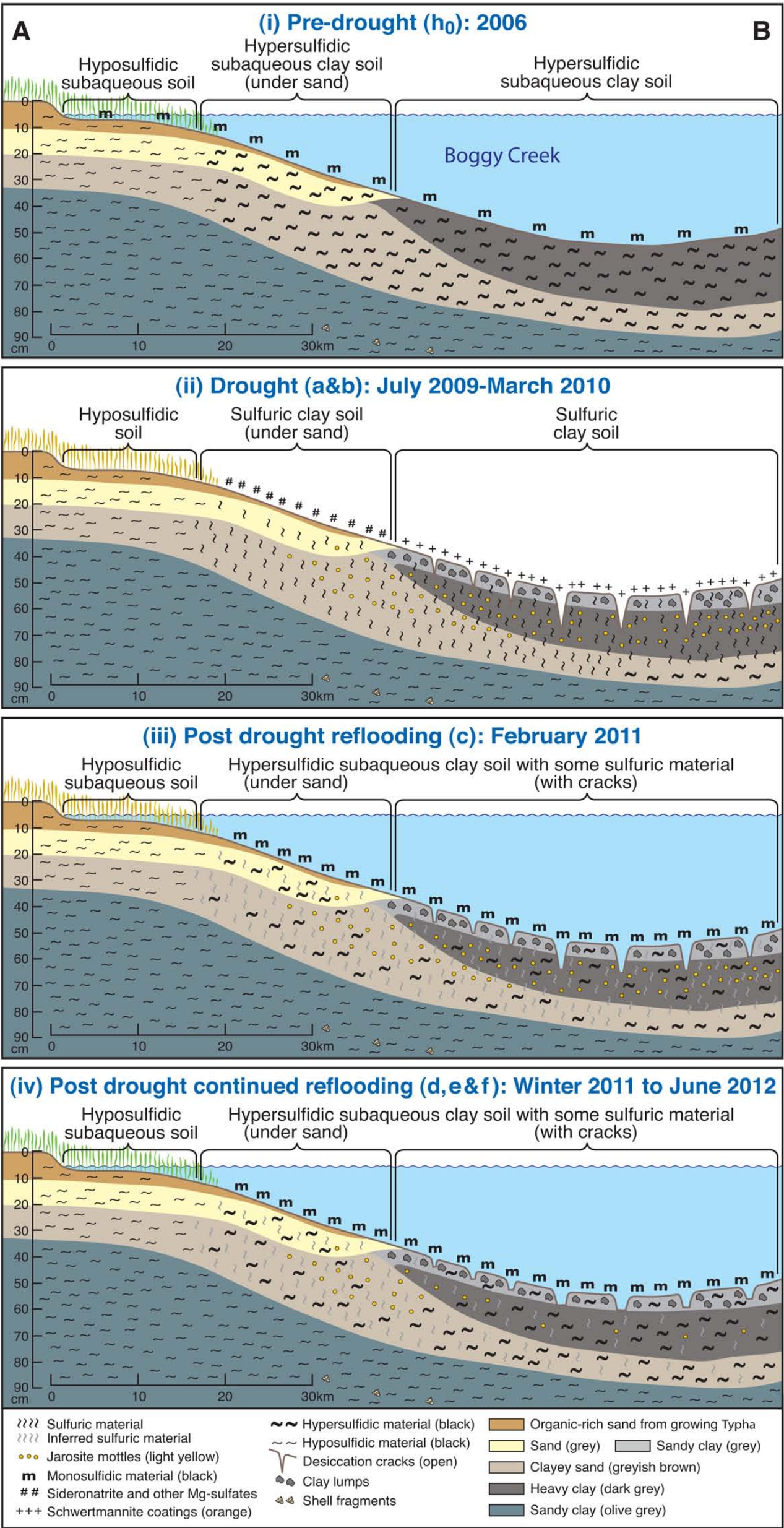
Figure 22-17 Predictive soil-regolith model for Boggy Creek (see A-B cross section in Figure 14-1)

22.6 LF07– Waltowa

This section provides a brief summary of how conceptual soil-regolith models are used to describe, explain and predict the spatial and temporal heterogeneity of ASS properties at the Waltowa revegetation trial site (Fitzpatrick *et al.* 2011). At this trial site soil-regolith models helped to describe and predict soil-regolith processes that occur as a consequence of fundamental shifts in the "environmental equilibrium" brought about by the impact of past management practices, such as the pumping of water from Lake Alexandrina to Lake Albert, revegetation and limestone applications (Fitzpatrick *et al.* 2011) and the reflooding at this Waltowa (data presented in Section 9 and Table 9-2).

An understanding of the detailed behaviour of not only the various ASS materials (e.g. sulfuric, hypersulfidic, hyposulfidic and monosulfidic) but especially the occurrence and distribution of the surface algal mats and organic layers is fundamental to the successful local site characterisation and rehabilitation of ASS at this site.

The soil-regolith model in Figure 22-18 was constructed in the form of a cross-section (see transect A-B in Figure 9-1) to help visualise the results of several representative ASS patterns. The detailed map of ASS subtypes of Waltowa mapped in October 2008 and March 2010 by Fitzpatrick *et al.* (2011) also provides an aid in describing and understanding the complex spatial and temporal heterogeneity of ASS properties. The ASS subtype map also indicates that there is an increase in the spatial occurrence of sulfuric soils during revegetation at the time of re-sampling in March 2010. The soil-regolith model (Figure 22-18) illustrates the transformation of hypersulfidic soils sampled during the baseline survey in 2008 to sulfuric soils following the revegetation / successive wetting and drying cycles measured in March 2010. These shallow ASS (i.e. are underlain by calcrete and/or carbonate-rich sandy clay material) in fluctuating water environments are not stable and therefore undergo rapid change depending on whether water levels are dropping or rising. ASS materials change depending on the water status of the soil (saturated or unsaturated), which controls whether chemical processes are oxidising or reducing, and the acid status.

In summary, during drought conditions, the profiles collected closest to the shoreline were classified as sulfuric soil with high acidification hazard ratings. However, following reflooding, in October 2010, these profiles transformed from sulfuric to hypersulfidic subaqueous soils. Profiles collected further into the lake were generally classified as hyposulfidic soils with very low acidification hazard ratings. In general, reflooding has had no discernable impact upon this site, with soil material remaining predominantly hyposulfidic and hypersulfidic. Overall, soil at Waltowa was considered to pose a medium acidification hazard.

These models are based on the summary data presented in Section 9 , especially in Table 9-2.

(i) Pre-drought (h₀): July 2007

Hyposulfidic subaqueous soil | Hypersulfidic subaqueous soil

(ii) Drought (h₁): Summer 2008 and (h₂): End winter 2008

Hyposulfidic soil | Sulfuric soil

(iii) Drought (a): End winter 2009 (Pumping ceased from Lake Alexandrina/Local rainfall)

Hyposulfidic soil | Sulfuric soil

(iv) Drought (b): End summer 2010 (No pumping from Lake Alexandrina)

Hyposulfidic soil | Sulfuric soil

(v) Post drought reflooding (c): Summer 2011

Hyposulfidic subaqueous soil | Hypersulfidic subaqueous soil

(vi) Post drought reflooding (d, e & f): Winter 2011 to June 2012

Hypersulfidic subaqueous soil | Hypersulfidic subaqueous soil

Legend:
- Sulfuric material (greyish)
- Jarosite mottles (light yellow)
- Clayey algal mat layer
- Sideronatrite and other Mg-sulfates
- Hypersulfidic material (black)
- Inferred hypersulfidic material
- Hyposulfidic material (black)
- Monosulfidic material
- Sand
- Clayey sand
- Organic horizon

Figure 22-18 Predictive soil-regolith model for Waltowa

23. Discussion and summary

Prior to mid 2010, drought in south eastern Australia had led to lowered water levels and exposure of large areas of previously submerged soils and sediments. This was particularly the case in the Lower Lakes (Lakes Alexandrina and Albert) and adjacent tributaries (Finniss River and Currency Creek), that are relatively shallow, where large tracts along the margins of the Lakes and surrounding wetlands had undergone extensive drying.

The exposure and drying of hypersulfidic materials caused a number of impacts related to ASS in the Lower Lakes. These included soil acidification and more locally, water acidification and metal mobilisation.

From March 2010, increased rainfall within the Murray Darling Basin catchment resulted in water levels in Lakes Alexandrina and Albert increasing from approximately -0.8 m to managed levels around 0.75 m AHD. Hence, ASS that had formed in the previously dried margins of the Lower Lakes have become inundated.

This investigation was carried out to develop further understanding of the temporal and spatial changes in ASS caused by inundation in areas around the Lower Lakes and adjacent tributaries (Finniss River and Currency Creek). It comprised field assessments at seventeen designated study areas (Figure 1-1). The assessments involved detailed field sampling at these study areas in November and December 2011 (Sampling-e) and in June 2012 (Sampling-f).

Key findings

Soil acidification hazard assessment

ASS acidification potential was determined using three independent standard methods: (i) peroxide pH testing, (ii) acid-base accounting, and (iii) incubation experiments. The findings highlighted temporal changes in soil pH, iron sulfide content and acid neutralising capacity in a number of study areas that related to the previous oxidation of sulfide minerals, bacterially mediated reduction of sulfate to sulfide, flushing and dilution of acidity (H^+) from sediments and the spatial variability of soils. These tests also highlighted considerable variability among study areas in terms of potential acid generation and neutralisation capacity.

An overall acidification hazard assessment was undertaken, which was based on: (i) landscape position, (ii) soil morphology, (iii) acid base accounting, (iv) pH data, (v) acidification potential and (vi) ASS material and subtype classification. Acidification hazard categories were: (i) very low, (ii) low, (iii) medium and (iv) high (Table 23-1; Figure 23-1). Soil acidification hazards in the Lower Lakes and adjacent tributaries were highly variable and ranged from very low to high as shown in Table 23-1 and Figure 23-1.

Acidification hazards generally remained unchanged during both drought and subsequent reflooding (Table 23-1). However, at Tauwitcherie (LF13), acidification hazard ratings decreased following reflooding. These changes were most likely related to the extreme heterogeneity of the reed bed sampled and reflooding causing dilution of acidity and/or flushing of acidity (H^+) from surface sediments.

Site ID	Study area	Soil acidification hazard during drought conditions (2007 to early 2010) (LF01 to LF18 from Baker *et al.* 2010)	Soil acidification hazard following reflooding (late 2010 to mid 2012)
LF01	Wallys Landing and Wetland	High	High
LF02	Point Sturt North	Medium	Medium
LF03	Milang	Medium	Medium
LF04	Tolderol	Medium	Medium
LF06	Poltalloch	Low	Low
LF07	Waltowa	Medium	Medium
LF08	Meningie	Medium	Medium
LF10	Campbell Park	High	High
LF12	Loveday Bay	High	High
LF13	Tauwitcherie	Medium	Low
LF15	Boggy Creek	High	High
LF17	Point Sturt South	High	High
LF19	Dog Lake	High	High
LF20	Boggy Lake	High	High
LF21	Windmill Site	Not assessed	Medium/High
LF23	Lower Currency	Medium/High	Medium/High
LF24	Lower Finniss	High	High

Table 23-1 Soil acidification hazard ratings for study areas around the Lower Lakes (refer to Figure 1-1 for site localities).

Spatial and temporal changes in acid sulfate soil environments

During drought conditions (2007 to 2009), falling water levels resulted in the exposure and oxidation of ASS materials that at a number of study areas resulted in hypersulfidic subaqueous soil transforming to sulfuric soil (Samplings-h#/a/b) (Baker *et al.* 2010).

From March 2010, increased rainfall within the Murray Darling Basin catchment caused the water levels in the Lower Lakes and adjacent tributaries to increase. ASS monitoring data collected following inundation, between late 2010 and mid 2011, are presented in Baker *et al.* (Baker *et al.* 2011). This project (Samplings-e/f) focussed on the effects of prolonged inundation of the previously exposed ASS, which were located in the margins of the Lower Lakes.

Following reflooding in September/October 2010, at the time of Sampling-f (June 2012),study areas in the Lower Lakes had been inundated for approximately 21 months (LF02 to LF22; Figure 23-1). In contrast, study areas in the Finnis River and Currency Creek had been inundated for between 2½ and 3 years because of the construction of the Clayton regulator and pumping water from Lake Alexandrina to the Goolwa Channel (over the regulator) in August/December 2009 (LF01, LF23 and LF24; Figure 23-1).

Generally, soil material that had remained non-acidic during drought conditions was relatively unaffected by reflooding (LF06 and LF08; Table 23-1; Figure 23-1). Soil material at these study areas transformed from hyposulfidic and hypersulfidic to hyposulfidic subaqueous and hypersulfidic subaqueous.

Soil material that had acidified during drought conditions was either partly neutralised, neutralised in the upper 20 to 40 cm of the profile or showed no significant evidence of neutralisation (Table 23-1; Figure 23-1).

Acidic study sites at Wallys Landing and Wetland (LF01), Lower Currency (LF23) and Lower Finniss (LF24) that had been inundated for between 2½ and 3 years, were partially neutralised (Table 23-1; Figure 23-1). In the Finniss River (LF01 and LF24), prolonged inundation most likely encouraged reducing conditions, leading to sulfate reduction and the transformation of previously sulfuric sediments to hypersulfidic subaqueous soil (Table 23-2). However, net acidities remained very high and TAA and RA were still present in soil profiles. Neutralisation was considered to be limited at these sites and soil material posed a high acidification hazard. On drying, soil material is likely to re-acidify rapidly and may impact upon surface waters. In the Lower Currency (LF23; Figure 23-1), it appears that both reduction of sulfate and flushing of acidity, in the top 30 cm of the profile, caused soil material to convert from sulfuric to hypersulfidic subaqueous (Table 23-1).

In Lakes Alexandrina and Albert, acidic sites that had been inundated for 21 months (LF02 to LF21), experienced (i) no neutralisation, (ii) limited neutralisation throughout the profile or (iii) neutralisation that was restricted to the upper 20 to 40 cm of the soil profile (Table 23-1; Figure 23-1).

Site ID	Locality	Time inundated following drought*	Neutralisation of acidic soil	Temporal changes in acid sulfate soil environments following reflooding
LF01	Wallys Landing and Wetland	3 years	**Yes**, limited neutralisation at all (2) acidic sites.	Acidic soil converted from sulfuric to hypersulfidic subaqueous. Net acidities remained very high and TAA and RA was still present in soil profiles. Neutralised soil material is likely to re-acidify rapidly upon drying and may impact upon surface waters.
LF02	Point Sturt North	21 months	**Yes/No**, limited neutralisation at (1 of 2) acidic sites	Acidic soil material closest to shore remained sulfuric. Further into the lake, soil material converted from sulfuric to hypersulfidic. Non-acidic soil remained hyposulfidic and hypersulfidic. Reflooding caused limited changes.
LF03	Milang	21 months	**Yes/No**, limited neutralisation at (1 of 2) acidic sites.	Soil material generally remained sulfuric or hypersulfidic following reflooding. However, some soil material (LF03-B) converted from sulfuric to hypersulfidic subaqueous. Neutralised soil material is likely to re-acidify rapidly upon drying.
LF04	Tolderol	21 months	**Yes**, limited neutralisation at all (1) acidic sites.	Acidic soil converted from sulfuric to hypersulfidic subaqueous. There was a slight lessening of TAA and a corresponding increase in S_{CR} in these soils. Non-acidic soil remained hyposulfidic and hypersulfidic.
LF06	Poltalloch	21 months	No acidic sites.	Non-acidic soil remained hyposulfidic and hypersulfidic. Reflooding caused limited changes.
LF07	Waltowa	21 months	**Yes**, neutralisation of upper 20 cm of sand at all (1) acidic sites.	Acidic soil in the upper 20 cm of sand (LF07-A) converted from sulfuric to hypersulfidic subaqueous. The underlying hypersulfidic soil material remained unchanged. All other non-acidic soil remained hyposulfidic and hypersulfidic.
LF08	Meningie	21 months	No acidic sites.	Non-acidic soil remained hyposulfidic and hypersulfidic. Reflooding caused limited changes.
LF10	Campbell Park	21 months	**Yes/No**, limited neutralisation at (1 of 2) acidic sites.	In a reed bed on the shoreline (LF10-A), soil material remained sulfuric and net acidity decreased in the upper 30 to 40 cm and increased in the underlying sediments. This may have been the result of extreme heterogeneity in the reed bed or a downward migration of acidity caused by rainfall and reflooding. Increases in pH and reduced RA meant that profiles collected 150 m into the lake converted from sulfuric to hypersulfidic. Non-acidic soil remained hyposulfidic and hypersulfidic.
LF12	Loveday Bay	21 months	**Yes**, neutralisation of upper 25 cm of sand at all (3) acidic sites.	Acidic soil converted from sulfuric to hypersulfidic subaqueous and acidity, in the upper 25 cm, converted from TAA to S_{CR}. Neutralised soil material is likely to re-acidify rapidly upon drying. Non-acidic soil remained hypersulfidic.
LF13	Tauwitcherie	21 months	**Yes**, neutralisation of upper 30 cm at all (1) acidic sites.	In a reed bed (LF13-A), net acidity of surface sediments changed from positive to negative and soil material transformed from sulfuric to hyposulfidic subaqueous. This may have been the result of extreme heterogeneity in the reed bed or flushing of acidity (H+) from surface sediments. Non-acidic soil remained hyposulfidic and hypersulfidic.
LF15	Boggy Creek	21 months	**Yes**, neutralisation of upper 35 to 45 cm of all (2) acidic sites.	Acidic soil converted from sulfuric to hypersulfidic subaqueous and acidity, in the upper 35 to 45 cm, converted from a combination of RA, TAA and S_{CR} to being dominated by S_{CR}. Neutralised soil material is likely to re-acidify rapidly upon drying. Non-acidic soil remained hyposulfidic and hypersulfidic.
LF17	Point Sturt South	21 months	**No** neutralisation at all (2) acidic sites.	Acidic soil generally remained sulfuric. At the time of Sampling-e, having been inundated for more than 15 months, slight increases in soil pH (≈ 0.3 pH units), meant that these profiles had converted to hypersulfidic. However, during Sampling-f, soils were again classified as sulfuric
LF19	Dog Lake	21 months	**No** neutralisation at all (1) acidic sites.	Acidic soil remained sulfuric. However, limited flushing of acidity (H+) by lake water caused a decrease in TAA above 25 cm, with only a slight increase in S_{CR}. Non-acidic soil remained hypersulfidic.
LF20	Boggy Lake	21 months	**Yes**, limited neutralisation at all (1) acidic sites.	Reflooding and inundation resulted in an increase in the proportion of S_{CR} relative to TAA and RA above 30 to 40 cm. At depth, NA remained extremely high and was dominated by S_{CR}.

LF21	Windmill Site	21 months	Unknown	All soil material was collected at this site following reflooding in October 2010. Soil material remained hypersulfidic and acidity was dominated by S_{CR} with minor TAA and no ANC.
LF23	Lower Currency	2 ½ years	**Yes**, neutralisation at all (1) acidic sites.	Acidic soil material converted from sulfuric to hypersulfidic. The amount of acidity above 30 cm had decreased and the amount of S_{CR} relative to TAA had increased. Inundation encouraged reducing conditions and sulfate reduction. Additionally, it may have caused some flushing of acidity (H+) from surface sediments .
LF24	Lower Finniss	2 ½ years	**Yes**, limited neutralisation at all (2) acidic sites.	Acidic soil material converted from sulfuric to hypersulfidic. However, net acidities remained very high and TAA and RA were still present in the profiles. On drying, soil material is likely to re-acidify rapidly and may impact upon surface waters.

Table 23-2 Summary of temporal changes in ASS environments following reflooding (refer to Figure 1-1 for site localities). *at time of Sampling-f (June 2012).

The acidic study sites at Point Sturt South (LF17), Dog Lake (LF19) and Boggy Lake (LF20), and some of the acidic sites at Point Sturt North (LF02-D) and Campbell Park (LF10-A), that had been inundated for 21 months (Table 23-1; Figure 23-1), showed no significant evidence of neutralisation following reflooding. Soil material generally remained sulfuric and there was only minor evidence of sulfate reduction and/or flushing of acidity.

Acidic study sites at Milang (LF03) and Tolderol (LF04), and some of the acidic sites at Point Sturt North (LF02-A) and Campbell Park (LF10-C), that had been inundated for 21 months (Table 23-1; Figure 23-1), showed limited evidence of neutralisation. Acidic soil material at these sites either transformed from sulfuric to hypersulfidic subaqueous and/or showed evidence of reduction of sulfate to sulfide (i.e. a lessening of TAA and/or RA with a corresponding increase in S_{CR}). Generally, neutralised soil material at these sites was considered to pose a high acidification hazard and is likely to re-acidify rapidly upon drying.

Acidic study sites at Waltowa (LF07), Loveday bay (LF12), Tauwitchere (LF13) and Boggy Creek (LF15), that had been inundated for 21 months (Table 23-1; Figure 23-1), showed evidence of neutralisation that was restricted to the upper 20 to 40 cm of the profile. Soil material transformed from sulfuric to hypersulfidic/hyposulfidic subaqueous, showed evidence of reduction of sulfate to sulfide (i.e. a lessening of TAA and/or RA with a corresponding increase in S_{CR}) and/or flushing of acidity from surface sediments. Underlying hypersulfidic soil material was not significantly impacted by reflooding. At Tauwitcherie (LF13), net acidity of surface sediments changed from positive to negative and soil material transformed from sulfuric to hyposulfidic subaqueous. This may have been the result of extreme heterogeneity in the reed bed sampled (i.e. distribution of organic matter) or flushing of acidity (H+) from surface sediments. Except at Tauwitcherie (LF13), neutralised soil material at Waltowa (LF07), Loveday Bay (LF12), and Boggy Creek (LF15) (Table 23-1; Figure 23-1), was considered to pose a high acidification hazard and is likely to re-acidify rapidly upon drying.

Follow-on work should include annual monitoring of ASS in the Lower Lakes to provide important information about soil acid-neutralisation rates following inundation that will be used for management decision making.

Figure 23-1 Map of study areas that summarises, soil acidification after reflooding, neutralisation of acidic soil and time inundated following drought conditions.

Contaminant and metalloid dynamics

The Contaminant and metalloid (CMD) dynamics study has highlighted the large degree of heterogeneity in metal, metalloid and nutrient concentrations both between different sites and within soil profiles in the subaqueous soils studied. The sites selected for study were from Lake Alexandrina in areas strongly oxidised during the drying phases of the previous drought. Despite up to three years of inundation by surface water, the soils in some areas still contain high concentrations of metal and metalloid

contaminants. The sites which contained the most acidic soils and highest metal and metalloid concentrations were Boggy Lake and Dog Lake, consistent with the soil monitoring data which shows these being slow to recover. The pH of the samples was shown to be a major influence on metal contents, but this is superimposed on metal availability, e.g. the concentrations of many metals are higher than those at Dog Lake despite similar soil pH. ANZECC Guideline values for freshwater ecosystems at a range of metals were exceeded at all sites.

Infiltration of fresh water into the soil profiles has likely diluted solute concentrations, but high SO_4/Cl ratios persist in the soils suggesting dissolution of soil hydroxysulfate minerals. This is consistent with visual evidence of yellow mottles (most likely natrojarosite) which helps explain the soil acidity through buffering reactions with this mineral. These have remained in the soils even after prolonged inundation, and are most likely responsible for the increase in metals and metalloids in soil samples during the dynamic tests.

The CMD results, sampled over a period of 56 days, showed that there was a very limited decrease in Eh, most likely due to the acid-generating buffering hydroxysulfate minerals. Alkalinity generation has, for most soil materials studied, remained negligible. The main contaminants identified in the tests include the nutrients ammonium and phosphate, and a range of metal species including Al, Co, Fe, Ni and Zn as well as smaller concentrations of Be, Cr, Cu and Pb. These highlight a significant hazard to soil ecosystems and diversity, but fluxes have not yet been quantified to the overlying surface water.

The two sampling periods were relatively close compared with the longer term monitoring completed: comparisons of data from Sampling-e (November-December 2011) and Sampling-f (June 2012) indicate that there has been little change in the bioavailability of many metals. A clear exception was at Dog Lake where the deepest soil layer studied increased in pH. This appears to have had the effect of lowering metal concentrations due to limited solubility and greater sorption at the higher pH encountered. It was also noted that the metalloid As was often less in the final sampling, Sampling-f, at all sites suggesting decreased bioavailability with time. It is likely that sorption is the dominant process, as Eh was typically too high to allow appreciable sulfide precipitation. During the tests, phosphate was commonly below the detection limit at the start of the tests, but increased over time indicating a potential hazard for nutrient release in these soils.

The CMD data provide a guide only to the contaminant hazards present in the different soil layers, but they do provide an indication of the likely pH and Eh buffering effects within the soils that may control the pH and Eh condition, hence the speciation and mobility of metals, metalloids and other contaminants. The conclusions of the CMD tests are consistent with the timescales of recovery shown in the soil monitoring. Acidity is a good surrogate for highlighting areas which may be at risk of contaminant solubility, but this should only be used in conjunction with transport considerations before a robust risk assessment can be derived.

Future work should include in-situ sampling to determine porewater concentrations at a greater resolution, the latter being related to advective vs. diffusive fluxes as well as chemical buffering reactions within the soil, required for an understanding of transport mechanisms and prediction of impact. It should also focus on imposed changes e.g. wetting and drying, but should be undertaken at least at soil core scale to better mimic reaction-transport in the complex profiles in the Lower Lakes. Impacts on soil ecosystem function and biodiversity should also be given some scope in future research programs.

Conceptual models

To aid in understanding the spatial heterogeneity of ASS properties, and explain and help predict ASS environments, six soil landscape cross-sections, in the form of conceptual soil-regolith toposequence models, were chosen to help visualise the results of several key ASS investigations performed at typical sites with complex surface and subsurface ASS features.

These case studies were chosen to help visualise the results of several key ASS investigations performed at typical sites with complex surface and subsurface ASS features, including several regolith layers (e.g. Coorongite) and shallow surface water interface systems.

The models illustrate the complexities and importance of understanding specific sites to assess the: (i) time-related changes and soil evolution, (ii) detailed behaviour and implications of various ASS materials (e.g. sulfuric, hypersulfidic, hyposulfidic and monosulfidic), (iii) features in layers and horizons (e.g. cracks, salt efflorescences, algal mats), (iv) shallow regolith materials (e.g. layers of calcrete and Coorongite), (v) degree of external and internal factors controlling pedogenic pathways and processes of soil evolution (i.e. extrinsic and intrinsic pedogenic thresholds, pedogenic rates and acid sulfate soil processes, such as sulfidization and sulfuricization) and (vi) different management options (e.g. pumping from Lake Alexandrina to Lake Albert, revegetation and limestone application).

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Appendix 1 – Australian acid sulfate soil identification key

Australia's current national soil classification (Isbell 1996) and other internationally recognised classification systems such as Soil Taxonomy (Soil Survey Staff 2003) require considerable expertise and experience to be used effectively. More importantly, these classification systems do not yet incorporate new acid sulfate soil terminologies such as: (i) monosulfidic, hypersulfidic and hyposulfidic material and (ii) subaqueous soils, which is used in the nationally consistent legend of "The Atlas of Australian Acid Sulfate Soils" (Fitzpatrick *et al.* 2008a; available on the Australian Soil Resource Information System: www.asris.gov.au). To assist users to identify types and subtypes of soils a user-friendly Soil Identification Key was developed to more readily define and identify the various types and subtypes of acid sulfate soil and non-acid sulfate soil (see Fitzpatrick *et al.* 2008b,c,d,e; 2009a). The key is designed for people who are not experts in soil classification systems such as the Australian Soil Classification (Isbell 1996). Hence it has been used to deliver soil-specific land development and soil management packages to advisors, planners and engineers working in the Murray-Darling Basin.

The soil identification key uses non-technical terms to categorise ASS and other soils in terms of attributes that can be assessed in the field by people with limited soil classification experience. Attributes include water inundation (subaqueous soils), soil cracks, structure, texture, colour, features indicating water logging and 'acid' status – already acidified, i.e. sulfuric material, or with the potential to acidify, i.e. sulfidic material– and the depths at which they occur or change in the soil profile.

The key consists of a systematic arrangement of soils into 5 broad acid sulfate soil types, each of which can be divided into up to 6 soil subtypes. The key layout is bifurcating, being based on the presence or absence of particular soil profile features (i.e. using a series of questions set out in a key). A soil is allocated to the first type whose diagnostic features it matches, even though it may also match diagnostic features further down the key. The key uses a collection of plain language names for types and subtypes of ASS in accordance with the legend for the Atlas of Australian Acid Sulfate Soils (Fitzpatrick *et al.* 2008c). It recognises the following five acid sulfate soil types: (i) Subaqueous Soils, (ii) Organic Soils, (iii) Cracking Clay Soils, (iv) Sulfuric Soils and (v) Hypersulfidic Soils (Table A2-1). These are further sub-divided into 18 soil subtypes based on occurrence of sulfuric material, hypersulfidic material, clayey or sandy layers; monosulfidic material and firmness.

Table A1-1: Summary soil identification key for ASS. After finding the soil type, use Table A2.2 to find the soil subtype.

Diagnostic features for Soil Type	Soil Type
Does the soil occur in shallow permanent flooded environments (typically not greater than 2.5 m)? No ↓ Yes →	**Subaqueous soil**
Does the upper 80cm of soil consist of more than 40 cm of organic material (peat)? No ↓ Yes →	**Organic soil**
Does the soil develop cracks at the surface OR in a clay layer within 150 cm of the soil surface OR have slickensides (polished and grooved surfaces between soil aggregates), **AND** is the subsoil uniformly grey coloured (poorly drained or very poorly drained)? No ↓ Yes →	**Cracking clay soil**
Does a sulfuric layer (pH<4) occur within 150 cm of the soil surface, **AND** is the subsoil uniformly grey coloured (poorly drained)? No ↓ Yes →	**Sulfuric soil**
Does sulfidic material (pH>4 which changes on ageing to pH<4) occur within 150 cm of the soil surface, **AND** is the subsoil uniformly grey coloured (poorly drained)? No ↓ Yes →	**Hypersulfidic soil**
Does sulfidic material (pH>4 which does not change on ageing to pH<4) occur within 150 cm of the soil surface, **AND** is the subsoil uniformly grey coloured (poorly drained)? No ↓ Yes →	**Hyposulfidic soil**
Other soils	**Other soils**

Table A2-2: Soil identification key for acid sulfate soil subtypes in this report

Soil Type	Diagnostic features for Soil Subtype		Soil Subtype
Subaqueous soil No ↓ Yes →	Does **sulfuric** material occur within 150 cm of the soil surface? No ↓ Yes →	Does the upper 80cm of soil consist of more than 40 cm of organic material (peat)? No ↓ Yes →	**Sulfuric subaqueous organic soil**
	↓	Does a clayey layer with slickensides occur within 150 cm of the soil surface? No ↓ Yes →	**Sulfuric subaqueous clay soil**
		→	**Sulfuric subaqueous soil**
	Does **hypersulfidic** material (pH>4 which changes on ageing to pH<4) occur within 150 cm of the soil surface? No ↓ Yes →	Does the upper 80cm of soil consist of more than 40 cm of organic material (peat)? No ↓ Yes →	**Hypersulfidic subaqueous organic soil**
	↓	Does a clayey layer with slickensides occur within 150 cm of the soil surface? No ↓ Yes →	**Hypersulfidic subaqueous clayey soil**
		→	**Hypersulfidic subaqueous soil**
	Does **hyposulfidic** material (pH>4 which does not change on ageing to pH<4) occur within 150 cm of the soil surface? No ↓ Yes →	Does the upper 80cm of soil consist of more than 40 cm of organic material (peat)? No ↓ Yes →	**Hyposulfidic subaqueous organic soil**
	↓	Does a clayey layer with slickensides occur within 150 cm of the soil surface? No ↓ Yes →	**Hyposulfidic subaqueous clayey soil**

Soil Type	Diagnostic features for Soil Subtype		Soil Subtype
		→	**Hyposulfidic subaqueous soil**
		→	**Subaqueous soil**
Not subaqueous soil No ↓ Yes →	Does **sulfuric** material occur within 150 cm of the soil surface? No ↓ Yes →	Does the upper 80cm of soil consist of more than 40 cm of organic material (peat)? No ↓ Yes →	**Sulfuric organic soil**
	↓	Does a clayey layer with slickensides occur within 150 cm of the soil surface? No ↓ Yes →	**Sulfuric clayey soil**
	→	→	**Sulfuric soil**
	Does **hypersulfidic** material (pH>4 which changes on ageing to pH<4) occur within 150 cm of the soil surface? No ↓ Yes →	Does the upper 80cm of soil consist of more than 40 cm of organic material (peat)? No ↓ Yes →	**Hypersulfidic organic soil**
	↓	Does a clayey layer with slickensides occur within 150 cm of the soil surface? No ↓ Yes →	**Hypersulfidic clayey soil**
	→	→	**Hypersulfidic soil**
	Does **hyposulfidic** material (pH>4 which does not change on ageing to pH<4) occur within 100 cm of the soil surface? No ↓ Yes →	Does the upper 80cm of soil consist of more than 40 cm of organic material (peat)? No ↓ Yes →	**Hyposulfidic organic soil**
	↓	Does a clayey layer with slickensides occur within 150 cm of the soil surface?	**Hyposulfidic clayey soil**

Soil Type	Diagnostic features for Soil Subtype		Soil Subtype
		No ↓ Yes →	
		→	Hyposulfidic soil
	→	→	Soil
Other soils			Hydrosol - sandy or loamy

Appendix 2 – Locations and dates of previous samplings

Table A2.1 Sampling d: May and June 2011 sampling dates and location of soil sampling sites. Eastings and Northings are based on the WGS84 datum, Zone 54H.

Site ID	Locality	Sampling Date	Easting	Northing
LFd01-A	Wallys Landing and Wetland	08/06/2011	303198	6079714
LFd01-B	Wallys Landing and Wetland	08/06/2011	303216	6079636
LFd01-C	Wallys Landing and Wetland	08/06/2011	303087	6079610
LFd01-D	Wallys Landing and Wetland	08/06/2011	303081	6079604
LFd02-A	Point Sturt North	26/05/2011	321247	6070294
LFd02-B	Point Sturt North	26/05/2011	321290	6070414
LFd02-C	Point Sturt North	26/05/2011	321310	6070444
LFd03-A	Milang	26/05/2011	316106	6079440
LFd03-B	Milang	26/05/2011	316461	6079069
LFd03-C	Milang	26/05/2011	316558	6078990
LFd04-A	Tolderol	19/05/2011	331889	6083697
LFd04-B	Tolderol	19/05/2011	332006	6083479
LFd04-C	Tolderol	19/05/2011	331944	6083033
LFd05-A	Lake Reserve Road	18/05/2011	339392	6089955
LFd05-B	Lake Reserve Road	18/05/2011	339455	6089878
LFd05-C	Lake Reserve Road	18/05/2011	339455	6089843
LFd06-A	Poltalloch	24/05/2011	338984	6070340
LFd06-B	Poltalloch	24/05/2011	338876	6070502
LFd07-A	Waltowa	01/06/2011	352351	6059112
LFd07-B	Waltowa	01/06/2011	352290	6059048
LFd08-A	Meningie	01/06/2011	349066	6049328
LFd08-B	Meningie	01/06/2011	349053	6049398
LFd09-A	Kennedy Bay	30/05/2011	343823	6044778
LFd09-B	Kennedy Bay	30/05/2011	343830	6044714
LFd10-A	Campbell Park	31/05/2011	341307	6056483
LFd10-B	Campbell Park	31/05/2011	341126	6056569
LFd10-C	Campbell Park	31/05/2011	341114	6056623
LFd10-D	Campbell Park	31/05/2011	341097	6056787
LFd10-E	Campbell Park	31/05/2011	341098	6056901
LFd11-A	The Narrows	24/05/2011	335102	6067460
LFd11-B	The Narrows	24/05/2011	335278	6067652
LFd12-A	Loveday Bay	30/05/2011	326796	6061286
LFd12-B	Loveday Bay	30/05/2011	326711	6061362
LFd12-C	Loveday Bay	30/05/2011	326420	6061713
LFd12-D	Loveday Bay	30/05/2011	327059	6060960
LFd13-A	Tauwitchere	06/06/2011	319050	6060550
LFd13-B	Tauwitchere	06/06/2011	318997	6060592
LFd14-A	Ewe Island Barrage	06/06/2011	315510	6062591
LFd15-A	Boggy Creek	27/06/2011	311128	6065875
LFd15-B	Boggy Creek	27/06/2011	311139	6065855
LFd15-C	Boggy Creek	27/06/2011	311147	6065827
LFd16-A	Clayton	07/06/2011	312384	6069230
LFd16-B	Clayton	07/06/2011	312402	6069239
LFd17-A	Point Sturt South	07/06/2011	314849	6069780
LFd17-B	Point Sturt South	07/06/2011	314806	6069675
LFd17-C	Point Sturt South	07/06/2011	314770	6069615
LFd18-A	Brown's Beach	01/06/2011	350089	6053293
LFd18-B	Brown's Beach	01/06/2011	350028	6053310
LFd18-C	Brown's Beach	01/06/2011	350085	6053821
LFd19-A	Dog Lake	19/05/2011	332033	6086787
LFd20-A	Boggy Lake	18/05/2011	335054	6089352
LFd21-A	Windmill Site	31/05/2011	345597	6064184
LFd21-B	Windmill Site	31/05/2011	345519	6064056
LFd22-A	Goolwa Channel	25/05/2011	302272	6070678
LFd23-A	Lower Currency	25/05/2011	301055	6072892
LFd24-A	Lower Finniss	08/06/2011	305780	6073929
LFd24-B	Lower Finniss	08/06/2011	305780	6073929

Table A2.2 Sampling c: January and February 2011 sampling dates and location of soil sampling sites. Eastings and Northings are based on the WGS84 datum, Zone 54H.

Site ID	Locality	Sampling Date	Easting	Northing
LFc01-A	Wallys Landing and Wetland	11/01/2011	303198	6079714
LFc01-B	Wallys Landing and Wetland	11/01/2011	303216	6079636
LFc01-C	Wallys Landing and Wetland	14/02/2011	303087	6079610
LFc01-D	Wallys Landing and Wetland	14/02/2011	303081	6079604
LFc02-A	Point Sturt North	18/01/2011	321247	6070294
LFc02-B	Point Sturt North	18/01/2011	321290	6070414
LFc02-C	Point Sturt North	18/01/2011	321310	6070444
LFc03-A	Milang	18/01/2011	316106	6079440
LFc03-B	Milang	18/01/2011	316461	6079069
LFc03-C	Milang	18/01/2011	316558	6078990
LFc04-A	Tolderol	14/01/2011	331889	6083697
LFc04-B	Tolderol	14/01/2011	332006	6083479
LFc04-C	Tolderol	14/01/2011	331944	6083033
LFc05-A	Lake Reserve Road	19/01/2011	339392	6089955
LFc05-B	Lake Reserve Road	19/01/2011	339455	6089878
LFc05-C	Lake Reserve Road	19/01/2011	339455	6089843
LFc06-A	Poltalloch	24/01/2011	338984	6070340
LFc06-B	Poltalloch	24/01/2011	338876	6070502
LFc07-A	Waltowa	25/01/2011	352351	6059112
LFc07-B	Waltowa	25/01/2011	352290	6059048
LFc08-A	Meningie	25/01/2011	349066	6049328
LFc08-B	Meningie	25/01/2011	349053	6049398
LFc09-A	Kennedy Bay	24/01/2011	343823	6044778
LFc09-B	Kennedy Bay	24/01/2011	343830	6044714
LFc10-A	Campbell Park	9/02/2011	341307	6056483
LFc10-B	Campbell Park	9/02/2011	341126	6056569
LFc10-C	Campbell Park	9/02/2011	341114	6056623
LFc10-D	Campbell Park	9/02/2011	341097	6056787
LFc10-E	Campbell Park	9/02/2011	341098	6056901
LFc11-A	The Narrows	24/01/2011	335102	6067460
LFc11-B	The Narrows	24/01/2011	335278	6067652
LFc12-A	Loveday Bay	8/02/2011	326796	6061286
LFc12-B	Loveday Bay	8/02/2011	326711	6061362
LFc12-C	Loveday Bay	8/02/2011	326420	6061713
LFc12-D	Loveday Bay	8/02/2011	327059	6060960
LFc13-A	Tauwitchere	15/02/2011	319050	6060550
LFc13-B	Tauwitchere	15/02/2011	318997	6060592
LFc14-A	Ewe Island Barrage	15/02/2011	315510	6062591
LFc15-A	Boggy Creek	21/02/2011	311128	6065875
LFc15-B	Boggy Creek	21/02/2011	311139	6065855
LFc15-C	Boggy Creek	21/02/2011	311147	6065827
LFc16-A	Clayton	2/02/2011	312384	6069230
LFc16-B	Clayton	14/02/2011	312402	6069239
LFc17-A	Point Sturt South	02/02/2011	314849	6069780
LFc17-B	Point Sturt South	02/02/2011	314806	6069675
LFc17-C	Point Sturt South	02/02/2011	314770	6069615
LFc18-A	Brown's Beach	25/01/2011	350089	6053293
LFc18-B	Brown's Beach	25/01/2011	350028	6053310
LFc18-C	Brown's Beach	25/01/2011	350085	6053821
LFc19-A	Dog Lake	19/01/2011	332033	6086787
LFc20-A	Boggy Lake	19/01/2011	335054	6089352
LFc21-A	Windmill Site	9/02/2011	345597	6064184
LFc21-B	Windmill Site	9/02/2011	345519	6064056
LFc22-A	Goolwa Channel	21/01/2011	302272	6070678
LFc23-A	Lower Currency	21/01/2011	301055	6072892
LFc24-A	Lower Finniss	14/02/2011	305780	6073929
LFc24-B	Lower Finniss	14/02/2011	305780	6073929

Table A2.3 Sampling b: March 2010 sampling dates and location of soil sampling sites. Eastings and Northings are based on the WGS84 datum, Zone 54H.

SIte ID	Sampling	Locality	Sampling Date	Easting	Northing
LFb01-A	b	Wallys Landing and Wetland	11/03/2010	303198	6079714
LFb01-B	b	Wallys Landing and Wetland	11/03/2010	303216	6079636
LFb01-C	b	Wallys Landing and Wetland	11/03/2010	303087	6079610
LFb01-D	b	Wallys Landing and Wetland	11/03/2010	303081	6079604
LFb02-A	b	Point Sturt North	10/03/2010	321247	6070294
LFb02-B	b	Point Sturt North	10/03/2010	321290	6070414
LFb02-C	b	Point Sturt North	10/03/2010	321310	6070444
LFb03-A	b	Milang	10/03/2010	316106	6079440
LFb03-B	b	Milang	10/03/2010	316461	6079069
LFb03-C	b	Milang	10/03/2010	316558	6078990
LFb04-A	b	Tolderol	12/03/2010	331889	6083697
LFb04-B	b	Tolderol	12/03/2010	332006	6083479
LFb04-C	b	Tolderol	12/03/2010	331944	6083033
LFb05-A	b	Lake Reserve Road	12/03/2010	339392	6089955
LFb05-B	b	Lake Reserve Road	12/03/2010	339455	6089878
LFb05-C	b	Lake Reserve Road	12/03/2010	339455	6089843
LFb06-A	b	Poltalloch	17/03/2010	338984	6070340
LFb06-B	b	Poltalloch	17/03/2010	338876	6070502
LFb07-A	b	Waltowa	1/03/2010	352351	6059112
LFb07-B	b	Waltowa	1/03/2010	352290	6059048
LFb08-A	b	Meningie	1/03/2010	349066	6049328
LFb08-B	b	Meningie	1/03/2010	349053	6049398
LFb09-A	b	Kennedy Bay	1/03/2010	343823	6044778
LFb09-B	b	Kennedy Bay	1/03/2010	343830	6044714
LFb10-A	b	Campbell Park	2/03/2010	341307	6056483
LFb10-B	b	Campbell Park	2/03/2010	341126	6056569
LFb10-C	b	Campbell Park	2/03/2010	341114	6056623
LFb10-D	b	Campbell Park	2/03/2010	341097	6056787
LFb10-E	b	Campbell Park	2/03/2010	341098	6056901
LFb11-A	b	The Narrows	17/03/2010	335102	6067460
LFb11-B	b	The Narrows	17/03/2010	335278	6067652
LFb12-A	b	Loveday Bay	2/03/2010	326796	6061286
LFb12-B	b	Loveday Bay	2/03/2010	326711	6061362
LFb12-C	b	Loveday Bay	2/03/2010	326420	6061713
LFb12-D	b	Loveday Bay	2/03/2010	327059	6060960
LFb13-A	b	Tauwitchere	3/03/2010	319050	6060550
LFb13-B	b	Tauwitchere	3/03/2010	318997	6060592
LFb14-A	b	Ewe Island Barrage	3/03/2010	315510	6062591
LFb15-A	b	Boggy Creek	3/03/2010	311128	6065875
LFb15-B	b	Boggy Creek	3/03/2010	311139	6065855
LFb15-C	b	Boggy Creek	3/03/2010	311147	6065827
LFb16-A	b	Clayton	3/03/2010	312384	6069230
LFb16-B	b	Clayton	3/03/2010	312402	6069239
LFb17-A	b	Point Sturt South	11/03/2010	314849	6069780
LFb17-B	b	Point Sturt South	11/03/2010	314806	6069675
LFb17-C	b	Point Sturt South	11/03/2010	314770	6069615
LFb17-D	b	Point Sturt South	11/03/2010	314760	6069582
LFb18-A	b	Brown's Beach	1/03/2010	350089	6053293
LFb18-B	b	Brown's Beach	1/03/2010	350028	6053310
LFb18-C	b	Brown's Beach	1/03/2010	350085	6053821
LFb19-A	b	Dog Lake	7/05/2010	332033	6086787
LFb20-A	b	Boggy Lake	7/05/2010	335054	6089352

Table A2.4 Sampling a: October and November 2009 sampling dates and location of soil sampling sites. Eastings and Northings are based on the WGS84 datum, Zone 54H.

Site ID	Sampling	Locality	Sampling Date	Easting	Northing
LFa01-A	a	Wallys Landing and Wetland	4/11/2009	303196	6079705
LFa01-B	a	Wallys Landing and Wetland	4/11/2009	303215	6079639
LFa01-C	a	Wallys Landing and Wetland	4/11/2009	303087	6079610
LFa01-D	a	Wallys Landing and Wetland	4/11/2009	303082	6079604
LFa02-A	a	Point Sturt North	25/11/2009	321244	6070293
LFa02-B	a	Point Sturt North	25/11/2009	321291	6070417
LFa02-C	a	Point Sturt North	25/11/2009	321313	6070439
LFa03-A	a	Milang	13/11/2009	316105	6079442
LFa03-B	a	Milang	13/11/2009	316462	6079066
LFa03-C	a	Milang	13/11/2009	316554	6078985
LFa04-A	a	Tolderol	13/11/2009	331884	6083694
LFa04-B	a	Tolderol	13/11/2009	332005	6083477
LFa04-C	a	Tolderol	13/11/2009	331945	6083035
LFa05-A	a	Lake Reserve Road	13/11/2009	339388	6089958
LFa05-B	a	Lake Reserve Road	13/11/2009	339454	6089877
LFa05-C	a	Lake Reserve Road	13/11/2009	339453	6089838
LFa06-A	a	Poltalloch	20/11/2009	338985	6070340
LFa06-B	a	Poltalloch	20/11/2009	338874	6070506
LFa07-A	a	Waltowa	20/11/2009	352347	6059111
LFa07-B	a	Waltowa	20/11/2009	352286	6059050
LFa08-A	a	Meningie	20/11/2009	349067	6049327
LFa08-B	a	Meningie	20/11/2009	349049	6049398
LFa09-A	a	Kennedy Bay	20/11/2009	343824	6044779
LFa09-B	a	Kennedy Bay	20/11/2009	343831	6044716
LFa10-A	a	Campbell Park	15/10/2009	341307	6056485
LFa10-B	a	Campbell Park	15/10/2009	341122	6056568
LFa10-C	a	Campbell Park	15/10/2009	341113	6056626
LFa10-D	a	Campbell Park	15/10/2009	341096	6056787
LFa10-E	a	Campbell Park	15/10/2009	341097	6056900
LFa11-A	a	The Narrows	20/11/2009	335099	6067460
LFa11-B	a	The Narrows	20/11/2009	335275	6067652
LFa12-A	a	Loveday Bay	25/10/2009	326800	6061294
LFa12-B	a	Loveday Bay	25/10/2009	326709	6061363
LFa12-C	a	Loveday Bay	25/10/2009	326423	6061710
LFa13-A	a	Tauwitchere	4/11/2009	319047	6060551
LFa13-B	a	Tauwitchere	4/11/2009	318995	6060591
LFa14-A	a	Ewe Island Barrage	4/11/2009	315509	6062590
LFa15-A	a	Boggy Creek	30/10/2009	311128	6065877
LFa15-B	a	Boggy Creek	30/10/2009	311138	6065855
LFa15-C	a	Boggy Creek	30/10/2009	311147	6065826
LFa16-A	a	Clayton	13/11/2009	312383	6069228
LFa16-B	a	Clayton	13/11/2009	312400	6069241
LFa17-A	a	Point Sturt South	30/10/2009	314850	6069781
LFa17-B	a	Point Sturt South	30/10/2009	314804	6069675
LFa17-C	a	Point Sturt South	30/10/2009	314771	6069616
LFa17-D	a	Point Sturt South	30/10/2009	314757	6069579
LFa18-A	a	Brown's Beach	20/11/2009	350088	6053294
LFa18-B	a	Brown's Beach	20/11/2009	350028	6053311
LFa18-C	a	Brown's Beach	20/11/2009	350085	6053824

Table A2.5 Historic sampling dates and location of historic soil sampling sites. Eastings and northings are based on the WGS84 datum, Zone 54H. Note: historic samplings(e.g. h_1 and h_2) refer to sampling carried out as part of previous project/studies (not all data from historic samplings are presented in this report). h_1 indicates the first historic sampling at a site and h_2 the second historic sampling. There is not necessarily any temporal correlation between historic samplings at different sites (i.e. h_2 at LF01-A ≠ h_2 at LF02-C)

Historic Site ID	Sampling	Site ID: Current study	Locality	Sampling Date	Easting	Northing
FIN 26M3 4	h_3	LF01-A	Wallys Landing and Wetland	14/05/2009	303199	6079705
FIN 26M3 5	h_3	LF01-B	Wallys Landing and Wetland	14/05/2009	303215	6079636
AAa 29	h_1	LF02-A	Point Sturt North	15/03/2008	321236	6070291
AAa 30	h_1	LF02-B	Point Sturt North	15/03/2008	321291	6070417
LL 1544[1]	h_2	LF02-C	Point Sturt North	10/08/2009	321334	6070428
AA 15	h_1	LF03-A	Milang	10/08/2007	316461	6079066
AA 16	h_1	LF03-B	Milang	10/08/2007	316102	6079442
LL 1579[2]	h_2	LF03-C	Milang	10/08/2009	316567	6079001
AA 11	h_1	LF04-A	Tolderol	10/08/2007	332005	6083476
AA 13	h_1	LF04-B	Tolderol	10/08/2007	331882	6083695
LL 1501[3]	h_2	LF04-C	Tolderol	10/08/2009	331981	6083057
AA 8	h_1	LF05-A	Lake Reserve Road	10/08/2007	339455	6089879
AA 10	h_1	LF05-B	Lake Reserve Road	10/08/2007	339385	6089959
PO 4	h_1	LF06-A	Poltalloch	4/03/2008	338986	6070340
AT 12	h_1	LF07-A	Waltowa	14/02/2008	352352	6059098
W1S 1	h_2	LF07-B	Waltowa	16/10/2008	352280	6059074
AT 4	h_1	LF08-A	Meningie	1/07/2007	349069	6049329
AT 17	h_2	LF08-A	Meningie	21/02/2008	349053	6049396
AT 5	h_1	LF09-A	Kennedy Bay	1/07/2007	343832	6044713
AT 6	h_1	LF09-A	Kennedy Bay	1/07/2007	343823	6044780
AT 7	h_1	LF10-C	Campbell Park	1/07/2007	341103	6056622
AT 9	h_1	LF10-A	Campbell Park	1/07/2007	341289	6056481
AT 19	h_2	LF10-C	Campbell Park	21/02/2008	341105	6056636
AT 10	h_1	LF11-A	The Narrows	1/07/2007	335099	6067460
AT 20	h_2	LF11-A	The Narrows	21/02/2008	335099	6067460
AT 21	h_2	LF11-B	The Narrows	21/02/2008	335274	6067653
LL 1826[4]	h_2	LF12-D	Loveday Bay	13/08/2009	327059	6060959
AA 33	h_1	LF13-A	Tauwitchere	13/02/2008	319047	6060552
AA 34	h_1	LF14-A	Ewe Island Barrage	13/02/2008	315500	6062595
BCM 1	h_1	LF15-B	Boggy Creek	21/07/2009	311143	6065859
AA 24	h_1	LF16-A	Clayton	24/08/2007	312400	6069240
AA 25	h_1	LF16-B	Clayton	24/08/2007	312388	6069229
PSM 1	h_1	LF17-B	Point Sturt South	21/07/2009	314800	6069677
M2N 1	h_1	LF18-A	Brown's Beach	17/10/2008	350088	6053297
M7S 1	h_1	LF18-C	Brown's Beach	17/10/2008	350084	6053823
CUR13	h_1	LF22-A	Goolwa Channel	18/11/2008	302272	6070678
CUR13-M2	h_2	LF22-A	Goolwa Channel	19/12/2009	302272	6070678
CUR27	h_1	LF23-A	Lower Currency	18/11/2008	301049	6072909
CUR27-M2	h_2	LF23-A	Lower Currency	20/12/2009	301055	6072892
FIN20	h_1	LF24-A	Lower Finniss	19/11/2008	305780	6073935
FIN20-M2	h_2	LF24-A	Lower Finniss	19/12/2009	305780	6073929
FIN23	h_1	LF24-B	Lower Finniss	19/11/2008	305748	6074053
FIN23-M2	h_2	LF24-B	Lower Finniss	19/12/2009	305749	6074053

Note - [1]Site LL1544 comprises samples LL1544-45, [2]Site LL1579 comprises samples LL1579-80, [3]Site LL1501 comprises samples LL1501-03, [4]Site LL1826 comprises samples LL1526-27

Appendix 3 – Site and sample descriptions

June 2012 sampling

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
LFf01-A.1			0	14	Black (10YR 2/1) hemic peat; soft, with thin black monosulfidic gel at the surface and staining the peat; saturate; abrupt boundary.
LFf01-A.2			14	16	Layer of mixed materials containing coarse rounded and sub-rounded quartz gravel (to ~ 1.5 cm) and sand; chip trays only; abrupt boundary.
LFf01-A.3	**Wallys Landing and Wetland -** Middle of drainage ditch located to the north east of the Finniss River. **Subaqueous (1.1 m).**		16	41	Dark olive grey (5Y 3/2) organic heavy clay with darker and lighter coloured layers; several horizontal planar cracks with medium, pale coloured sand; probable medium polyhedral structure; ; no obvious jarosite except for a single very pale, almost white, coarse mottle in one core), but paler colours surrounding vertical medium root channels; strong vertical planar cracks (probable columnar structure); clear to gradual boundary.
LFf01-A.4			41	57	Very dark grey (5Y 3/1) heavy or loamy clay with some slightly paler patches and prominent sub-horizontal planar cracks with some sand and a paler, dark grey colour; few strong, vertical planar cracks; diffuse boundary.
LFf01-A.5			57	89	Very dark grey to black (5Y 2.5/1) heavy clay or loamy clay; spongy; strong vertical planar cracks.
LFf01-D.1			0	15	Very dark brown(10YR 2/2) mixed materials, upper few cm decomposing organic matter, gravel and clay grading to decomposing peaty material, approaching sapric (very little coarse material after light rubbing); medium and fine roots and a few coarse (~ 1.5 cm) *Phragmites* roots; clear boundary.
LFf01-D.2	Southern side of Finniss River channel on western side of Wallys Jetty, approximately one metre from the bank. **Subaqueous (0.6 m).**		15	41	Dark brown (7.5Y 3/2) sapric peat, clayey towards the base; darker in parts with some coarse plant remnants that break to very fine organic matter; common medium root remnants and few coarse roots; few coarse quartz gravel; moderate sulfidic smell in lower part; boundary clear to gradual, but sharp in one core.
LFf01-D.3			41	60	Black (5Y 2.5/1) heavy clay, organic towards the upper part; sub-rounded coarse to ~ 1cm and bands of coarse sand with clay; few medium (live?) roots; weak sulfidic smell; gradual boundary.
LFf01-D.4			60	90	Very dark greyish brown (2.5Y 3/2) heavy clay, spongy; few medium roots.
LFf02-A.1	**Point Sturt North –** Approximately 60 m offshore. **Subaqueous**		0	8	Dark grey (5Y 4/1) medium sand, uniform, apart from oxidised surface; this layer 12 cm in one core; saturated and loose in upper

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
	(0.7 m).				part; lower part may have weak sulfidic smell; abrupt irregular boundary.
LFf02-A.2	This profile showed oxidation to the outer part of the cores on storage, cold, for nearly three days.		8	23	Dark grey (5Y 4/1) medium sand grading in colour to the next layer; 20 – 30% black mottles which are distinct in thin horizontal layers or following root channels; few coarse (1 cm diameter) decomposing roots; diffuse boundary.
LFf02-A.3			23	42	Greyish brown (2.5Y 5/2) medium sand, mostly uniform; weak sulfidic smell; abrupt boundary.
LFf02-A.4			42	67	Dark grey (5Y 4/1) sandy loam to sandy clay loam with diffuse, coarse pale mottles, some with brown circular (5 – 10 mm) cores; rare yellow jarosite mottles in upper part.
LFf02-B.1	Approximately 200 m offshore. **Subaqueous (1.0 m).**		0	12	Black (2.5Y 2/0) medium sand, oxidised in surface few cm; the lower boundary grades to the material below with black root channel; few fine to medium blackened roots; gradual boundary.
LFf02-B.2			12	35	Grey (5Y 5/1 grading to 5Y 6/1) medium sand,; mostly whole coloured with a few black root channels; abrupt way boundary.
LFf02-B.3	These cores had oxidised in their outer part. The inner part of the cores was described.		35	47	Dark grey (5Y 4/1) clayey medium sand, becoming paler coloured at lower boundary; diffuse boundary.
LFf02-B.4			47	78	Grey (5Y 5/1) clayey sand; few fine shell fragments.
LFf02-D.1			0	11	Grey (5Y 5/1) clayey sand to loamy sand; immediate surface oxidised light brownish grey (2.5Y 6/2) over several thin black bands of monosulfide and fine organic matter; abrupt boundary.
LFf02-D.2			11	25	Greyish brown (2.5YR 5/2) loamy sand with weak, coarse mottles of slightly paler colour and few brown mottles associated with old fine roots; clear boundary.
LFf02-D.3	Approximately 10 m offshore. **Subaqueous (0.5 m).**		25	40	Greyish brown (2.5Y 5/2) loamy sand to clayey sand with horizontal light yellowish brown (2.5Y 6/3) bands (3-5 mm) and few very dark brown and black horizontal bands (1-3 mm) associated with organic matter and some fine roots; abrupt, smooth boundary.
LFf02-D.4			40	72	Dark grey (5Y 4/1) sandy loam with few brown mottles root channels and coarse, diffuse paler mottles (oxidised brown on exposure to the air) and some paler horizontal banding in the upper 10 cm; very few fine roots running vertically with a paler halo surrounding a brown core.

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
LFf03-A.1	**Milang -** Approximately 200 m offshore. **Subaqueous (0.9 m).**		0	15	Dark grey (2.5Y 4/1) loamy fine sand; surface layer of 3 cm of washed on saturated, loose sand over 1 cm dark organic material marking old surface; 30% black mottles and bands, common fine roots; sharp, irregular boundary.
LFf03-A.2			15	20	Grey (10YR 5/1) loamy fine sand, darker towards the base; 55 dark root channels; sharp boundary.
LFf03-A.3			20	26	Dark greyish brown (2.5Y 4/2) heavy clay; medium and fine roots common near upper boundary; sharp wavy boundary.
LFf03-A.4			26	60	Greyish brown (2.5YR 5/2) loamy medium sand with prominent jarosite mottles in upper 1-2 cm, very weak jarosite mottling below this until lower boundary where there are coarse, prominent jarosite mottles above a 2 cm clay band; several darker (2.5Y 4/1) clay bands to4 cm; sharp wavy boundary.
LFf03-A.5			60	68	Grey (5Y 5/1) loamy medium sand. One core only. Note that there was no sign of peat recorded earlier.
LFf03-B.1	Approximately 550 m offshore. **Subaqueous (1.0 m).**		0	9	Light brownish grey (10YR 6/2 with black flecks) medium sand with a loose, saturated surface few cm which are greyer and has some clay; abrupt wavy boundary.
LFf03-B.2			9	15	Greyish brown (2.5Y 5/2) medium sand containing 10% diffuse, weak black mottles and <5% brown mottles; clear boundary.
LFf03-B.3			15	28	Light brownish grey (2.4Y 6/2) medium sand; one core has a single, coarse, prominent jarosite mottle close to the lower boundary; clear boundary.
LFf03- B.4			28	50	Greyish brown (2.5Y 5/2) medium sand, upper boundary marked by a layer (1-2 cm) of sandy clay; the horizon contains several dark grey clayey bands (5Y 4/1) of varying thickness to ~ 2 cm; there is a dark clayey band marking the lower boundary; abrupt boundary.
LFf03-B.5			50	72	Greyish brown (2.5Y 5/2) medium sand, mostly uniform but with a few diffuse, coarse darker and paler mottles or bands.
LFf04-A.1	**Tolderol -** Approximately 80 m offshore. **Subaqueous (1.0 m).**		0	10	Dark Grey (5Y4/1) medium sand, uniform, but with darker material associated with coarse organic matter in one core, clear boundary.
LFf04-A.2	Some variability in layer thicknesses – A.2 varies from a few cm		10	23	Greyish brown (2.5Y 5/2) medium sand with < 5% diffuse jarosite mottles, few coarse, dark brown root remnants, abrupt boundary.

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
LFf04-A.3	to~ 15 cm thick.		23	30	Dark greenish grey (5GY 4/1) sandy clay loam to sandy clay with jarosite mottles extending along old root channels with dark brown (7.5YR 4/4) staining (<5%) and few (<5%) diffuse, darker mottles around fine root channels; abrupt boundary.
LFf04-A.4			30	52	Grey (5Y 5/1) medium sand with few brown mottles along old root channels in upper part; rare fine and medium roots, clear boundary.
LFf04-A.5			52	80	Grey to dark grey (5Y 5/1 to 4/1) sandy clay loam to sandy clay, soft, in upper part then reverting to loamy sand; rare shell fragments at 70-80 cm, rare fine roots.
LFf04-C.1			0	23	Black (5Y 2.5/1) medium sand with variable disturbance (0-8 cm, 0-18 in one core) over oxidised (grey 5Y 5/1 and light olive brown 2.5Y 5/3) medium sand with dark (monosulfidic?) material in 'swirls'; abrupt, irregular boundary.
LFf04-C.2	Approximately 550 m offshore. **Subaqueous (1.3 m).**		23	47	Grey (5Y 5/1) medium sand, uniform except for some 'swirls' or root channels in upper few cm; diffuse boundary.
LFf04-C.3			47	78	Grey (5Y 5/1) grading to dark grey (5Y 4/1) medium sand, darker in the lower 10-15 cm; very few coarse, black mottles; few whole (5-8 mm) and fragments of bivalve shells; abrupt boundary.
LFf04-C.4			78	82	Dark grey (5Y 4/10) light clay with some sand found in one core only (chip tray sample).
LFf06-A.1			0	29	Dark grey (5Y4/1) medium sand to loamy sand, probably with a thin, oxidised surface layer; few coarse pale mottles and darker to black mottles surrounding black medium to fine roots; very few fine shell fragments concentrated near surface; diffuse boundary.
LFf06-A.2	**Poltalloch -** Approximately 200 m offshore. **Subaqueous (1.1 m).**		29	45	Greyish brown (2.5Y 5/2) medium sand, uniform coloured with very few brownish mottles and coarse darker mottles associated with medium roots in some cores; very few fine hell fragments; oxidised quickly on exposure to air giving reddish drown (Fe oxide?) colour (~ 10YR 6/3); diffuse boundary.
LFf06-A.3			45	65	Grey (5Y 5/1) medium sand with few coarse darker mottles; few whole bivalve shells and fragments; diffuse boundary.
LFf06-A.4			65	83	Grey (5y 5/1) medium sand to loamy sand, uniform; few whole (~ 1cm) bivalve shells and shell fragments in upper part.
LFf06-B.1	Approximately 400 m offshore. **Subaqueous (1.5 m).** Top layer was variable in depth – 8, 10, 12, and 20 cm.		0	9	Dark grey (5Y 4/1) medium sand with 10-15% diffuse, medium black mottles; saturated and loose; very few fine shell fragments; abrupt, smooth boundary.
LFf06-B.2	Note: one core of 5 differed greatly in layer depths – 0-22, 22-40, 40-63, 63-85 cm.		9	19	Very dark grey (2.5Y 3/0) loamy sand or sandy loam (oxidises to 5Y 4/1) with a soft, sticky, Black (2.5Y 2/0) clay band in the upper three cm over sandy material with 40% black bands, mostly

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
					horizontal; no shell material except in the lowest few cm; abrupt, irregular boundary.
LFf06-B.3			19	37	Olive grey (5Y 4/2) sandy loam; 3 of 5 cores have a dark greyish green (5GY 4/1) clayey band in the upper few cm; very dense band 5-6 cm) of mainly whole bivalve shells between 40 and 50 cm; clear boundary.
LFf06-B.4			37	41	Dark grey (5Y 4/1) heavy clay with sand (chip tray sample only)
LFf07-A.1			0	8	Black (2.5Y 2/0) loamy sand or a little more clayey, monosulfidic and organic in upper 2 cm, saturated, over sandier material; abrupt to clear boundary.
LFf07-A.2			8	18	Very dark grey to dark grey (5Y 3/1 to 4/1) loamy sand with diffuse, grey (5Y 5/1, 40%) mottles and black mottles (20%) probably associated with organic matter; firmer than above; common fine roots; abrupt boundary.
LFf07-A.3	**Waltowa -** Approximately 100 m offshore. **Subaqueous (0.6 m).**		18	38	Dark grey (5Y 4/1) loamy sand with distinct black 'ropey' monosulfidic material with diffuse edges (10%) in upper part; this material becomes whole-coloured black in one core where this layer is thicker (to 48 cm); common fine roots; lower boundary marked by thin horizontal bands of brown and black organic matter; sharp to abrupt boundary.
LFf07-A.4			38	62	Dark grey to olive grey (5Y 4/1 to 4/2) heavy clay with some very fine sand; soft, sticky and slightly spongy; lower boundary marked by thin horizontal bands of olive and brown material with fine shell fragments; abrupt boundary.
LFf07-A.5			62	84	Dark grey to grey (5Y 4/1 to 5/1) heavy clay; soft, slightly spongy; calcareous material reported in the 'e' sampling only present in the lower 2 cm of one core.
LFf07-B.1			0	12	Very dark grey to dark grey (5Y3/1 to 4/1) sand (2-5 cm) at surface over black (2.5Y 2/1) loamy sand with black flecks of monosulfide (?); saturated; clear boundary.
LFf07-B.2	Approximately 200 m offshore. **Subaqueous (0.7 m).**		12	36	Dark grey (5Y 4/1) loamy sand, paler grey (5Y 5/1) towards the base with coarse, diffuse, darker patches and more prominent, smaller black mottles (20%) towards the upper boundary; abrupt boundary.
LFf07-B.3			36	59	Black to very dark grey (5Y 2.5/1 to 3/1) light clay or loamy clay, with fine (sapric) organic matter in finely layered with darker bands; very soft and saturated (difficult to texture); few to common mica flakes; abrupt boundary.
LFf07-B.4			59	76	Dark grey to grey (5Y 4/1 to 5/1, greenish?) heavy clay, uniform (no $CaCO_3$).

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
LFf08-A.1	**Meningie -** West of the Meningie jetty. Approximately 35 m offshore. **Subaqueous (0.6 m).** The thicknesses of layers A.2 and A.3 were variable – average depth shown.		0	8	Very dark grey (5Y 3/1) loamy sand; soft, saturated; coarse black organic matter and medium fine roots; abrupt boundary.
LFf08-A.2			8	32	Dark grey (5Y 4/1) loamy sand with very coarse, diffuse, darker mottles (5Y 4/1 to 3/1); few shell fragments with a band at the base of the layer; abrupt boundary.
LFf08-A.3			32	52	Dark grey to very dark grey (5Y 4/1 to 3/1) heavy clay with decomposing (sapric) organic matter in the upper part and in several bands; with common coarse and medium roots; bands of coarse quartz sand near base of layer; strong sulfidic smell; abrupt boundary.
LFf08-A.4			52	86	Dark grey (5Y 4/1) heavy clay, uniform with a band of coarse sand and some coarse organic matter; strong sulfidic smell.
LFf08-B.1	Approximately 125 m offshore. **Subaqueous (1.1 m).** A large amount of grey to dark grey water with clay was sampled above the soil surface.		0	23	Very dark grey (5Y 3/1) sand to loamy sand with a few thin black clayey lenses in the lower part; and grading to dark grey (5Y 4/1); possibly monosulfidic at surface (lost on sampling?); saturated; no coherence in upper 10 cm; abrupt, irregular boundary.
LFf08-B.2			23	30	Black (2.5Y 2/0) loamy sand to very dark grey at upper boundary where there is some well decomposed organic matter; fine shell fragments concentrated near lower boundary; sharp boundary.
LFf08-B.3			30	35	Black (2.5Y 2/0) grading to very dark grey (2.5Y 3/0) heavy clay; soft; absent in one core; gradual boundary.
LFf08-B.4			35	77	Dark grey (5Y 4/1) heavy clay; soft and spongy in parts with few very thin sandy lenses with some organic matter; very few whole bivalve shells (to 5 mm); *no* sulfidic smell.
LFf10-A.1	**Campbell Park -** Approximately 5 m offshore. **Subaqueous (0.2 m).** Three of four cores had hemic peaty material at 10-14, 12-21 and 20-29 cm.		0	12	Very dark brown (10YR 3/2) hemic peat with monosulfide in the upper 1-3 cm, dark grey clay to about 8cm and some sand with clay between 8 and 12 cm; common fine, few medium and very few coarse live roots (1.5cm diameter); abrupt boundary.
LFf10-A.2			12	21	Dark brown (7.5YR 3/3) brown hemic (?) peat (3/4 cores) which breaks to firm, coarse, sand-sized particles; few fine roots; sharp wavy boundary.
LFf10-A.3			21	53	Grey (5Y 5/1) heavy clay with 20-30%clear, prominent, medium jarosite mottles (2.5Y 7/4); 2/4 cores slightly darker in upper 10 cm; sticky; few sub-horizontal planar cracks with a small amount of sand; blocky and coarse columnar structure; few medium roots

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
					running vertically; clear boundary.
LFf10-A.4			53	86	Dark grey (5Y 4/1) heavy clay with very few old, medium root channels in the upper 10-15 cm with brown core and jarosite mottle; few old medium roots running more or less vertically.
LFf10-C.1			0	18	Very dark grey (5Y 3/2) medium sand to loamy sand; mixed materials – 30% coarse, black, decomposing organic matter; loose; saturated; clear boundary.
LFf10-C.2			18	23	Very dark grey and black(2.5Y 3/2) loamy organic clay with coarse, decomposing, black or very dark brown organic matter; some thin lenses of grey medium sand in one core; strong decomposing (not H_2S) smell; sharp, wavy boundary.
LFf10-C.3	Approximately 125 m offshore. **Subaqueous (0.7 m).** There is some variability of depth of layers among the cores.		23	40	Dark greyish to very dark greyish brown (2.5Y 4/2 to 5/2) loamy sand, darker in a few clayey lenses and paler in the upper parts, one core with one prominent jarosite mottle along a medium root channel; 10-155 black mottling around old root channels; decomposing smell; diffuse boundary.
LFf10-C.4			40	70	Dark grey (5Y 4/1) medium sand; mostly uniform with < 5% brownish mottles (2-3 mm) along old root channels, mainly in the upper part.
LFf10-D.1			0	4	Dark grey (5Y 4/1 to 4/2) medium sand; loose, saturated; few fine black roots (this layer absent in one core); abrupt boundary.
LFf10-D.2			4	12	Dark grey (5Y 4/1) loamy sand with a very dark grey upper layer about 2 cm thick; few fine black roots; clear boundary.
LFf10-D.3	Approximately 300 m offshore. **Subaqueous (0.9 m).** Cores were variable with 3/6 similar to ones described in the 'e' sampling and the other 3 not having the carbonate layer below 20 cm. Soil sampled from the latter are labelled LFf10-D.4a and 5a. The surface layer varied from 0 to 10 cm thick among the cores – averaged 4 cm.		12	20	Olive grey (5Y 4/2) loamy sand with clayey lenses; few to common fine, live roots; clear boundary.
LFf10-D.4			20	33	Olive grey (5Y 4/2) clay or sandy clay with about 50% coarse (to 15mm) carbonate nodules.
LFf10-D.4a			20	45	Olive grey (5Y 4/2) mainly sandy clay loam or sandy clay (2/3) with several bands of loamy sand; clay slightly darker colour; soft; diffuse upper and lower boundaries.
LFf10-D.5a			45	88	Dark grey (5Y 4/1) mainly sandy clay loam with sandier and more clayey lenses; few fine shell fragments; one core with a layer (3 cm) containing carbonate nodules.
LFf12-A.1	**Loveday Bay -** Approximately 300 m offshore. **Subaqueous (1.2**		0	8	Greyish brown (2.5Y 5/2) loamy sand, the upper few cm with black sulfidic mottles associated with roots; loose, saturated; common

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
	m).				very fine roots and few medium roots; abrupt boundary.
LFf12-A.2			8	15	Greyish brown (2.5Y 5/2) loamy sand with some clayey lenses; firmer than above; very fine roots in upper part; moderate sulfidic smell; abrupt boundary.
LFf12-A.3			15	33	Olive grey (5Y 4/2) sandy clay with a paler sandy lens at 25-28 cm; very soft; diffuse dark brown (7.5YR 4/4) staining around few fine, vertical root channels; clear boundary.
LFf12-A.4			33	50	Dark grey to grey (5Y 4/1 to 5/1) sandy clay, with some sandy lenses; very soft; clear boundary.
LFf12-A.5			50	71	Grey to dark grey (5Y 5/1 to 4/1) fine sandy clay; very soft; sharp to abrupt boundary.
LFf12-A.6			71	84	Dark grey to dark greenish grey (5Y 4/1 to 5GY 4/1) heavy clay without sand; soft.
LFf12-B.1			0	9	Black (5Y 2.5/1) loamy sand with some coarse sand and with a monosulfidic surface that washes away easily; few coarse leaf and root sheath organic fragments; loose, saturated; abrupt boundary.
LFf12-B.2			9	15	Black (2.5Y 2/0) organic loamy sand with firm, sapric peat inclusions and clay lenses; monosulfidic; few coarse organic fragments; clear boundary.
LFf12-B.3			15	30	Very dark grey (5Y 3/1) loamy sand with diffuse patches of dark grey (5Y 4/1) material that may also be monosulfidic; sharp (clear in photographed core) boundary.
LFf12-B.4	Approximately 250 m offshore. **Subaqueous (1.0 m).**		30	43	Dark grey to grey (5Y 4/1 to 5/1) loamy sand, darker at the upper boundary; very few circular (5 mm) reddish yellow mottles; few vertical root channels with black (monosulfidic?) mottles extending through the layer; clear boundary.
LFf12-B.5			43	67	Grey (5Y 5/1) loamy sand with 5% prominent, circular black mottles and 5-10% diffuse dark grey mottles and few vertical root channels with black (monosulfidic?) mottles extending through the layer; few shell fragments (to 2mm); towards the base; clear boundary.
LFf12-B.6			67	84	Grey (5Y 5/1) sandy clay loam with clayey lenses; few circular voids to 2mm; few fine shell fragments; few very fine roots; sulfidic smell.
LFf12-C.1	Approximately 50 m offshore. **Subaqueous (0.7 m).**		0	10	Grey (10YR 5/1) loamy sand with black (monosulfidic?) flecks and

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
					black (2/5Y 2/0, monosulfidic) in patches with some residual organic matter near the surface and some diffuse, coarse mottles (~2.5Y 5/2); black mottling follows old fine roots; diffuse boundary.
LFf12-C.2			10	40	Greyish brown (2.5Y 5/2) loamy sand with some distinct, but not prominent light brownish grey (2.5Y 6/2) remnant jarosite mottles, especially towards the base; few coarse remnant Phragmites roots; this layer to 50 cm in two cores; pH$_f$ 4-4.4; gradual boundary.
LFf12-C.3			40	77	Dark greenish grey to dark grey (5GY 4/1 to 5Y 4/1) loamy sand grading to sandy loam at the base, possibly with coarser sand grains.
LFf13-A.1			0	12	Black (2.5Y 2/0) monosulfidic fibric peat with clay in the upper part and sand towards the lower part; common coarse, medium and fine roots (live); strong sulfidic smell; clear boundary.
LFf13-A.2	**Tauwitchere -** Northern side of Tauwitchere Island in tall (> 2 m) reeds. Approximately 30 m offshore. **Subaqueous (0.5 m).**		12	22	Dark grey (5Y 4/1) loamy sand with diffuse very dark grey to black mottles around coarse roots and organic matter; some old, blackened roots; common coarse, medium and fine roots; strong sulfidic smell; clear boundary.
LFf13-A.3			22	40	Dark grey (5Y 4/1) medium sand to loamy sand with common small bivalve shells and fragments; common coarse and medium roots, and blackened old roots; no smell; clear boundary.
LFf13-A.4			40	50	Dark grey to grey (5Y 4/1 to 5/1) loamy sand; uniform; few shell fragments in upper part; mica flakes; few medium live roots; sulfidic smell.
LFf15-B.1			0	2	Black (2.5Y 2/0) monosulfidic to very dark brown sapric peat with some coarser fragments (3-5 mm) with some clay towards the base; sharp, uneven boundary.
LFf15-B.2			2	12	Dark grey (5Y 4/1) loamy sand, uniform; abrupt boundary.
LFf15-B.3	Soil profile located on the northern side of the creek bed. **Subaqueous (1.0 m).**		12	27	Olive grey (5Y 5/2) sandy loam with inclusions of grey, very clayey material; upper part has prominent pale yellow (2.5Y 6/2, 3-5 mm) jarosite mottles following more or less vertical old root channels, lower part has brown mottles with diffuse haloes around fine roots; sharp, irregular boundary.
LFf15-B.4			27	54	Dark grey (5Y 4/1) sandy clay with several soft clayey and bleached sandy lenses (1-2 cm); firm; few shell fragments; weak sulfidic smell;
LFf15-B.5			54	82	Dark grey (5Y 4/1) sandy clay with some sandy and more clayey lenses; softer than above; very few brown, decomposing coarse

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
					roots (~ 1 cm diameter); the lower 15 cm of one long core was dark grey sandy loam to loamy sand.
LFf15-C.1			0	8	Black (2.5Y 2/0) heavy clay, monosulfidic but light olive grey within hard peds; polyhedral structure, with some very hard peds; abrupt, wavy boundary.
LFf15-C.2			8	17	Light olive grey (5Y 6/2) clay with indistinct, diffuse, yellowish mottles and some sandy lenses; sharp, wavy boundary.
LFf15-C.3	Soil profile located in the middle of the creek bed. **Subaqueous (1.2 m).**		17	35	Dark grey (5Y 4/1) to dark brownish grey heavy clay with few medium light olive grey mottles, possibly following old root channels; gradual boundary.
LFf15-C.4			35	62	Dark grey to greenish grey (5Y 4/1 to 5GY 5/1) sandy clay with few to fine shell fragments and few whole bivalve and conical shells, gradual boundary.
LFf15-C.5			62	80	Dark grey (5Y 4/1) sandy clay , but soft clay in the upper 8-10 cm; few fine shell fragments and whole bivalves.
LFf17-A.1			0	17	Dark grey to grey (5Y 4/1 to 5/1) loamy sand with greyish brown (2.5Y 5/2) oxidised upper few cm; abrupt wavy boundary.
LFf17-A.2	**Point Sturt South -** Approximately 50 m offshore. **Subaqueous (0.7 m).**		17	46	Greyish brown (2.5Y 5/2) sandy loam to sandy clay loam with 15-30% pale yellow, distinct light yellowish brown (2.5Y 6/3) jarosite mottles; several clayey bands (to 2 cm thick); uncommon remnant organic matter and few old root channels, brow in the upper part, grey in the lower part; abrupt, wavy boundary.
LFf17-A.3			46	80	Dark grey (5Y 4/1) mixed materials from sandy loam to sandy clay in layers; few diffuse, darker mottles (< 5%, associated with organic matter?); firmer than above.
LFf17-B.1			0	23	Greyish brown or paler (2.5Y 5/2) loamy sand two cores were greyer in the upper few cm, one black in the upper 6 cm, saturated and of weak consistence; clear boundary.
LFf17-B.2	Approximately 140 m offshore. **Subaqueous (0.9 m).**		23	44	Greyish brown (2.5Y 5/2) loamy sand with 5-10% distinct jarosite (light yellowish brown, 2.5Y 6/3) mottles; two cores had distinct, darker clayey bands, including one at the base of the layer; clear boundary.
LFf17-B.3			44	57	Greyish brown (2.5Y 5/2) loamy sand, uniform; clear boundary.
LFf17-B.4			57	89	Olive grey (5Y4/2) variable, but mainly sandy clay loam with loamy sand in part and a pale distinct sandy layer (2 – 3 cm) at 70 cm as well as thin clayey bands.
LFf19-A.1			0	18	Greyish brown (10YR 5/2) loamy sand with dark greyish brown

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
	Dog Lake - Approximately 130 m offshore. **Subaqueous (0.9 m).**				(2.5Y 4/2) sandy loam (one core had a clayey band) in the upper 5 cm; 5% diffuse jarosite mottles below 5 cm; few fine roots; abrupt to sharp wavy boundary.
LFf19-A.2			18	32	Greyish brown (2.5YR 5/2) loamy or clayey sand with 10-15% coarse jarosite mottles becoming more prominent in the lower 10 cm, some in horizontal bands in upper part and along vertical fine root channels in the lower part; common fine roots; abrupt, wavy boundary.
LFf19-A.3			32	42	Dark greenish grey (5GY 4/1) light clay becoming heavier with depth; few jarosite mottles along old root channels with brown root remnant cores in upper part.
LFf19-B.1			0	8	Very dark grey (5Y 3/1) loam or clay loam with black monosulfide gel at surface 1-2 cm over soft, slightly spongy clay with some fine sand and fine (sapric) morganic matter; abrupt to clear boundary.
LFf19-B.2			8	26	Dark greyish brown (2.5Y 4/2) light clay or loamy clay (one core distinctly loamy with fine sand) with fine (sapric?) organic matter; soft; more or less uniform throughout; few fine pores in upper part; abrupt boundary.
LFf19-B.3	Approximately 400 m offshore approximately 1.5 km closer to the terminus of Dog Lake than site LFe19-A. **Subaqueous (0.9 m).**		26	36	Dark greenish grey (5GY 4/1) light? clay; upper part ha 5-10% distinct to prominent jarosite mottles around remnant organic matter and around voids and root channels with dark brown cores, lower half has 10-20% diffuse dark brown mottles, some in thin horizontal layers and others following old root channels; drier than above; gradual boundary.
LFf19-B.4			36	49	Dark greenish grey (5GY 4/1) heavy clay, the upper part having few diffuse dark brown mottles; much drier and firmer than above.
LFf20-A.1			0	8	Olive grey (5Y 4/2) heavy clay with some fine sand in black (2.5Y 2/0) monosulfidic gel with decomposing, coarse organic matter; common medium and fine (live) roots; residual medium polyhedral structure with black gel in cracks; abrupt, irregular boundary.
LFf20-A.2	**Boggy Lake -** Approximately 300 m offshore. **Subaqueous (0.9 m).**		8	18	Very dark greyish brown (10YR 3/2) heavy clay; firm; common live medium (vertical) and fine roots; some residual structure evident in upper parts; jarosite mottles in lower few cm; gradual boundary.
LFf20-A.3			18	42	Greyish brown (2.5Y 5/2) heavy clay with 20-30% medium, prominent, clear jarosite (2.5Y7/4) mottles, most of which are probably associated with old root channels and decomposing organic matter; weak residual structure with mainly vertical planar cracks; common medium live (vertical) and fine (horizontal) roots;

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
					diffuse boundary.
LFf20-A.4			42	57	Dark grey (5Y 4/1) heavy clay with a small amount of fine sand and few fine jarosite mottles in upper part associated with old roots and coarse, decomposing organic matter, and especially lining the vertical planar cracks; firm; gradual (irregular?) boundary.
LFf20-A.5			57	92	Dark greenish grey (5GY 4/1) heavy clay; contains a small amount of fine sand in weak, horizontal planar cracks; few fine, live roots in the upper part.
LFf20-B.1			0	11	Very dark greyish brown (10YR 3/2) heavy clay with fine organic matter; surface monosulfide gel with some staining of material below, especially along root channels and cracks (one core had much gel and stronger polyhedral structure that resulted in staining most of the layer) soft and slightly spongy; very weak structure; clear boundary.
LFf20-B.2	Approximately 300 m offshore. **Subaqueous (0.9 m).**		11	20	Dark grey (5Y 4/1) heavy clay with fine organic matter and with < 5% diffuse fine jarosite mottles; firm; very weak structure apart from some horizontal planar cracks; abrupt boundary.
LFf20-B.3			20	35	Dark greyish brown (2.5Y 4/20 heavy clay; 5-10% weak jarosite mottles; soft; rare grit (quartz?) and some pale grey sandy lenses; diffuse boundary.
LFf20-B.4			35	60	Olive grey (5Y 4/2 grading to 4/1) heavy clay; soft, sticky; few horizontal thin sandy lenses, but not paler coloured as in layer above; few fine roots; abrupt boundary.
LFf20-B.5			60	70	Dark grey (5Y 4/1) sandy loam with few coarse, diffuse, slightly paler mottles; few mica flakes (note: clay recorded in 'e' sampling was not recovered).
LFf21-A.1			0	6	Dark grey (10YR 4/1) medium sand; saturated, loose wash-on to previous surface; fine black particles of monosulfide and/or organic matter that separate easily; abrupt wavy boundary.
LFf21-A.2			6	26	Dark grey (5Y 4/1) medium sand with common coarse roots and other coarse organic matter which is stained brown and has a paler 'halo'; upper 2 cm black (monosulfidic and organic) former surface; few diffuse, darker mottles associated with organic matter; clear boundary.
LFf21-A.3	**Windmill Site -** Approximately 100 m offshore. **Subaqueous (0.5 m).**		26	47	Dark grey, but lighter than above (5Y 4/1) medium sand , mostly uniform but with ~ 20% slightly darker coarse mottles associated with old roots and 5% coarse, lighter coloured mottles in the upper half; few fine shell fragments in lower part; clear boundary.
LFf21-A.4			47	67	Grey (a little darker than 5Y 5/1) loamy sand, the sand being finer than above, with darker medium mottles in the upper 10 cm; very few fine shell fragments in the upper part; few coarse relict roots.

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
LFf21-B.1	Approximately 250 m offshore. **Subaqueous (0.7 m).**		0	25	Dark grey (5Y 4/1) or a little darker, medium sand; uniform, saturated, loose; black particles that separate easily from the sand; wash-on material; few medium black roots; abrupt boundary.
LFf21-B.2			25	58	Dark grey (5Y 4/1) medium sand; previous surface of residual black organic matter at upper levels, but there is evidence of what may be disturbance with swirl lines in some cores; black mottling around old medium to fine root channels; few medium and fine live roots; below the black material is a paler greyish brown (2.5Y 5/2) layer that varies in thickness from 2 to 7 cm; bivalve layer at lower boundary; sharp smooth boundary.
LFf21-B.3			58	84	Very dark grey (5Y 3/1) loamy light clay; spongy and soft when worked, coorongite-like but without 'rubberiness' and horizontal layering; very few medium and fine roots; sharp boundary.
LFf21-B.4			84	88	Dark grey (5Y 4/1) loamy sand with clayey bands and a shelly bivalve layer in the upper2 cm.
LFf23-A.1	**Lower Currency -** Approximately 60 m offshore. **Subaqueous (0.9 m).**		0	8	Very dark grey (5Y 3/1) loamy sand to medium sand, probably with monosulfide flecks; loose; few fine black roots; (this layer very disturbed in 2 cores); abrupt to clear boundary.
LFf23-A.2			8	25	Greyish brown (2.5Y 5/2) medium sand, whole coloured with few brown and very dark grey mottles around fine roots and voids; diffuse boundary (this boundary at 43 cm in photographed core).
LFf23-A.3			25	49	Greyish brown (2.5Y 5/2) medium sand, as above with 10% medium, distinct jarosite mottles (2.5Y 7/4) and < 5% very diffuse black mottles; abrupt wavy boundary.
LFf23-A.4			49	75	Very dark grey to dark grey (5Y 3/1 to 4/1) sand with clay; very soft with many bluish grey clay and sandy bands and a distinct clay band at the base of the layer; medium sulfidic smell; abrupt boundary.
LFf23-A.5			75	83	Dark grey (5Y 4/1) medium sand to clayey sand; uniform and massive; sulfidic smell.
LFf24-A.1	**Lower Finniss -** Approximately 125 m offshore. **Subaqueous (1.0 m).**		0	28	Very dark brown (10YR 2/2) sapric peat with very dark grey clayey material in the upper few cm; colour grades to very dark greyish brown (10YR 3/2) in the lower part; clear to abrupt boundary.
LFf24-A.2			28	37	Dark olive grey (5Y 3/2) heavy clay; firm; some sub-horizontal planar cracks; common fine and medium roots and vertical pores to 3 mm with pale yellow lining; common coarse, decomposing root material; sulfidic smell; clear boundary.
LFf24-A.3			37	57	Very dark grey (5Y 3/1) heavy clay with prominent, planar vertical cracks associated with pale yellow jarosite mottling; medium roots (3-4 mm) running vertically and few fine roots; clear irregular boundary.

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
LFf24-A.4			57	76	Dark grey (5Y 4/1) heavy clay, slightly darker in the upper part; few sub-horizontal planar cracks; softer than above.
LFf24-B.1			0	17	Black (10YR 2/1) sapric peat grading to very dark brown (10YR 2/2) with monosulfidic gel at surface and the upper parts blackened by monosulfide, some coarser material close to the base; ~ 1cm of bleached, medium to coarse sand at the base of the layer; sharp wavy boundary.
LFf24-B.2	Approximately 60 m offshore. **Subaqueous (0.9 m).**		17	42	Very dark grey (5Y 3/1) heavy clay; common fine (vertical) roots in the upper part and decreasing in frequency with depth; contains well defined channels (to ~ 3-5 mm) and voids containing black monosulfide; diffuse boundary.
LFf24-B.3			42	74	Dark grey (5Y 4/1) heavy clay; very soft; very few fine roots in upper 10 cm; contain monosulfide in channels and voids, as above.

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

November and December 2011 sampling

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
LFe01-A.1	**Wallys Landing and Wetland -** Middle of drainage ditch located to the north east of the Finniss River. **Subaqueous (1.1 m).** Note: layer LFe01-A.2 was minimal in all but the described core (1 cm or less). Chip tray sample only.	UWS	0	11	Black (10YR 2/1, with a brownish hue) hemic peat with black gel at surface of some cores; saturated; abrupt boundary.
LFe01-A.2			11	15	Dark grey (10YR 4/1) medium and coarse rounded sand with some material from above and below; chip tray only; abrupt boundary.
LFe01-A.3			15	38	Dark olive grey (5Y 3/2) heavy clay with darker patches (with coarse remnant plant material) and 5 to 10% distinct greyish brown (2.5Y 5/2) jarosite mottle remnants; rare closed vertical and more common horizontal to sub-horizontal cracks with organic matter and sand grains; few medium roots, pH$_F$ 4-5; gradual boundary.
LFe01-A.4			38	59	Very dark grey (5Y 3/1) heavy clay or loamy clay, paler in the upper part; sticky; few closed vertical cracks with organic matter; pH$_F$ > 7; diffuse boundary.
LFe01-A.5			59	86	Very dark grey (5Y 3/1, brownish) heavy clay or loamy clay; few closed vertical cracks.
LFe01-D.1	Southern side of Finniss River channel on western side of Wallys Jetty, approximately one metre from the bank. **Subaqueous (0.6 m).** Note: this profile description does not match at all well with the 'd' sampling material.	UWS	0	12	Very dark brown (10YR 2/2) mixed materials, mainly clay with peat, coarse plant remains (laminae and coarse roots of Phragmites?), and coarse, angular gravel (to ~2 cm, road base?); few medium and coarse roots and laminae; clear boundary.
LFe01-D.2			12	51	Very dark greyish brown (10YR 3/2) sapric peat; some coarse and hard plant remains (looks fibric, but easily rubs to fine particles); more clayey towards the base; includes very thin layers of coarse to medium sand in sub-horizontal closed cracks which may also have some organic remains; few roots (vertical); weak sulfidic smell; gradual boundary.
LFe01-D.3			51	87	Black (2.5Y 2.5/1) heavy clay or loamy clay; not sticky; few sub-horizontal closed cracks with a thin layer of medium sand grains, vertical cracks not seen, but likely to be present in coarse structural units; slightly spongy; few medium roots running vertically.
LFe02-A.1	**Point Sturt North –** Approximately 60 m offshore. **Subaqueous (0.7 m).** Note: core lengths: 28, 34, 40, 47, 69 Depth to clay: 20, -, 39, 30, 57	Vibrating UWS	0	4	Pale brown (10YR 6/3) medium sand, some slightly coarse grains; uniform colour, loose; pH$_f$ 7+; sharp wavy boundary.
LFe02-A.2			4	13	Grey (2.5 Y 5/1) loamy sand with 30% black (2.5 Y 2/0) medium to coarse, clear, prominent mottles which tend to be in horizontal bands (but not in the core described); few brownish fine to medium roots; sulfidic smell (from black mottles?); pH$_f$ ~6; abrupt smooth boundary.
LFe02-A.3			13	25	Light grey (10YR 6/2) medium sand with the few darker horizontal bands, (one core has a weak yellowish band (pH$_f$ 4 .5)), few very bright yellow (jarosite) mottles; few fine to medium roots stained

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
					brown; pH$_f$ 5.5; clear smooth boundary.
LFe02-A.4			25	57	Dark grey (5Y 4/1) clayey sand with some darker (5Y 3/1) loamy sand to clayey sand diffuse layers to about 5 cm thickness; few coarse roots and plant remains; one core has 5 cm of dark brown peat; weak sulfidic smell; pH$_f$ ~7 with 5.5 to 4 or less around orange stained plant material; sharp smooth boundary.
LFe02-A.5			57	69	Greyish green (5G 4/2) heavy clay with some sand grains, upper centimetres have a darker (organic?) colour; soft and moist, but drier than above; pH$_f$ >7?
LFe02-B.1			0	12	Grey (5Y 5/1) medium sand, variable (10 to 40%) black mottles, in layers or along old, fine root channels, paler oxidised rind of a few millimetres at surface; few shell fragments (1 to 2 mm); few fine roots; clear boundary.
LFe02-B.2	Approximately 200 m offshore. **Subaqueous (1.0 m).**	Vibrating UWS	12	19	Light olive brown (2.5Y 5/3) medium sand, pale and bleached; few shell fragments to 2 to 3 mm; abrupt irregular to wavy boundary.
LFe02-B.3	Note: core lengths: 26, 28, 35, 37, 38 cm		19	25	Grey (5Y 5/1) clayey sand with black diffuse layering (3 to 5 mm); abrupt boundary.
LFe02-B.4			25	38	Grey (5Y 5/1) clayey sand, upper 4 cm very dark (5Y 3/1) with some black banding; common fine (to 2 millimetres, occasionally larger) shell fragments; one core had 5% hard carbonate from 35 to 37 cm).
LFe02-D.1			0	8	Grey (5Y 5/1) medium to coarse sand, some coarse grains; 30 to 40% black mottles in upper 5 cm, pale brown surface rind (oxidised); few coarse and more common fine roots; pH$_f$ 5.8; abrupt smooth boundary.
LFe02-D.2	Approximately 10 m offshore. **Subaqueous (0.5 m).**	Vibrating UWS	8	19	Greyish brown (2.5Y 5/2) clayey sand with 5% clear, prominent jarosite mottles; few dark brown, organic, old root channels; pH$_f$ ~5; gradual boundary.
LFe02-D.3	Note: core lengths: 37, 42, 53, 56 Depth to clay: 24, 36, 44, 46 Depth to dark grey layer: 16, 24, 28, 31		19	31	Light grey (2.5Y 7/2) medium sand to clayey sand with 10% jarosite mottles and several 3 to 10 mm layers of dark brown organic; few old root channels; few fine roots; pH$_f$ 3.9 to 4; sharp boundary.
LFe02-D.4			31	47	Dark grey (5Y 4/1) clayey sand to loamy sand with diffuse darker (organic?) layering; few prominent old root channels with yellow to orange brown (core) colours; few fine roots; pH$_f$ 3.9-4.2; sharp boundary.

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
LFe02-D.5			47	56	Greenish grey (5GY 5/1) heavy clay for 2 to 3 cm grading to hard $CaCO_3$ (2 to 5 mm, 5GY 6/1); the clay layer varies between 3 and 10 cm among the cores.
LFe03-A.1		Vibrating UWS	0	10	Dark grey (5Y 4/1) loamy saturated sand with many fine roots and 30% black mottles and bands.
LFe03-A.2			10	16	Grey brown (2.5Y 5/2) loamy sand to sandy loam with 5% black mottles along fine root channels with some darker bands. (pH_F > 7). Gradual boundary.
LFe03-A.3	**Milang -** Approximately 200 m offshore. **Subaqueous (0.9 m).**		16	19	Very dark grey brown (2.5Y 3/2) heavy clay with remnant fine roots and coarse reed roots and minor black mottling (pH_F ≈ 4.5). Sharp wavy boundary.
LFe03-A.4			19	42	Grey brown (10YR 5/2) loamy sand grading to dark grey (5Y 4/1) in lower 8 cm. 15 -30% prominent and distinct light yellowish (2.5YR 6/3) to yellow (2.5YR 7/6) jarosite mottles. layered brown and dark grey bands 5 t0 10 mm thick (pH_F ≈ 3.6). Sharp boundary.
LFe03-A.5			42	48	Very dark brown (10YR 2/2) sapric peat, spongy, no roots.
LFe03-B.1		Vibrating UWS	0	8	greyish brown (2.5Y 5/2) sand grading to light greyish brown (2.5Y 6/2) sand. Abrupt boundary.
LFe03-B.2			8	14	Dark greyish brown (2.5Y 4/2) sand grading to greyish brown (2.5Y 5/2) sand with 10% black mottles associated with old root channels in upper half of layer. Clear boundary.
LFe03-B.3	Approximately 550 m offshore. **Subaqueous (1.0 m).**		14	29	Grey (5Y 5/1) sand. Clear boundary.
LFe03- B.4			29	37	Grey (5Y 5/1) clayey sand that was slightly bluish at base (pH_F ≈ 4.5). Clear wavy boundary.
LFe03-B.1			37	48	Very dark grey (5Y 3/1) loamy sand with darker browner layers in upper 3 mm (pH_F > 7).
LFe04-A.1	**Tolderol -** Approximately 80 m offshore. **Subaqueous (1.0 m).**	Vibrating UWS	0	5	Very dark grey (5Y 3/1) medium sand; light olive brown (2.5Y 5/3) oxidised surface; clear, irregular boundary.
LFe04-A.2			5	12	Light brownish grey (2.5 Y 6/2) medium sand with very few (<5%) diffuse yellowish jarosite (?) mottles; few coarse root remnants; abrupt to clear boundary.

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
LFe04-A.3			12	45	Grey (5Y 5/1) medium sand, variable with greenish grey (5GY 5/1) bands of clay (up to 5 cm wide in described core); few coarse root remnants; abrupt boundary.
LFe04-A.4			45	67	Dark greenish grey (5GY 4/1) clay (heavy?); soft with some sandy lenses and prominent layers of shell fragments.
LFe04-C.1			0	15	Very dark grey (5Y 3/1) medium sand (with monosulfide) with 10-30% oxidised light olive brown (2.5Y 5/3) surface; abrupt, irregular boundary.
LFe04-C.2	Approximately 550 m offshore. **Subaqueous (1.3 m).**	Vibrating UWS	15	51	Grey (5Y 5/1) medium sand, uniform but with several thin darker band of clay or organic matter (in one core, there was a soft clay band 10 cm thick which was discarded); few mica flakes; clear boundary.
LFe04-C.3			51	62	Grey (5Y 5/1) medium sand with a slightly darker band at top; common bivalve shells (to ~ 5mm) and shell fragments; sharp boundary.
LFe04-C.4			62	68	Dark grey (5Y 4/1) heavy clay ; soft; some small, whole bivalve shells at the upper boundary.
LFe06-A.1			0	9	Dark greyish brown (2.5Y 4/2) medium sand with 5 – 15 % very diffuse dark (to black cores sometimes) mottles and some oxidised surface material; few bivalve shell fragments to 5 mm; rare medium roots and old organic matter (roots?); very weak sulfidic smell (?); clear irregular boundary.
LFe06-A.2			9	22	Greyish brown (2.5Y 5/2) medium sand, uniform but one core browner towards the base; few small shell fragments (<2 mm); abrupt wavy boundary.
LFe06-A.3	**Poltalloch -** Approximately 200 m offshore. **Subaqueous (1.1 m).**	Vibrating UWS	22	35	Dark grey (5Y 4/1) medium sand with < 5% diffuse black mottles or bands at upper boundary; rare brown mottles (old roots?); upper boundary (buried surface?) marked by whole bivalve shells (~ 5-8 mm); few shell fragments; diffuse boundary.
LFe06-A.4			35	55	Grey (5Y 5/10) medium sand with faint darker banding; more or less continuous with the layer above and similar, but with more prominent weak banding; boundary marked by a thin (~5 mm) band; abrupt even boundary.
LFe06-A.5			55	66	Dark grey (5Y 4/1) loamy sand with some lighter bands.
LFe06-B.1	Approximately 400 m offshore. **Subaqueous (1.5 m).** Top layer was variable in depth – 8, 10, 12, and 20 cm.	Vibrating UWS	0	10	Dark grey (5Y 4/1) medium sand with an oxidised surface (0-6 cm) over a very dark grey to black (5Y 2.5/1) layer (6 -10 cm) with some thin banding, especially in the upper few cm; rare shell fragments; sharp wavy boundary.
LFe06-B.2			10	35	Dark grey (5Y 4/1) sandy loam with clayey or sandy clay bands; very common bivalve shells (to 12 mm) and shell fragments (the

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
					described core has a few shells below 25 cm - this layer is thinner in the other three cores); weak sulfidic smell (?); abrupt boundary.
LFe06-B.3			35	47	Dark greenish grey (5 GY 4/1) heavy clay, uniform; soft; no shells.
LFe07-A.1		Vibrating UWS	0	12	0-6 cm: black (2.5Y2/0) organic clay, possibly with some black gel; soft; saturated; many fine to medium roots; sulfidic smell; grading to 6-12 cm very dark grey (2.5Y 3/1) loamy fine sand; saturated; common fine roots; abrupt boundary.
LFe07-A.2	**Waltowa -** Approximately 100 m offshore. **Subaqueous (0.6 m).**		12	22	Grey (2.5Y 5/1) loamy fine sand; 10% diffuse black mottles, few vertical along root channels; fine roots more prolific at base where there is also some organic accumulation; abrupt boundary.
LFe07-A.3			22	48	Very dark grey (2.5Y 3/1) fine sandy clay; soft; slightly spongy; few mica grains; sharp, wavy boundary.
LFe07-A.4			48	66	Dark grey (5Y 4/1) heavy clay; soft, slightly spongy; abrupt boundary.
LFe07-A.5			66	68	Greenish grey (5GY 6/1) and dark greenish grey (5GY 4/1) heavy clay with some pale mottles (CaCO$_3$) (2 cores only; chip tray samples).
LFe07-B.1		Vibrating UWS	0	25	Brown (10YR5/3) oxidised medium sand (1-3 cm)over black (2.5Y 2/1) medium sand (3-5 cm) grading to greyish brown (2.5Y 4/2) medium sand with < 5% diffuse brown mottles associated with old fine root channels, few medium roots; saturated; abrupt boundary.
LFe07-B.2	Approximately 200 m offshore. **Subaqueous (0.7 m).**		25	32	Very dark grey (5Y 3/1) sandy loam with faint layering; few mica grains; saturated, pH$_F$ > 7; clear boundary.
LFe07-B.3	Cores variable; two of five cores had only about 2 cm of the B.2 layer.		32	50	Dark grey (5Y 4/1) heavy clay (no sand grains felt, soft condition made texturing difficult), soft, slightly spongy and very moist, parts very spongy and probably organic with sandier material near base; abrupt boundary.
LFe07-B.4			50	58	Greenish grey (5GY 5/1) heavy clay with some coarse grains that could be CaCO$_3$; may have weak structure with crack infills of a lighter colour; abrupt boundary.
LFe07-B.5			58	61	Grey (5Y 5/1) heavy clay with rounded CaCO$_3$ gravel (3-10 mm).
LFe08-A.1		Push tube	0	8	Black (5Y 2.5/1) saturated sand. Clear boundary.
LFe08-A.2	**Meningie -** West of the Meningie jetty. Approximately 35 m offshore. **Subaqueous (0.6 m).**		8	26	Dark grey (5Y 4/1) sand with sulfidic smell and very dark grey bands at base. Tonguing boundary.
LFe08-A.3			26	43	Very dark grey (5Y 3/1) heavy clay with few fine roots. Grey sand in vertical coarse pores, common fine shell fragments and sulfidic smell. Clear gradual boundary.

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
LFe08-A.4			43	58	Dark grey to dark greenish grey (5Y 4/1 to 5GY 4/1) heavy clay with fine and medium roots and a sulfidic smell.
LFe08-A.5			58	60	Dark grey (5Y 4/1) sand with coarse roots and sulfidic smell (chip tray only).
LFe08-B.1		Push tube	0	20	Very dark grey (5Y 3/1) saturated sand grading to dark grey (5Y 4/1) sand. 2 of 4 cores had 2 cm of black (2.5Y 2/0) material at surface. Abrupt to clear, irregular boundary.
LFe08-B.2	Approximately 125 m offshore. **Subaqueous (1.1 m).**		20	30	Black (2.5Y 2/0) loamy sand with one core containing common small bivalves and shell fragments. Sharp wavy boundary.
LFe08-B.3			30	37	Very dark grey (2.5Y 3/0) soft heavy clay. Few fine medium pores with some dark monosulfidic staining. Gradual boundary.
LFe08-B.4			37	70	Dark grey (5Y 4/1) softer heavy clay. Strong sulfidic smell and few fine to medium pores.
LFe10-A.1		Vibrating UWS	0	10	Very dark brown (10YR 2/2) hemic peat, saturated; two cores had several cm of MBO gel at surface; $pH_F > 7$; abrupt wavy boundary.
LFe10-A.2			10	20	Dark grey (5Y 4/1) matrix and brown (10YR 4/3) mottles (10%) medium to coarse sand, clayey in the upper part; common fine roots with few strong brown coloured root channels; $pH_F > 3.5$ to 4.0; sharp wavy boundary.
LFe10-A.3	**Campbell Park -** Approximately 5 m offshore. **Subaqueous (0.2 m).**		20	57	Grey (5Y 5/1) heavy clay, upper 15 cm dark greenish grey (5GY 4/1) with 30% very prominent pale yellow (2.5Y 7/4, moist; 2.5 7/6 dry) jarosite mottles, especially along vertical root channels in the lower 20-57 cm section – where in one core a continuous vertical root channel 5mm wide extended from 40 cm to 57 cm (photograph taken of core and sampled for XRD); blocky and coarse columnar structure with some sandy lenses; sticky; abundant coarse roots; pH_F 3.5 to 4.0. sharp wavy boundary.
LFe10-A.4			57	65	Dark grey (5Y 4/1) heavy clay, sticky; few fine roots pH_F 3.5 to 4.0.
LFe10-C.1	Approximately 125 m offshore. **Subaqueous (0.7 m).**	Vibrating UWS	0	5	Very dark grey (2.5Y 3/1) heavy clay with brown (7.5YR 4/2) organic matter-rich at surface 3 cm and in a few cracks; black decomposing organic matter at surface soft and massive in lower part; strong sulfidic smell; pH_F 7; sharp boundary.
LFe10-C.2			5	18	Light olive brown (2.5Y 5/3) loamy sand, very variable and 20% parts coarsely greyer and browner; clayey organic matter (10%) and root concentrations in upper 5 cm and lower 5 to 10 cm; pH_F 6;

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
					abrupt boundary.
LFe10-C.3			18	30	Grey (5Y 5/1) loamy sand, darker grey in the upper 10 cm; common medium roots, which are slightly blackened and with diffuse staining of surrounding soil; pH_F 5; gradual boundary.
LFe10-C.4			30	45	Grey (5Y 5/1) loamy sand, as above but with few old roots; pH_F 4-5.
LFe10-D.1			0	5	Black (5Y 2.5/1) surface grading to dark grey (5Y 4/1) at 2 cm, brown (10YR 5/3) loamy sand; likely surface wash; sharp boundary. pH_F >7.
LFe10-D.2	Approximately 300 m offshore. **Subaqueous (0.9 m).** N.b. the soil cores sampled at this site showed high variability. See the description notes.	Vibrating UWS	5	17	Olive brown (2.5Y 4/3) matrix grading to olive grey (5Y 4/2) loamy sand with many fine roots and a thin clay lens near base; abrupt boundary. pH_F >7.
LFe10-D.3			17	35	Grey (5Y 5/1) soft and hard carbonate nodules (20%) with some greenish grey (5G 5/1) clay mixed in the upper few cm and sandy loam with nodules at base; rare coarse roots. pH_F >7.
LFe12-A.1			0	8	Olive grey (5Y 5/2) loamy sand overlain by up to 5 cm of black (5Y 2.5/N) loamy sand with weak jarosite mottles and few fine rootlets. Sharp boundary.
LFe12-A.2			8	21	Grey (5Y 5/1) clayey loamy sand with few fine rootlets and pale yellow diffuse jarosite mottles (pH<4.4). More distinct yellow mottles associate with clumped rootlets.
LFe12-A.3	**Loveday Bay -** Approximately 300 m offshore. **Subaqueous (1.2 m).**	Push tube	21	33	Grey (5Y 5/1) sandy clay with grey (5Y 6/1) clayey sand lenses associated with dark yellowish brown (10YR ¾) distinct mottles (pH≈5).
LFe12-A.4			33	49	Grey (5Y 5/1) sandy clay with some sandier layers.
LFe12-A.5			49	72	Dark grey (5Y 4/1) fine sandy clay. Soft and spongy.
LFe12-B.1			0	10	Black (5Y 2.5/1) sand to coarse sand overlain by 1 cm of olive brown (2.5Y 4/3) sand. Sharp boundary.
LFe12-B.2	Approximately 250 m offshore. **Subaqueous (1.0 m).**	Push tube	10	12	Compressed layer of black (Gley1 2.5/N) medium clay (was surface layer during sampling 'a').
LFe12-B.3			12	38	Mix of black (Gley1 2.5/N) to very dark grey (Gley1 3/N) loamy sand with grey (5Y 5/1) sand.

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
LFe12-B.4			38	60	Dark grey (2.5Y 4/1) grading to grey (2.5Y 5/1) loamy sand.
LFe12-B.5			60	72	Olive grey (5Y 4/2) sandy clay loam to medium clay with moderate sulfuric smell and some clayey and sandy lenses.
LFe12-C.1			0	13	Black (5Y 2.5/1) loamy sand grading to grey (5Y 5/1). Loose, saturated and minor rootlets and black organic matter.
LFe12-C.2	Approximately 50 m offshore. **Subaqueous (0.7 m).**	Push tube	13	32	Light brownish grey (2.5Y 6/2) with loamy sand with indistinct diffuse jarosite mottles (pH≈4) and medium to coarse phragmites roots.
LFe12-C.3			32	45	Grey (5Y 5/1) loamy sand with medium phragmites roots.
LFe13-A.1					Up to 20 cm of black, monosulfidic water. This material was drawn off, mixed and placed into chip trays and two 125 ml plastic bottles. The bottles were frozen for AVS analysis. No 70 ml vial sample.
LFe13-A.2			0	13	Black (2.5Y 2/0) monosulfidic fibric peaty material with coarse and fine roots of Phragmites, some clay and sand size material; saturated; strong sulfidic smell; clear boundary.
LFe13-A.3	**Tauwitchere -** Northern side of Tauwitchere Island in tall (> 2 m) reeds. Approximately 30 m offshore. **Subaqueous (0.5 m).**	UWS	13	31	Dark to very dark grey (5Y 4/1 to 5/1) loamy sand with 3 to 20% diffuse, coarse black mottles; saturated; coarse organic matter and Phragmites roots; common shell fragments; strong sulfidic smell; clear to gradual boundary.
LFe13-A.4			31	47	Dark grey (5Y 4/1) loamy sand; common shell fragments; strong sulfidic smell; clear boundary.
LFe13-A.5			47	65	Grey to dark grey (5Y 5/1 to 4/1) upper 10 cm is sandy clay loam or sandy light clay overlying loamy to clayey sand; few shell fragments; few coarse and medium live roots; strong sulfidic smell.
LFe15-B.1			0	7	Black (5Y 2.5/1) sandy grits feel (30%) in MBO gel (n value >2), which surrounds small lumps of clay with medium polyhedral structure; sharp, smooth boundary (pH > 7).
LFe15-B.2	Soil profile located on the northern side of the creek bed. **Subaqueous (1.0 m).**	UWS	7	14	Grey (5Y 5/1) loamy sand but sloppy with n value 1.4 – 2 and diffuse pale yellow (5Y 7/4, 10%) mottles along root channels; clear, smooth boundary (pH 7). *Not sampled but placed in chip-tray.*
LFe15-B.3			14	32	Dark grey (5Y 4/1) sandy loam with prominent, sharp pale yellow (5Y 7/4, 20%) mottles, especially along old root channels (pH 3.5 to 4); clear, wavy boundary.
LFe15-B.4			32	39	Dark grey (5Y 4/1) sandy clay with diffuse yellowish-brown (7.5YR 5/6, 10%) mottles; clear, wavy boundary. *Not sampled but placed*

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
					in chip-tray.
LFe15-B.5			39	84	Dark grey (5Y 4/1) sandy clay with fine shell fragments.
LFe15-C.1			0	14	Black (5Y 2.5/1) sandy gel; medium polyhedral structure; sharp, smooth boundary.
LFe15-C.2			14	34	Light olive grey (5Y 6/2) medium clay (also some thin layers with heavy clay) with distinct and prominent pale yellow (5Y 7/4, 15%) and distinct yellow (10YR 6/8, 10%) mottles; clear, wavy boundary.
LFe15-C.3	Soil profile located in the middle of the creek bed. **Subaqueous (1.2 m).**	UWS	34	60	Grey heavy clay (2.5Y 5/1) with prominent pale yellow (5Y 7/4, 10%) and distinct brownish yellow (10YR 6/8, 10%) mottles; clear, wavy boundary.
LFe15-C.4			60	95	Dark grey (5Y 4/1) sandy clay with fine (2-5mm) and medium (5-10mm) shell fragments (large shell fragment placed in chip-tray).
LFe15-C.5			60	70	Dark grey (5Y 4/1) sandy clay with fine shell fragments and minor coarse shell fragments (5 %).
LFe17-A.1			0	10	Dark grey (5Y 4/10 loamy sand with about 30% black mottles and bands; decomposing organic matter; saturated; many fine roots; pH_F > 7; gradual boundary.
LFe17-A.2			10	16	Greyish brown (2.5Y 5/2) loamy sand to sandy loam with 5% black mottles along root channels and some darker banding; pH_F ~ 4.5; sharp, wavy boundary.
LFe17-A.3	Point Sturt South - Approximately 50 m offshore. **Subaqueous (0.7 m).**	Vibrating UWS	16	19	Very dark greyish brown (2.5Y 3/2) heavy clay (up to 10 cm thick in another core) with few black mottles; some coarse remnants of reed roots and few fine roots; pH_F ~ 4.3; sharp wavy boundary.
LFe17-A.4			19	42	Greyish brown (10YR 5/2) loamy sand grading to dark grey (5Y 4/1) in lower 8 to 10 cm (this grey layer was sampled separately in the chip trays to confirm its low pH); 15 to 30% distinct and prominent light yellowish brown (2.5Y 6/3) to yellow (2.5Y 7/6) jarosite mottles; 10% layered brown and dark grey bands (5-10 mm); pH_F 3.6-3.9, ~ 4.5 in dark grey layer; sharp boundary.
LFe17-A.5			42	48	Very dark brown (10YR 2/2) to black (10YR 2/1) sapric peat; spongy (not coorongite); no roots.
LFe17-B.1			0	8	Upper 0-5 cm greyish brown (2.5Y5/2) medium sand with a wavy boundary to (5-8 cm) of light greyish brown (2.5Y 6/2) medium sand; abrupt, wavy boundary.
LFe17-B.2	Approximately 140 m offshore. **Subaqueous (0.9 m).**	Vibrating UWS	8	14	Dark greyish brown (2.5Y 4/2) medium sand grading to greyish brown (2.5Y 5/2) medium sand; upper part has 10% black mottles associated with old root channels; pH_F ~ 7; clear boundary.

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
LFe17-B.3			14	29	Grey (5Y 5/1) medium sand, uniform without mottling or evidence of old jarosite mottles; pH_F ~ 4.5; clear, wavy boundary.
LFe17-B.4			29	37	Grey (5Y 5/1) clayey sand, slightly darker than above and slightly bluish at the base with four slightly darker bands; pH_F > 7; clear, wavy boundary.
LFe17-B.4			37	48	Very dark grey (5Y 3/1) loamy sand with several darker and possibly browner layers n upper 3 cm; probably becomes paler grey beyond 45 cm (one core reached this depth).
LFe19-A.1			0	16	Greyish brown (10YR 5/2) loamy sand and darker sandy loam with common fine rootlets in the upper half of the layer. 5-10% yellow jarosite mottles throughout but more frequent at the base of the layer. Abrupt wavy boundary.
LFe19-A.2	**Dog Lake -** Approximately 130 m offshore. **Subaqueous (0.9 m).**	Push tube	16	24	Grey brown (2.5Y 5/2) loamy sand to clayey sand with up to 10-20% coarse jarosite mottles with diffuse edges and prominent near lower boundary. Clear wavy boundary.
LFe19-A.3			24	46	dark greenish grey (5GY 4/1) soft loamy clay with few fine prominent jarosite mottles associated with fine roots in the top 1-2 cm of layer. Paler at base. Clear boundary.
LFe19-A.4			46	53	Olive grey (5Y 4/2) heavy clay with some darker horizontal layer and some sand and mica. Slightly spongy and relatively dry.
LFe19-B.1			0	13	Black (2.5Y 2/4) monosulfidic surface layer over very dark (2.5Y 3/2) saturated slightly spongy clay.
LFe19-B.2			13	27	Very dark (2.5Y 3/2) loamy clay grading to darker grey. Very soft and saturated. Clear boundary.
LFe19-B.3	Approximately 400 m offshore approximately 1.5 km closer to the terminus of Dog Lake than site LFe19-A. **Subaqueous (0.9 m).**	Push tube	27	45	Dark grey (10 YR 5/2) soft loamy clay with 5 -20% jarosite mottles mainly near the base of the layer. Clear boundary.
LFe19-B.4			45	56	Dark grey brown (10YR 4/2) heavy clay with 30% dark greenish grey (5GY 4/1) coarse mottles. Much dryer than overlying layers with few prominent fine jarosite mottles near upper boundary. One core was predominantly dark greenish grey.
LFe20-A.1	**Boggy Lake -** Approximately 300 m offshore. **Subaqueous (0.9 m).**	UWS	0	10	Black (2.5Y 2/0) clay; very soft and sticky with monosulfide gel; decomposing plant remains; sulfidic smell; abrupt irregular boundary.
LFe20-A.2	These clayey samples were all too soft and wet to texture properly. All likely to be heavy clays as no coarse particle were felt.		10	17	Dark greyish brown (10YR 4/2) clay; two cores have a distinct brown layer in upper 2 cm; soft and sticky; few small, distinct, prominent jarosite mottles appear towards the base; pH_F 4.2; gradual boundary.

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
LFe20-A.3			17	30	Greyish brown (10YR 5/2) clay with 30% clear, medium, prominent jarosite mottles, coarser towards the base; soft and sticky, but a little firmer than above; weak residual structure which is mainly near vertical in two cores; few medium roots; pH$_F$ 3.6; clear , irregular boundary.
LFe20-A.4			30	55	Dark grey (5Y 4/1) clay; soft and sticky; few to rare jarosite mottles along vertical root channels (5 mm diameter); few medium roots; very weak residual structure; diffuse boundary.
LFe20-A.5			55	89	Dark greenish grey (5GY 4/1) clay; very soft and sticky; may include some fine sand towards the base.
LFe20-B.1			0	8	Very dark greyish brown (10YR 3/2) heavy clay bathed in black monosulfide; medium polyhedral structure; firm; some fine roots; clear boundary.
LFe20-B.2			8	16	Very dark greyish brown (2.5Y 3/2) heavy clay with brown and black (monosulfide) staining along cracks and 5% jarosite mottles; clear boundary
LFe20-B.3	Approximately 300 m offshore. **Subaqueous (0.9 m).**		16	38	Dark greyish brown (2.5Y 4/2) heavy clay with up to 20% diffuse but prominent jarosite mottles; some sandy material, probably in old cracks; firm; many fine and few medium roots; pH$_F$ ~ 4.2); clear boundary.
LFe20-B.4			38	58	Dark grey (5Y 4/1) heavy clay with some mica flakes; sub-vertical cracks (virtually closed); few sandy lenses, probably filling old cracks; abrupt boundary.
LFe20-B.5			58	66	Dark grey (5Y 4/1) sandy loam with few black, circular mottles with diffuse edges; some mica flakes; abrupt boundary.
LFe20-B.6			66	80	Dark olive grey (5Y 3/2) heavy clay, probably with very coarse, indistinct, brown (organic?) mottles; mica flakes; slightly spongy but firm; medium sized, hard carbonate cemented nodules and some lighter coloured patches (moderate reaction to HCl); medium to coarse angular blocky structure (?).
LFe21-A.1		Vibrating UWS	0	16	Dark grey (5Y 4/1) medium sand, paler towards the base (5Y 5/1) and in diffuse patches with an oxidised surface; few roots and black root channels; clear boundary.
LFe21-A.2	**Windmill Site -** Approximately 100 m offshore. **Subaqueous (0.5 m).**		16	32	Dark grey (5Y 4/1) medium sand with loamy sand and thin clay layers with very dark grey material (5Y 3/1) in a few thin bands; few brown remnant root channels and layers and a black band in the lower part; few medium to coarse roots; firmer than above or below; weak sulfidic smell (?); abrupt boundary.
LFe21-A.3			32	59	Grey (5Y 5/1) loamy sand; uniform; few medium to coarse roots.
LFe21-B.1	Approximately 250 m offshore. **Subaqueous (0.7 m).**		0	21	Light brownish grey (2.5Y 6/2) medium sand with a brown oxidised

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
	Sample B.2 was only 1, 3 and 6 cm thick in the other cores.				(10YR 5/3) surface, 5 -20% very dark grey (5Y 5/1) to black layers (1-2 cm), mostly in the upper half and around old root channels, and <5% brown mottles; few medium roots; small bivalve shells and fragments from 20 to 21 cm; sharp wavy boundary.
LFe21-B.2			21	44	Very dark grey (2.5Y 3/1) loamy light clay; very spongy (coorongite); coarsely layered with slightly darker and lighter bands; a thin band of this material occurred at 19-20 cm (also in other cores); sharp, wavy boundary.
LFe21-B.3			44	54	Dark grey (5Y 4/1) medium sand to loamy sand with common shell fragments at the upper interface and few fragments below this; finely brown organic (?) layers becoming coarser, more olive coloured layers with depth.
LFe23-A.1			0	7	Black (5Y 2.5/1) medium sand with monosulfide staining; saturated; few medium to fine roots (blackenend0 and few very fine 'straight' roots; abrupt, irregular boundary.
LFe23-A.2	Lower Currency - Approximately 60 m offshore. **Subaqueous (0.9 m).**	UWS	7	26	Greyish brown (2.5Y 5/2) medium sand with ~ 10% pale, weak jarosite mottles and darker mottles towards the base (similar to A.3 layer); rare prominent brown mottle and black medium roots extending from above; gradual boundary.
LFe23-A.3			26	40	Grey (5Y 5/1) medium sand with few diffuse darker bands; abrupt boundary.
LFe23-A.4			40	54	Grey (5Y 5/1) medium sand to loamy sand; upper boundary marked by a darker grey band, coarse dark grey (5Y 4/1) banding below which may be slightly more clayey; slightly firmer than above.
LFe24-A.1			0	28	Very dark brown (10YR 2/2) sapric peat with very dark grey clayey material deposited in the upper 3 to 5 cm (in ¾ of profiles), colour grades to very dark greyish brown (10YR 3/2) in the lower 10 cm; remnant laminae and coarse roots; common fine roots especially at the interface with the layer below; sulfidic smell; clear boundary.
LFe24-A.2	Lower Finniss - Approximately 125 m offshore. **Subaqueous (1.0 m).**	UWS	28	42	Dark grey (5Y 4/1) heavy clay grading from brownish to greyish with 20 to 30% pale olive (5Y 6/3) jarosite mottles concentrated towards the lower half; many fine roots in the upper few centimetres, medium and fine roots common running along vertical closed cracks; pH_F ~ 4.5; gradual boundary.
LFe24-A.3			42	56	Very dark grey (5Y 3/1) heavy clay; few vertical cracks with medium and fine roots; firmer than above and below; sulfidic smell; pH_F ~4.5-5 in upper part.
LFe24-A.4			56	87	Dark grey (5Y 4/1) heavy clay, slightly darker in upper part, and nearer 5Y 4/1 at base; very soft.

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
LFe24-B.1	Approximately 60 m offshore. **Subaqueous (0.9 m).**		0	30	Black (10YR 2/1) towards very dark brown peat, blackened by monosulfide in the upper 15 cm (2 of 4 cored had only 15 cm of this layer) over increasingly clayey peat of a very dark grey (10YR 3/1) colour (without monosulfide); active roots rare; lower boundary marked by a very thin layer (1-2 mm) of medium to coarse sand (bleached); sharp boundary.
LFe24-B.2			30	50	Dark grey (5Y 4/1) heavy clay; very soft; sticky; common very fine, straight roots in one core; rare medium root channels; arbitrary boundary.
LFe24-B.3			50	69	As above, no roots.

May and June 2011 sampling

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
LFd01-A.1	**Wallys Landing and Wetland -** Middle of drainage ditch located to the north east of the Finniss River. **Subaqueous (1.1 m).**	UWS	0	17	Black (2.5Y 2/0) loamy clay, no sand grains in upper part; fine gravel (to 5 mm) in the lower part; spongy when worked; gradual boundary.
LFd01-A.2			17	55	Dark grey (5Y 4/1) heavy clay with 10% pale yellow jarosite mottles between 28 and 45 cm; gritty coarse sand and fine to medium gravel (to 10 mm) in the upper 5 cm; moderately soft; few medium roots; pH_F about 4.5; diffuse boundary.
LFd01-A.3			55	89	Black (5Y 2.5/1) heavy clay or loamy clay; strong planar vertical cracks and weaker horizontal planes/closed cracks, probably with remnant organic matter or fine roots maintaining the surfaces and preserving plans of weakness, some have some sand grains in these cracks; soft and spongy.
LFd01-D.1	Southern side of Finniss River channel on western side of Wallys Jetty, approximately one metre from the bank. **Subaqueous (0.6 m).**	UWS	0	10	Very dark grey (10YR 3/1) peaty clay, with decomposing organic matter at the surface, some harder, lumpy material near the surface gradually becoming soft as it merges with material below; no sand grains; few fine roots; gradual boundary.
LFd01-D.2			10	40	Black (5Y 2.5/2) clay with some diffuse darker bands; soft, sticky, no sand grains; few fine roots; arbitrary boundary.
LFd01-D.3			40	84	Black (2.5Y 2/0) clay as above with no sand grains and a few fine roots.
LFd02-A.1	**Point Sturt North –** Approximately 60 m offshore. **Subaqueous (0.7 m).**	Vibrating UWS	0	19	Greyish brown (2.5Y 5/2) medium sand with 30% black mottles associated with decomposing organic matter and roots; two of four cores had oxidised surfaces to 3 to 5 cm (pale brown, 10YR 6/3); clear boundary.
LFd02-A.2			19	33	Light brownish grey (10YR 6/2) medium sand with three clayey lenses about 1 cm thick at 22, 27 and 32 cm (very dark greyish brown, 2.5Y 3/2) and containing old root material; strong brown staining associated with old medium roots; 10% prominent yellow and diffuse weak jarosite mottles also associated with old roots; pH_F 4.2 to 4.5; sharp boundary.
LFd02-A.3			33	61	Dark grey (5Y 4/1) loamy sand with clayey lenses; darker bands and few old medium roots stained strong brown; abrupt boundary.

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
LFd02-A.4			61	78	Greenish grey (upper part 5G 5/1, and 5GY 5/1) heavy clay; soft carbonate in small patches; drier than above.
LFd02-B.1		Vibrating UWS	0	7	Pale brown (10YR 6/3) medium sand, speckled, and probably washed on (two of four cores); chip tray only; sharp wavy boundary.
LFd02-B.2		Vibrating UWS	7	23	Dark grey (5Y4/1) medium sand with 30% black mottles, especially towards the top where there is residual organic matter (old surface); abrupt to clear boundary.
LFd02-B.3	Approximately 200 m offshore. **Subaqueous (1.0 m).**	Vibrating UWS	23	36	Light brownish grey (10 YR 6/2) medium sand, speckled, with a darker brown stained layer in the lower two centimetres; abrupt boundary.
LFd02-B.4		Vibrating UWS	36	59	Dark grey (5Y 4/1) medium sand with several horizontal black bands (5%) to about 1 cm thick; possible weak sulfidic smell; clear boundary.
LFd02-B.5		Vibrating UWS	59	78	Dark grey (5Y 4/1) medium sand, darker than above but not 5Y 3/1 with many very dark grey bands (40%); weak sulfidic smell; and rare shell fragments.
LFd03-A.1		Vibrating UWS	0	10	Very dark grey (5Y 3/1) loamy sand with residual black organic matter, decomposing fine roots and 30% black mottles especially at base of layer; pH 6.5-7; sharp, irregular boundary.
LFd03-A.2		Vibrating UWS	10	16	Greyish brown (2.5Y 5/2) loamy sand to sandy loam with 5% small (1-2 mm) black mottles along fine root channels; wet; sharp, wavy boundary.
LFd03-A.3	**Milang -** Approximately 200 m offshore. **Subaqueous (0.9 m).**	Vibrating UWS	16	21	Olive brown (2.5Y 4/3) heavy clay band which perches water and probably prevents it from entering the layers below; contains fragments of reed leaves and root material; few jarosite mottles; chip tray only; sharp boundary.
LFd03-A.4		Vibrating UWS	21	47	Greyish brown (10YR 5/2) loamy sand, paler in the upper third and grey (5Y 5/1) in the lower 10 cm; 30% prominent jarosite mottles and 10% layered brown mottles; pH 3.6 to 4.2; sharp wavy boundary.
LFd03-A.5		Vibrating UWS	47	65	Very dark brown (10Y 2/2) sapric peat (not coorongite) but has a similar spongy feel; no roots.

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
LFd03-B.1	Approximately 550 m offshore. **Subaqueous (1.0 m).**	Vibrating UWS	0	6	Dark grey (5Y 4/1) medium sand, speckled black and black towards the base; weak sulfidic smell; pH >7; sharp, irregular boundary.
LFd03-B.2			13	20	Light brownish grey (2.5Y 6/2) medium sand with very diffuse, yellowish remnant jarosite mottles and rare strong brown staining associated with a root; pH 4.5; abrupt, even boundary.
LFd03-B.3			20	48	Grey (10YR 5/1) medium sand, speckled with some yellow material; two or three very diffuse slightly darker layers (1 to 2 cm); pH 4.5; clear boundary.
LFd03- B.4			48	53	Dark grey (5Y 4/1) loamy sand, with a black clayey lens (less than 1 cm); chip tray only.
LFd04-A.1	**Tolderol -** Approximately 80 m offshore. **Subaqueous (1.0 m).**	Vibrating UWS	0	10	Dark grey (5Y 4/1) medium sand, parts diffusely darker and paler; saturated; pH > 7; clear boundary.
LFd04-A.2			10	20	Light brownish grey (2.5Y 6/2) medium sand with 10% diffuse jarosite mottles and 10% darker mottles, brownish around old root channels at the base where there may be a slight clay increase; pH ~4.5; abrupt boundary.
LFd04-A.3			20	38	Grey (5Y 5/1) medium sand, uniform, with rare shells fragments (?); rare live roots (2 to 3 mm diameter); pH ~4.5; abrupt boundary.
LFd04-A.4			38	77	Dark greenish grey (5Y 4/1 to 5GY 4/1) clay with three sandy bands (to about 3 cm) each with shells (to 10 mm) and shell fragments; slightly soft; pH > 7.
LFd04-C.1	Approximately 550 m offshore. **Subaqueous (1.3 m).**	Vibrating UWS	0	23	Very dark grey (2.5Y 3/2) medium sand with 20 to 40% light yellowish brown (2.5Y 6/3) patches in 2 of 4 cores; few diffuse black (2.5Y 2/0) mottles at base; sharp boundary.
LFd04-C.2			23	47	Grey (5Y 5/1) medium sand with < 5% diffuse black mottles; abrupt boundary.
LFd04-C.3			47	70	Dark grey (5Y 4/1 to 5/1) soft sandy clayey band (2 to 6 cm) over grey (5Y 5/1) medium sand; shelly layers in upper clayey band and at about 65 cm.
LFd06-A.1	**Poltalloch -** Approximately 200 m offshore. **Subaqueous (1.1 m).**	Vibrating UWS	0	18	Dark grey (10YR 4/1) medium sand with 20% black (2.5Y 2/0) mottles and light olive brown (2.5Y 5/3) surface (oxidised) and a rare brownish staining associated with old roots; few shell fragments towards base; rare black medium roots; oxidised quickly;

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
					abrupt boundary.
LFd06-A.2			18	35	Light olive brown (2.5Y 5/3) medium sand with <2 % diffuse black root channels; shell fragments to 5 mm throughout; abrupt boundary.
LFd06-A.3			35	48	Greyish brown (2.5Y 5/2) medium sand with 5% to diffuse black (2.5Y 2/0) mottles and diffuse darker mottles, often in bands; shell fragments to 1 to 2 mm throughout; probably an old surface; clear boundary.
LFd06-A.4			48	59	Grey (10YR 5/1) medium sand with very faint, diffuse darker patches; no shells; clear boundary.
LFd06-A.5			59	83	Dark grey (5Y 4/1) loamy sand; uniform; no shells.
LFd06-B.1		Vibrating UWS	0	12	Dark greyish brown (2.5Y 4/2) medium sand, light olive brown (2.5Y 5/3) oxidised surface and deeper in one core; no shells (?); sharp boundary.
LFd06-B.2	Approximately 400 m offshore. **Subaqueous (1.5 m).** Top layer was variable in depth – 8, 10, 12, and 20 cm.		12	19	Black (2.5Y 2/0) loamy to clayey medium sand, slightly banded horizontally; rare whole shells; sharp boundary.
LFd06-B.3			19	47	Grey (5Y 4/1) sandy loam with a sandy clay section from 28 to 38 cm; many shells throughout, 10 to 12 mm bivalves; sharp boundary.
LFd06-B.4			47	70	Dark greenish grey (5GY 4/1) heavy clay possibly with blocky structure; uniform; no shells.
LFd07-A.1		Vibrating UWS	0	18	Upper 5 cm black (2.5Y 2/0) decomposing organic matter; loose; saturated; a few fine roots, over grey to dark grey (5Y 4/1) sandy loam (sand finer than medium); 10% black root channels and diffuse brown and dark bands associated with organic matter; this layer oxidised rapidly; clear boundary.
LFd07-A.2	**Waltowa -** Approximately 100 m offshore. **Subaqueous (0.6 m).**		18	50	Dark olive grey (5Y 3/2) light clay or loamy clay, very spongy, soft, sticky; uniform but with small gastropod shells (less than 2 mm) in the lower 3 cm; two 1 cm bands of brown decomposing organic matter; weak diffuse dark and brownish bands in the upper half; saturated; sharp boundary.
LFd07-A.3			50	69	Greenish grey (5GY 5/1) light clay or loamy clay with diffuse, slightly lighter mottles in upper part; very spongy, soft, sticky; sharp boundary.

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
LFd07-A.4			69	76	Greenish grey (5G 6/1) fine calcareous nodules in a heavy clay matrix.
LFd07-B.1	Approximately 200 m offshore. **Subaqueous (0.7 m).**	Vibrating UWS	0	30	Black (2.5Y 2/0) loamy sand, organic in the top 10 cm and oxidised in the surface 2 cm; wet, sulfidic smell; 10 to 22 cm is dark olive grey (5Y 3/2) loamy sand, less organic than above and grading from 22 to 30 cm to dark grey (5Y4/1) sand with some organic bands (less than 1 cm thick); clear boundary.
LFd07-B.2			30	37	Black (5Y 2.5/1) loam, some mica flakes; layered with darker bands, some accumulated organic matter; slightly spongy; sharp under even boundary.
LFd07-B.3			37	53	Dark grey (5Y 4/1) light clay; soft, spongy, sticky, firmer than above; some sandy material included near base; sharp boundary.
LFd07-B.4			53	62	Greenish grey (5G 5/1) heavy clay with paler (calcareous) mottles near the base; sharp boundary.
LFd07-B.5			62	70	Greenish grey (5G 5/1) heavy clay with hard calcareous grit to 1 cm, some angular.
LFd08-A.1	**Meningie -** West of the Meningie jetty. Approximately 35 m offshore. **Subaqueous (0.6 m).**	Vibrating UWS	0	12	Greyish brown (5Y 3/2) medium sand; surface very wet; very loose in 2 cores; surface 2 cm with many fine roots; < 2% diffuse brown mottles; strong sulfidic smell, clear boundary.
LFd08-A.2			12	21	Grey (5Y 5/1) loamy sand to medium sand with several weak, diffuse dark bands (5%); sulfidic smell; abrupt boundary.
LFd08-A.3			21	33	Very dark grey (5Y 3/1) heavy clay, soft, very sticky and slightly spongy; upper few cm with common Phragmites root remnants; many small (2 mm) gastropod shells in upper 4 cm; sandy layer at 38-40 cm; very strong sulfidic smell; gradual boundary.
LFd08-A.4			33	60	Dark grey (5Y 4/1) heavy clay, but with an olive shade; very strong sulfidic smell.
LFd08-B.1	Approximately 125 m offshore. **Subaqueous (1.1 m).**	Vibrating UWS	0	16	Black (2.5Y 2/0) 0-7 cm grading to greyish brown (2.5Y 5/2) 7-16 cm medium sand; loose; few bivalve shells and shell fragments; abrupt boundary.
LFd08-B.2			16	23	Black (5Y 2.5/1) loamy sand with 30% very dark grey (5Y 3/1) in

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
					strong layers; abrupt boundary
LFd08-B.3			23	56	Dark greenish grey (5GY 4/1) light clay; uniform; soft; sulfidic smell.
LFd10-A.1			0	12	Very dark brown (10YR 2/2) hemic peat, saturated; one core had several cm of black gel at surface; pH_F> 7; abrupt boundary.
LFd10-A.2	**Campbell Park -** Approximately 5 m offshore. **Subaqueous (0.2 m).**	Vibrating UWS	12	19	Dark grey (5Y 4/1) and dark yellowish brown (10YR 4/4) medium to coarse sand, clayey in the upper part; common fine roots with strong brown coloured root channels; sharp boundary.
LFd10-A.3			19	63	Grey (5Y 5/1) heavy clay, upper few cm dark greenish grey (5G 4/1) with 25% pale yellow (2.5Y 7/4) jarosite mottles along vertical root channels; possible blocky and coarse columnar structure with some sandy lenses; sticky; abundant coarse roots; pH_F 4.
LFd10-C.1			0	10	Very dark greyish brown (2.5Y 3/2) heavy clay with brown (7.5Y 4/4) organic matter at surface 2-3 cm and in a few cracks; black decomposing organic matter at surface and 5% jarosite mottles in lower part; soft and massive in lower part; moderate sulfidic smell; pH_F 6; sharp boundary.
LFd10-C.2	Approximately 125 m offshore. **Subaqueous (0.7 m).**	Vibrating UWS	10	29	Light olive brown (2.5Y 5/3) loamy sand, very variable materials with 15% distinct pale yellow jarosite mottles, and parts coarsely greyer and browner; clayey organic matter and root concentrations in upper 10 cm and lower 5 to 10 cm; pH_F 4.5; abrupt boundary.
LFd10-C.3			29	50	Grey (5Y 5/1) loamy sand, darker grey in the upper 3-4 cm; common medium roots which are blackened and with diffuse staining of surrounding soil; pH_F 3.9; gradual boundary.
LFd10-C.4			50	70	Grey (5Y 5/1) loamy sand, as above but with few old roots; pH_F 4.
LFd10-D.1			0	5	Very dark grey (5Y 3/1 speckled black) surface grading to grey (5Y 5/1) at 3 cm, greyish brown (10YR 5/2) loamy sand; probably surface wash on, 12 cm deep in one core; sharp boundary.
LFd10-D.2	Approximately 300 m offshore. **Subaqueous (0.9 m).** N.b. the soil cores sampled at this site showed high variability. See the description notes.	Vibrating UWS	5	12	Greyish brown (2.5Y 5/2), black (5Y 2.5/2) at upper part (old surface with many fine roots) loamy sand with a thin clay lens near base; abrupt boundary.
LFd10-D.3			12	30	Grey (5Y 5/1) soft and hard carbonate nodules with some greenish grey (5G 5/1) clay mixed in the upper few cm and sandy loam with nodules at base; rare coarse roots.

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
LFd12-A.1	**Loveday Bay -** Approximately 300 m offshore. **Subaqueous (1.2 m).**	Vibrating UWS	0	10	Greyish brown (2.5Y 5/2) loamy sand with black (5Y 2.5/1) surface 2 cm; possible very weak and diffuse jarosite mottles; saturated; abrupt boundary.
LFd12-A.2			10	18	Grey (5Y 5/1) sandy loam to sandy clay loam, soft with some sandier and more clayey layers; remnant jarosite mottles (pH 4.2 in mottles) following old root channels in the lower 5 cm of one core; clear to gradual boundary.
LFd12-A.3			18	30	Dark grey (5Y 4/1) or slightly paler sandy clay with clayey sand lenses; soft; very few brown stained roots; gradual boundary.
LFd12-A.4			30	47	Dark grey (5Y 4/1) sandy clay; uniform colour; soft with sandy layers; wet; clear boundary.
LFd12-A.5			47	76	Dark olive grey (5Y 3/2) heavy clay; uniform colour; slightly soft and spongy, structureless; weak sulfidic smell; sharp boundary.
LFd12-A.6			76	80	Dark greyish brown (2.5Y 4/2) medium sand; one core only; chip tray sample only.
LFd12-B.1	Approximately 250 m offshore. **Subaqueous (1.0 m).** Four variable cores, representative described. pH > 7 throughout.	Vibrating UWS	0	10	Very dark grey (5Y 3/1) medium sand to loamy sand [6 cm, mixed surface layer over older surface]; 40% speckled dark grey brown (10YR 4/2) sand; saturated; abrupt, uneven boundary.
LFd12-B.2			10	26	Dark olive grey (5Y 3/2) loamy sand, black at the upper surface [a former surface] with 5% black mottles and few brown mottles; few roots and organic matter with strong brown staining of root channels just above the lower boundary; abrupt boundary.
LFd12-B.3			26	35	Dark grey (5Y 4/1) loamy sand with < 5% diffuse black mottles in upper part; abrupt boundary.
LFd12-B.4			35	70	Olive grey (5Y 4/2) sandy clay loam to heavy clay with clayey and sandy lenses; soft and wet at base; strong sulfidic smell.
LFd12-C.1	Approximately 50 m offshore. **Subaqueous (0.7 m).**	Vibrating UWS	0	12	Black (5Y 2.5/1) medium to loamy sand, black with some organic matter at the surface grading to dark grey (5Y 4/1); loose; saturated; clear boundary.
LFd12-C.2			12	34	Light brownish grey (2.5Y 6/2) medium sand to loamy sand with indistinct and very diffuse jarosite mottles; very few medium roots; pH$_F$ 3.5; abrupt boundary.
LFd12-C.3			34	50	Grey (5Y 5/1) light loamy sand with a few clayey bands (< 2cm);

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
					uniform colour except for a few brownish and yellowish stained roots in the upper part and a few diffuse, dark mottles; firmer than above; pH$_F$ 4.5 in upper part; clear boundary.
LFd12-C.4			50	64	Grey (5YR 5/1) loamy sand; uniform colour; firm.
LFd13-A.1			0	12	Black (2.5Y 2/0) with monosulfide and fibric peaty material in the upper 6 cm with common coarse roots and organic matter; upper 2 cm has accumulated clayey material; dark olive grey (5Y 3/2) sand from 6 -12 cm with coarse roots and organic material, weak sulfidic smell; loose and wet; clear boundary.
LFd13-A.2	**Tauwitchere -** Northern side of Tauwitchere Island in tall (> 2 m) reeds. Approximately 30 m offshore. **Subaqueous (0.5 m).**	UWS	12	36	Grey to dark grey (5Y 5/1 to 4/1) medium sand to loamy sand with few diffuse dark mottles in upper part; coarse organic matter, few medium roots and coarse (live?) roots running more or less vertically; common shell fragments; sulfidic smell; oxidised on exposure to air; saturated; clear boundary.
LFd13-A.3			36	50	Dark grey (5Y 4/1) sandy loam; coarse organic matter mixed throughout; firm; fewer shell fragments than above.
LFd15-B.1			0	10	Black (5Y 2.5/1) sandy (30%) gel; sharp, smooth boundary.
LFd15-B.2			10	20	Grey (5Y 5/1) loamy sand with pale yellow (5Y 7/4, 10%) mottles along root channels; clear, smooth boundary.
LFd15-B.3	Soil profile located on the northern side of the creek bed. **Subaqueous (1.0 m).**	UWS	20	35	Dark grey (5Y 4/1) sandy loam with prominent, sharp pale yellow (5Y 7/4, 30%) mottles, especially along old root channels; clear, wavy boundary.
LFd15-B.4			35	55	Dark grey (5Y 4/1) sandy clay; diffuse boundary.
LFd15-B.5			55	68	Dark grey (5Y 4/1) sandy clay with fine shell fragments.
LFd15-C.1			0	5	Black (5Y 2.5/1) sandy gel; medium polyhedral structure; sharp, smooth boundary.
LFd15-C.2			5	20	Light olive grey (5Y 6/2) medium clay with diffuse yellow (10YR 7/8, 20%) mottles; clear, wavy boundary.
LFd15-C.3	Soil profile located in the middle of the creek bed. **Subaqueous (1.2 m).**	UWS	20	38	Grey heavy clay (2.5Y 5/1) with prominent pale yellow (5Y 7/4, 10%) and distinct brownish yellow (10YR 6/8, 5%) mottles; clear, wavy boundary.
LFd15-C.4			38	60	Dark grey (5Y 4/1) sandy clay with fine shell fragments; clear, wavy boundary.

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
LFd15-C.5			60	70	Dark grey (5Y 4/1) sandy clay with fine shell fragments and minor coarse shell fragments (5 %).
LFd17-A.1	**Point Sturt South -** Approximately 50 m offshore. **Subaqueous (0.7 m).**	Vibrating UWS	0	20	Light yellowish brown (2.5Y 6/3) medium sand grading to grey (5Y 5/1) with a black, discontinuous band at boundary (old surface), wash on (only 5-10 cm in two cores); pH$_F$ ~7.5; abrupt boundary.
LFd17-A.2			20	47	Greyish brown (2.5Y 5/2) loamy sand with 20-30% light yellowish brown (2.5Y 6/2) jarosite mottles along old root channels, 5% grey (5Y 5/1) mottles; several clayey bands in upper 5 cm and others distributed through layer; firm, pH$_F$ ~ 3.7; sharp, uneven boundary.
LFd17-A.3			47	60	Dark grey (5Y 4/1) sandy clay loam with soft clayey lenses (~ 1 cm thick) and a few lighter coloured sandy lenses; few root channels with some pale yellow jarosite and strong brown colours; firm; few brown roots; pH$_F$ 6 – 6.5; abrupt, irregular boundary
LFd17-A.4			60	73	Black (5Y 2.5/2) sandy loam to sandy clay loam with organic matter grading to dark grey (5Y 4/1) and dark greenish grey (5 GY 4/1) sandy heavy clay; firm; few brown roots; pH$_F$ ~7.
LFd17-B.1	Approximately 140 m offshore. **Subaqueous (0.9 m).**	Vibrating UWS	0	7	Greyish brown (2.5Y 5/2) medium sand , surface wash on, one core with black material which oxidised rapidly, otherwise with the surface few mm oxidised; loose; saturated; few fine roots; pH$_F$ 6-7; abrupt boundary.
LFd17-B.2			7	25	Light yellowish brown (2.5Y 6/2) medium sand with (10%) very diffuse light yellowish brown (2.5Y 6/3) jarosite mottles; firm; pH$_F$ ~4; clear, irregular boundary.
LFd17-B.3			25	52	Grey (5Y 5/1) loamy sand with diffuse, broad, slightly lighter and darker bands; firm; pH$_F$ ~ 7.5-8; clear boundary.
LFd17-B.4			52	72	Dark grey (5Y 4/1) sandy clay loam; soft, sulfidic smell; pH$_F$ ~ 7.5-8.
LFd19-A.1	**Dog Lake -** Approximately 130 m offshore. **Subaqueous (0.9 m).**	Vibrating UWS	0	19	Greyish brown (10YR 5/2) loamy sand with 15% yellow jarosite mottles especially towards the base, 20% browner organic (?) mottles and staining, often in horizontal bands; soft, very wet; very common fine roots in the upper 2 to 3 cm; pH 4.2 at 3 cm, 3.3 at 16 cm; abrupt boundary.
LFd19-A.2			19	29	Greyish brown (2.5Y 5/2) clayey sand to loamy sand with 10% yellow jarosite mottles; massive, firm; pH 3.6 at 27 cm; abrupt boundary

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
LFd19-A.3			29	45	Dark grey (5Y 4/1) light clay with sand, with a few jarosite mottles in upper 10 cm following vertical root channels (3 to 4 mm wide), soft, wet, but may have structure; pH 3.9 at 33 cm; clear boundary.
LFd19-A.4			43	58	Grey (5Y 5/1) heavy clay with some fine sand; firm, massive.
LFd20-A.1		Vibrating UWS	0	6	Black (2.5Y 2/0) clay; very soft and sticky; few roots; weak sulfidic smell; pH about 6; abrupt boundary.
LFd20-A.2			6	15	Dark greyish brown (10YR 4/2) light clay with a few pale yellow (2.5Y 7/2) jarosite mottles; soft, sticky; many very fine roots; pH 4.5; abrupt boundary.
LFd20-A.3	**Boggy Lake -** Approximately 300 m offshore. **Subaqueous (0.9 m).**		15	29	Greyish brown (10YR 5/2) medium clay with clear, common, medium, prominent yellow (2.5Y 7/2) jarosite mottles, more common towards the base and along old root channels; soft, sticky; few to common fine roots; pH 3.6 to 3.9; clear boundary.
LFd20-A.4			29	55	Dark greyish brown (2.5Y 4/2) medium clay with few to rare jarosite mottles along near vertical fine root channels; soft, sticky; pH 5 to 5.5; abrupt boundary.
LFd20-A.5			55	78	Dark greenish grey (5GY 4/1) light clay with some fine sand; very soft.
LFd21-A.1		Vibrating UWS	0	7	Very dark grey (5Y 3/1) medium sand, could be washed on; oxidised quickly; abrupt boundary.
LFd21-A.2	**Windmill Site -** Approximately 100 m offshore. **Subaqueous (0.5 m).**		7	37	Dark grey (5Y 4/1) loamy sand in variable layers; grey (5Y 5/1) medium sand at 29 to 33 cm; black and very dark grey horizontal layers of organic matter throughout with some pale grey layers; common medium to coarse Phragmites roots and decomposing organic matter, stained brown; 10% diffuse black layers and root remnants in the upper half; moderate sulfidic smell; clear boundary.
LFd21-A.3			37	65	Grey (5Y 5/1) loamy sand; uniform throughout.
LFd21-B.1	Approximately 250 m offshore. **Subaqueous (0.7 m).** There is some variability in the upper, sandy layer – 15, 17, 32, 34, and 36 cm deep. Upper 20 to 30 cm has probably been re-worked.		0	36	Light olive brown (2.5Y 5/3) medium sand with 10% weak, diffuse brown (10YR 5/4) and 10% black (2.5Y 2/0) and very dark grey mottles, mainly in the upper 2-4 cm; loose; organic remnants in well defined horizontal layers; few whole bivalve shells (to 10 mm); common medium roots; sharp, even boundary.
LFd21-B.2			36	61	Dark olive grey (5Y 3/2) loamy light clay, very spongy and coorongite like, no sand grains; weak black layering; 'fractures' rather than breaks structurally; sharp, even boundary.

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
LFd21-B.3			61	73	Dark grey (5Y 4/1) medium sand to loamy sand with weak darker banding; firm; common shell fragments.
LFd23-A.1		Vibrating UWS	0	10	Very dark grey (5Y 3/1) medium sand, speckled black, with black gel-like material at surface; very wet; low bulk density; few medium roots; pH 5.5-7; gradual boundary.
LFd23-A.2	**Lower Currency -** Approximately 60 m offshore. **Subaqueous (0.9 m).**		10	28	Light brownish grey (2.5Y 6/2) medium sand; faint remnant jarosite mottles in lower 10 cm; uniform; pH 4.5-5.3; clear to gradual boundary.
LFd23-A.3			28	54	Dark grey (5Y 4/1) loamy sand with broad, slightly paler bands; firmer than above; contains a darker clayey band (2 – 10 cm) which is thicker when deeper in the layer; few black root channels; strong sulfidic smell.
LFd24-A.1			0	27	Black (10YR 2/1) or very dark brown sapric peat (looks fibric but disperses in water) with a thin (0.5 cm) layer of clay at the surface; few shell fragments; many fine roots; abrupt boundary.
LFd24-A.2	**Lower Finniss -** Approximately 125 m offshore. **Subaqueous (1.0 m).**		27	46	Very dark greyish brown (2.5Y 3/2) clay in upper part with remnant Phragmites roots and organic matter, probably filling cracks; 10-15% yellow jarosite mottles following root channels; pH$_F$ ~4.5; diffuse boundary.
LFd24-A.3		Vibrating UWS	46	70	Very dark grey (5Y 3/1) or slightly bluer heavy clay with a few jarosite mottles extending down root channels into upper 10 cm of the layer; soft, sticky with no sand grains.
LFd24-B.1			0	17	Black (10YR 2/1) sapric peat; clayey with black gel material at surface; some coarse, blackened organic matter at base with many fine roots; abrupt boundary.
LFd24-B.2	Approximately 60 m offshore. **Subaqueous (0.9 m).**		17	44	Very dark greyish brown (2.5Y 3/2) grading to dark olive grey (5Y 3/2) heavy clay with few weak, pale yellow jarosite mottles in upper 5 cm; some remnant blocky structure; firmer than below and sticky in upper 5 cm; diffuse boundary.
LFd24-B.3			44	83	Dark greenish grey (5GY 4/1) clay; soft, sticky and massive; sulfidic smell.

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

January and February 2011 sampling

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
LFc01-A.1	**Wallys Landing and Wetland -** Middle of drainage ditch located to the north east of the Finniss River. **Subaqueous (1.1 m).**	UWS	0	10	Black (2.5Y 2.5/1) light to medium clayey gel containing black silty clay peds and very few sub-rounded quartz gravel (0.5-1 cm); polygonally cracked soils.
LFc01-A.2		UWS	10	30	Very dark grey (2.5Y 3/1) clay (pH 6.28) with vertical cracks infilled with grey (2.5Y 5/1) medium sand (pH 4.62); no obvious jarosite coatings were observed in any of the four cores taken.
LFc01-A.3			30	90	Very dark grey (5Y 4/1) medium to heavy clay.
LFc01-D.1	Southern side of Finniss River channel on western side of Wallys Jetty, approximately one metre from the bank. **Subaqueous (0.6 m).**	UWS	0	5	Dark olive grey (5Y 3/2) coarse sandy clay with few fine and coarse roots.
LFc01-D.2		UWS	5	20	Very dark greyish brown (10YR 3/2) slightly sandy clay with many common roots and yellow (2.5Y 8/6) mottles (5 %).
LFc01-D.3			20	60	Very dark grey (2.5Y 3/1) clay with many coarse roots and fine rootlets; few small bands (< 10 %) of medium to coarse sandy clay.
LFc02-A.1	**Point Sturt North –** Approximately 60 m offshore. **Subaqueous (0.7 m).**	Vibrating UWS	0	13	Greyish brown (10YR 5/2) medium sand with 5% diffuse, black mottles; bleached in lower two centimetres, light grey (10YR 6/1 or 10YR 7/1); abrupt boundary.
LFc02-A.2		Vibrating UWS	13	25	Light brownish grey (10YR 6/2) medium sand with 30% strong jarosite mottles especially in the lower 8 cm; few brown areas with old root channels; sharp even boundary.
LFc02-A.3			25	57	Greyish brown (2.5Y 5/2) medium sand with a few strong brown (7.5YR 4/6) mottles along old root channels; weak, diffuse darker layers but becoming very dark grey for the 3-5 cm above the lower boundary; sharp, irregular boundary
LFc02-A.4			57	60	Dark greenish grey (5G 4/1) heavy clay with black staining in parts; few fine roots.
LFc02-B.1	Approximately 200 m offshore. **Subaqueous (1.0 m).**	Vibrating UWS	0	9	Pale brown (10YR 6/3) medium sand with 20% diffuse black (2.5Y 2/0) mottles at core; two of four profiles have 5% diffuse, strong brown (7.5 YR 5/8) mottles; sharp boundary.
LFc02-B.2		Vibrating UWS	9	25	Pale brown (10YR 6/3) medium sand with very weakly evident layers slightly darker than pale brown; sharp boundary.
LFc02-B.3			25	57	Dark grey (N4/) medium sand with 30% diffuse bands of black

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
					(2.5Y 2/0); slightly paler in lower 5 cm; sharp boundary.
LFc02-B.4			57	67	Dark grey (5Y 4/1) medium sand; three profiles had a thin shell fragment (to 3 mm) layers at about 59 cm; others had about 20% black (2.5Y 2/0) mottles.
LFc03-A.1			0	7	Black (2.5Y 2/0) organic loamy sand; many decomposing roots and litter; sulfidic smell; sharp irregular boundary.
LFc03-A.2			7	16	Greyish brown (2.5Y 5/0) loamy sand with less than 5% small (1-2 mm) black mottles; clear boundary.
LFc03-A.3	Milang - Approximately 200 m offshore. Subaqueous (0.9 m).	Vibrating UWS	16	24	Olive brown (2.5Y 4/3) light clay, possibly structured with vertical cracks; inclusions of material from layers above; common fine roots; jarosite along few medium roots channels; one core did not have this layer; sharp, wavy boundary.
LFc03-A.4			24	54	Light brownish grey (2.5Y 6/2) loamy sand with 30% diffuse jarosite mottles and 15% diffuse brown (organic) mottles; one core had two 1 cm bands of clay similar to the material in the layer above; abrupt, even boundary.
LFc03-A.5			54	63	Dark grey (5Y 4/1) medium sand, but clayey sand in the upper 5 cm or so with very few medium roots channels with jarosite mottles up to 1 cm wide.
LFc03-B.1			0	13	Dark grey (5Y 4/1) medium sand with 15% diffuse black (5Y 2.5/1) mottles; the upper 1 cm of this layer had oxidised; sharp boundary.
LFc03-B.2	Approximately 550 m offshore. Subaqueous (1.0 m).	Vibrating UWS	13	30	Grey (10YR 6/1) medium sand with less than 5% very diffuse darker and some red mottles; (note that one core had 20% jarosite and diffuse reddish mottles in this layer); sharp boundary.
LFc03-B.3			30	57	Grey (10YR 5/1) medium sand with very slightly darker layers; sharp boundary.
LFc03-B.4			57	74	Dark grey (5Y 4/1) medium sand, appears speckled with very slightly darker and lighter banding.
LFc04-A.1			0	18	Black (2.5Y 2.5/1) sand (40%) with 60% distinct grey (2.5Y 5/1) mottles due to oxidation of monosulfides.
LFc04-A.2	Tolderol - Approximately 80 m offshore. Subaqueous (0.9 m).	Vibrating UWS	18	28	Grey (2.5Y 6/1) medium sand with 20% dark grey (5Y 5/1) and 10-15% prominent, pale yellow (5Y 8/6) mottles.
LFc04-A.3			28	45	Grey (5Y 5/1) sand with reddish brown (5YR 4/4) stained roots.

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

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LFc04-A.4			45	58	Grey (5Y 6/1) medium sand.
LFc04-A.5			58	65	Dark grey (5Y4/1) medium to heavy clay with 5% shells (2-12 mm).
LFc04-C.1		Vibrating UWS	0	15	Black (2.5Y 2.5/1) medium sand with 10% distinct grey (2.5Y 5/1) mottles.
LFc04-C.2	Approximately 550 m offshore. **Subaqueous (1.3 m).**		15	40	Grey (5Y 6/1) sand with 30% dark grey (5Y 4/1) mottles.
LFc04-C.3			40	70	Dark grey (5Y 4/1) sand but gradually increasing in clay with depth.
LFc06-A.1		Vibrating UWS	0	18	Dark grey (10YR 4/1) medium sand with 30% black (2.5Y 2/0) mottles associated with fine black roots growing more or less vertically with diffuse edges and less than 5% yellowish brown (10YR 5/8) mottles; upper 5 to 10 mm is a black organic sand with an H_2S smell; few shell fragments throughout; abrupt boundary.
LFc06-A.2	**Poltalloch -** Approximately 200 m offshore. **Subaqueous (0.9 m).**		18	35	Light olive brown (2.5Y 5/3) medium sand with 5% diffuse greyish brown mottles in upper 5 cm; some shell fragments in lower 5 cm; abrupt boundary.
LFc06-A.3			35	49	Greyish brown (2.5Y 5/2) medium sand with less than 5% black (2.5Y 2/0) mottles with diffuse edges and very diffuse, slightly darker mottles; common fine shell fragments especially in upper 5 cm; clear boundary.
LFc06-A.4			49	61	Grey (10YR 5/1) medium sand with very faint darker patches.
LFc06-B.1		Vibrating UWS	0	14	Greyish brown (2.5Y 5/2) medium sand to loamy sand with some yellow and black speckling, some black layers (2 to 3 mm) near base of layer; few heavy clay bands; few fine roots; sharp boundary.
LFc06-B.2	Approximately 400 m offshore. **Subaqueous (1.3 m).**		14	25	Black (2.5Y 2/0) clayey sand to sandy loam; mostly whole coloured black but described core has black clayey band (2.5Y 3/0, 25%) and dark olive grey material (5Y 3/2, 25%) in upper part; very moist due to water perching on clay and near the top of the layer below; sharp boundary
LFc06-B.3			25	60	Grey (5Y 5/1) mainly loamy sand with common shell (bivalve to about 8 to 10 mm); 36 to 50 cm is dark grey (5Y 4/1) sandy clay with shell; sharp boundary.
LFc06-B.4			60	75	Dark grey (5Y 4/1, slightly bluer) heavy clay; soft; possibly with medium blocky structure or fracture; few shells.

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
LFc07-A.1	**Waltowa -** Approximately 100 m offshore. **Subaqueous (0.7 m).**	Vibrating UWS	0	25	3 cm of black (Gley 1 2.5/N) fibric sand with many fine roots; from 3 to 25 cm has grey (5Y 5/1) sand bands (2-3 cm) with very dark grey (5Y 3/1) bands (0.5 cm); some yellow (5Y 7/6) linear mottles along root channels; sharp boundary.
LFc07-A.2			25	40	Dark grey (5Y 4/1) fine sandy clay loam with many fine roots and small (< 1 cm) lenses of grey to black fibric material; sharp boundary.
LFc07-A.3			40	55	Very dark greenish (Gley 1 3/10Y) silty light medium clay with bands (0.5 cm) of sapric material and small (< 1 cm) gastropods associated with layer of olive (5Y 4/3) clay.
LFc07-A.4			55	70	Dark grey (5Y 4/1) slightly silty light medium clay with few lenses of fine sand.
LFc07-B.1	Approximately 200 m offshore. **Subaqueous (0.8 m).**	Vibrating UWS	0	30	3 cm of black (Gley 1 2.5/N) fibric sand with many fine rootlets; underlying this was grey (2.5Y 5/1) sand with black (Gley 1 2.5/N) vertical mottles associated with decomposing roots; few yellowish brown (10YR 5/6) mottles.
LFc07-B.2			30	40	Very dark bluish grey (Gley 2 3/2B) clayey sand.
LFc07-B.3			40	57	Dark greenish grey (Gley 1 4/5GY) clay with sandy clay lenses from 53 to 57 cm.
LFc08-A.1	**Meningie -** West of the Meningie jetty. Approximately 35 m offshore. **Subaqueous (0.7 m).**	Vibrating UWS	0	12	Light olive brown (2.5Y 5/3) medium sand to loamy sand; upper 2 to 3 cm is sandy clay; very diffuse grey (5Y 5/1) and brighter light olive brown (2.5Y 5/4) mottles; clear boundary.
LFc08-A.2			12	28	Grey (5Y 5/1) medium sand to loamy sand with several (2 to 4) dark greenish grey (5GY 4/1) clay bands less than 1 cm thick and at least one diffuse, dark grey (5Y 4/1, 15%) band; few shell fragments towards base; sulfidic smell; abrupt boundary.
LFc08-A.3			28	60	Upper 6 cm dark olive grey (5Y 3/2) organic clay, sapric; common shell fragments; over dark olive grey (5Y 3/2) clay with shell fragments; strong sulfidic smell; inclusions of layers of medium sand (to 2 cm); abrupt boundary.
LFc08-A.4			60	78	Dark greenish grey (5GY 4/1) heavy clay, soft and appears structureless; strong sulfidic smell.

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
LFc08-B.1	Approximately 125 m offshore. **Subaqueous (1.2 m).**	Vibrating UWS	0	20	Oxidised brown sand from 0 to 2 cm underlain by black sand (Gley 1 2.5/N) to 10 cm; underlying this was mottled (50:50) light olive brown (2.5Y 5/4) and black (Gley 1 2.5/N) sand; few strong brown (7.5YR 4/6) distinct mottles (< 7.5 mm) below 10 cm; sharp boundary.
LFc08-B.2			20	33	Black (Gley 1 2.5/N) slightly sandy clay.
LFc08-B.3			33	45	Dark greenish grey (Gley 1 4/5G) fine to medium sandy light clay; shell layer from 33 to 34 cm (small gastropods); sharp boundary.
LFc08-B.4			45	65	Dark greenish grey (Gley 1 2.5/10GY) light clay.
LFc10-A.1	**Campbell Park -** Approximately 5 m offshore. **Subaqueous (0.2 m).**	Vibrating UWS	0	18	Black (10YR 2/1) sandy clay loam with strong structure; abundant fibric to hemic organic matter; abundant roots; lower 2 cm of this layer very dark grey (7.5YR 3/0) clayey sand; sharp boundary.
LFc10-A.2			18	36	Grey (5Y 5/1) light clay with few coarse dark grey (2.5Y 4/0) mottles; massive, strong structure; few coarse roots; abrupt boundary.
LFc10-A.3			36	66	Grey (10YR 5/1) medium and heavy clay with common prominent, large yellow (5Y 8/6) mottles; strongly structured; few medium roots with prominent yellow (5Y 8/6) coatings, abrupt boundary.
LFc10-A.4			66	80	Very dark grey (2.5YR 3/0) medium heavy clay, massive; few finer relict roots; n.b. dryer, more crumbly than layer above; some yellow mottles (5Y 8/6) noted in the roots of other, not described cores (see description notes).
LFc10-C.1	Approximately 125 m offshore. **Subaqueous (0.7 m).**	Vibrating UWS	0	7	Light olive brown (2.5Y 5/3) sandy clay loam with a thin (less than 1 cm dark) greyish brown (10YR 4/2) heavy clay surface and 40% decomposing organic matter coloured brown to black; faint sulfidic smell; abrupt, wavy boundary.
LFc10-C.2			7	29	Greyish brown (2.5Y 5/2) sandy clay loam with medium sandy bands, 25% jarosite (2.5Y 6/5) mottles, and 25% diffuse, darker colours ranging to black (2.5Y 2/0) associated with roots and old organic matter; coarse Phragmites remnants; $pH_F < 3.9$; clear wavy boundary.
LFc10-C.3			29	45	Greyish brown (2.5Y 5/2) loamy medium sand with 10% darker, diffuse mottles; few vertical roots with dark brown and black colours; $pH_F < 3.9$.

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
LFc10-C.4			45	70	As above but with fewer black and very dark brown old root channels; pH$_F$ < 3.9.
LFc10-D.1	Approximately 300 m offshore. **Subaqueous (0.9 m).** N.b. the soil cores sampled at this site showed high variability. See the description notes.	Vibrating UWS	0	16	Loamy sand, strongly layered, organic and black (2.5Y 2/0) at 6 to 8 cm; over layered greyish brown to brownish grey (2.5Y 5/2, 2.5Y 6/2 and 2.5Y 4.2) loamy sand; upper part has common to fine roots, lower part has few medium to fine stained (strong brown, 7.5YR 5/6) channels; fine shell fragments; sharp wavy boundary.
LFc10-D.2			16	28	Soft and hard carbonate with greenish grey (5GY 5/1) loamy sand at base; similar colour but clayey sand in upper part; few black root channels.
LFc10-D.3			28	47	Calcareous rubble; very wet.
LFc10-D.4			47	56	Greenish grey (5GY 5/1) sandy loam.
LFc12-A.1	**Loveday Bay -** Approximately 300 m offshore. **Subaqueous (1.4 m).**	Vibrating UWS	0	9	Greyish brown (10YR 5/2) loamy sand with some clayey lenses; 0-3 cm very dark greyish brown (2.5Y 3/2) in most cores; few fine roots; pH 4-4.5; clear boundary.
LFc12-A.2			9	17	Grey (5Y 5/1) sandy loam to sandy clay loam, probably finely layered with pale yellow (5Y 7/4, 10%) and dark yellowish brown (10YR 4/6, < 5%) mottles associated with fine root channels; clear boundary.
LFc12-A.3			17	37	Dark grey (5Y 4/1) sandy clay with clayey sand lenses; olive (5Y 4/4, 5%) mottles with diffuse edges, probably along a root channel; pH > 7; gradual boundary.
LFc12-A.4			37	58	Dark grey (5Y 4/1) sandy clay with several distinct sandy layers (to 3-5 cm) which are slightly lighter grey (5Y 5/1) in colour; sulfidic smell; pH > 7; abrupt boundary.
LFc12-A.5			58	74	Dark greenish grey (5G 4/1) to greenish grey (5GY 4/1) heavy clay; soft; wet; no obvious structure; possible weak sulfidic smell.
LFc12-B.1	Approximately 250 m offshore. **Subaqueous (1.2 m).** Four variable cores, representative described. pH > 7 throughout.	Vibrating UWS	0	12	Dark grey (5Y 4/1) loamy sand with diffuse dark olive grey (5Y 3/2) mottles, possibly layered; oxidised very quickly on exposure to air; abrupt boundary.
LFc12-B.2			12	32	Black (5Y 2.5/1) loamy sand to sandy loam grading to dark grey (5Y 4/1) with depth; probable thin clay lenses; other cores have

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
					distinct black layering and two cores had strong black layers 3-5 cm thick at the base and a clay layer below; black layers smell sulfidic; other black colours follow old fine roots vertically; gradual boundary;
LFc12-B.3			32	63	Dark grey (5Y 4/1) sandy clay loam with sandy and clayey lenses; band (10 – 15 cm) of fine shell fragments towards the base; sulfidic smell; clear boundary.
LFc12-B.4			63	76	Dark grey (5Y 4/1) heavy clay (sandy); some shell fragments in upper few cm; sulfidic smell.
LFc12-C.1			0	11	Grey (5Y 5/1) medium sand to loamy sand with a black (2.5Y 2/0) layer near the surface associated with organic matter and following fine roots down about 5 cm; colour gets paler towards the base; pH > 7; gradual boundary.
LFc12-C.2	Approximately 50 m offshore. **Subaqueous (0.9 m).**	Vibrating UWS	11	36	Light brownish grey (10YR 6/2) medium to loamy sand with about 20% very diffuse jarosite mottle (olive yellow, 2.5Y 6/6), < 2% black mottles and slightly browner mottles; pH 3.9; abrupt boundary.
LFc12-C.3			36	50	Grey (5Y 5/1) loamy sand (light) with few yellowish brown (10YR 5/6) mottles about 1 cm diameter along root channel; pH 3.9-4.2); gradual boundary.
LFc12-C.4			50	66	Reddish grey (5YR 5/2) light loamy sand; pH > 6.
LFc13-A.1			0	10	Black (Gley 1 2.5/N) fibric peat with some bands of black sand with sulfidic smell.
LFc13-A.2	**Tauwitchere -** Northern side of Tauwitchere Island in tall (> 2 m) reeds. Approximately 30 m offshore. **Subaqueous (0.7 m).**	UWS	10	35	Grey (5Y 5/1) slightly silty sand with prominent black (Gley 1 2.5/N) mottles from 10 to 15 cm; many fine (< 0.5 cm) shell and coarse and fine roots with sulfidic smell.
LFc13-A.3			35	50	Dark grey (5Y 4/1) silty sand with few fine roots; some fine (< 0.5 cm) shell fragments and few larger (< 2 cm) whole shells near base.
LFc15-B.1			0	6	Black (5Y 2.5/1) organic sand (50%) and loam (40%) with some (10%) clay nodules; sharp, smooth boundary.
LFc15-B.2	Soil profile located on the northern side of the creek bed. **Subaqueous (1.0 m).**	UWS	6	12	Grey (5Y 5/1) sand distinct, diffuse pale yellow (5Y 7/4, 10%) mottles; clear, smooth boundary.
LFc15-B.3			12	24	Grey (5Y 5/1) sandy clay with prominent, sharp pale yellow (5Y 7/4, 30%) mottles, especially along old root channels; clear, wavy

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
					boundary.
LFc15-B.4			24	60	Dark grey (5Y 4/1) sandy loam with distinct, diffuse pale yellow (5Y 7/4, 30%) mottles, mainly in the upper part and along root channels; whole shells and shell fragments diffuse boundary.
LFc15-B.5			60	80	Dark grey (N 4/1) sandy clay (pH 7.6)
LFc15-C.1		UWS	0	5	Black (5Y 2.5/1) sandy clay; medium polyhedral structure; sticky; wet; sharp, smooth boundary.
LFc15-C.2			5	20	Light olive grey (5Y 6/2) heavy clay with prominent and diffuse pale yellow (5Y 7/4, 30%) mottles; pH of mottles 3.9-4; clear, wavy boundary.
LFc15-C.3	Soil profile located in the middle of the creek bed. **Subaqueous (1.2 m).**		20	38	Grey heavy clay (2.5Y 5/1) with prominent pale yellow (5Y 7/4, 10%) and distinct brownish yellow (10YR 6/8, 10%) mottles; clear, wavy boundary.
LFc15-C.4			38	60	Dark grey (5Y 4/1) sandy clay with faint, diffuse pale yellow (5Y 7/4, 5%) mottles; clear, wavy boundary.
LFc15-C.5			60	70	Dark grey (5Y 4/1) sandy clay.
LFc17-A.1			0	2	Light brownish grey (2.5Y 6/2) medium sand with diffuse greyish brown (2.5Y 5/2) very diffuse mottles; pH 5.8-6.5; abrupt boundary.
LFc17-A.2			2	30	Light brownish grey (2.5Y 6/2) medium sand with common, fine, prominent pale yellow (2.5 Y 7/4) mottles; clear boundary.
LFc17-A.3	**Point Sturt South -** Approximately 50 m offshore. **Subaqueous (0.5 m).**	Vibrating UWS	30	40	Dark grey (2.5Y 4/1) medium sand with a few, fine, distinct pale yellow (2.5Y 7/4) mottles; few relict roots; clear boundary.
LFc17-A.4			40	53	Dark grey (2.5Y 4/1) medium clay loam with few relict roots; abrupt boundary.
LFc17-A.5			53	60	Dark grey (2.5Y 4/1) medium sandy clay loam with common medium (20%) and coarse (5%) carbonate nodules (placed in chip tray); very few roots.
LFc17-B.1	Approximately 140 m offshore. **Subaqueous (1.0 m).**	Vibrating UWS	0	25	Light brownish grey (2.5Y 6/2) medium sand with common, fine, prominent pale yellow (2.5Y 7/4) mottles with clear boundaries; abrupt boundary.
LFc17-B.2			25	38	Grey (2.5Y 5/1) medium sand with a few (10%) fine, distinct pale yellow (2.5Y 7/4) mottles with very diffuse boundaries between

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
					mottles; abrupt boundary.
LFc17-B.3			38	50	Dark grey (2.5Y 4/1) medium sand with very few (2%) fine, with very diffuse boundaries, pale yellow (2.5Y 7/4) mottles; clear boundary.
LFc17-B.4			50	68	Dark grey (2.5Y 4/1) clayey sand.
LFc19-A.1			0	12	Greyish brown (10YR 5/2) loamy sand to clayey sand with 20% dark greyish brown (10YR 4/2) and 10% light greyish brown (10YR 6/2, probably jarosite) mottles; darker layer at base, probably organic matter; pH 3-3.3; clear boundary.
LFc19-A.2	Dog Lake - Approximately 130 m offshore. Subaqueous (1.0 m).	Vibrating UWS	12	29	Greyish brown (2.5Y 5/2) loamy sand with 25% diffuse, coarse, light yellowish brown mottles near upper surface and along root channels (8-10 mm) towards the base; pH 3-3.3; sharp, wavy boundary.
LFc19-A.3			29	43	Dark grey (5Y 4/1) heavy clay with pale yellow (2.5Y 7/4) jarosite mottles along old root channels (~5%) in upper 7-10 cm of the layer; pH 4-4.3; abrupt boundary.
LFc19-A.4			43	50	Dark greyish brown (2.5Y 4/2) heavy clay with hard, angular carbonate to about 1 cm; pH ~ 8.
LFc20-A.1			0	26	Dark grey (5Y 4/1) fine sandy clay; soft, uniform but becoming firmer and less moist at about 12 cm; no roots; clear boundary.
LFc20-A.2			26	36	Dark grey (5Y 4/1) fine sandy clay; mottled reddish-brown in upper part, jarosite in lower part; few medium, vertical root channels with some remaining root material (less than 5%); abrupt boundary.
LFc20-A.3	Boggy Lake - Approximately 300 m offshore. Subaqueous (1.0 m).	Vibrating UWS	36	49	Greyish brown (10YR 5/2) fine sandy clay; softer than above; 20% jarosite mottle increasing towards base; increasing roots with old root material present, especially just above lower boundary.
LFc20-A.4			49	65	Very dark greyish brown (10YR 3/2) heavy clay; firmer and drier than above; less than 5% thin jarosite mottles; few to common medium roots with old root material (brown); the lower 3 cm is a paler colour with no mottles; abrupt boundary.
LFc20-A.5			65	80	Dark grey (5Y 4/1) fine sandy clay with black (5Y 2.5/1) mottles about 20%, and probably along vertical cracks; no roots.
LFc21-A.1	Windmill Site - Approximately 100 m offshore. Subaqueous (0.6 m).	Vibrating UWS	0	7	Dark grey (N4/) medium sand, not uniform across cores, two are dark grey, one mottled 20% and the other a paler olive grey (5Y 5/2) sand with black (2.5Y 2/0) mottled areas around few medium

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
					roots; weak sulfidic smell from darker cores; sharp, wavy boundary.
LFc21-A.2			7	14	Olive grey (5Y 5/2) medium sand with 10% black (2.5Y 2/0) mottled areas around old medium roots, brown organic remnant roots and faint diffuse brown mottles; sulfidic smell; abrupt, wavy boundary.
LFc21-A.3			14	36	Dark grey (5Y 4/1) loamy sand with a few diffuse strong brown (7.5YR 5/8) mottles along old medium Phragmites roots; firmer than above; sulfidic smell; this layer was probably an old surface with Phragmites or other vegetation; abrupt, wavy boundary.
LFc21-A.4			36	62	Grey (5Y 5/1) loamy sand, sand finer than above but still medium grain size; few organic accumulations and roots (less than 1%).
LFc21-B.1			0	27	Light olive grey (5Y 6/2) medium sand with 30% weak, diffuse brown (10YR 5/3) and 20% black (2.5Y 2/0) mottles, mainly in the upper 2-4 cm and below this associated with old root channels; few reddish brown medium roots; many live roots in top 5 cm; lower few centimetres have small bivalve shells to about 5 mm; sharp boundary.
LFc21-B.2	Approximately 250 m offshore. **Subaqueous (0.8 m).**		27	52	Dark olive grey (5Y 3/2) spongy loam or organic loam, too wet to texture properly; horizontally layered coorongite with slightly darker and lighter layers and a few prominent black (2.5Y 2/0) bands about 1 cm thick; faint sulfidic smell; sharp boundary.
LFc21-B.3			52	62	Dark grey (5Y 4/1) clayey sand to sandy loam with a few thin, black bands near the upper boundary; slightly bleached layer in upper 2 to 3 cm has common shell fragments.
LFc23-A.1			0	12	Dark grey (5Y 4/1) medium sand; three cores have 3-5 cm of black (2.5Y 2/0) sand at surface; two cores have few brown decomposing roots in upper 5 cm; clear boundary.
LFc23-A.2	**Lower Currency -** Approximately 60 m offshore. **Subaqueous (0.9 m).**	Vibrating UWS	12	33	Light brownish grey (2.5Y 6/2) medium sand; profiles very variable, others have the lower boundary at 18, 20, 26, 28 cm (one core did not have this layer), three of six cores had jarosite mottles, both diffuse ones and distinct ones in old root channels, some with reddish brown cores; pH of mottles about 3.9 and matrix between 4 and 4.2; abrupt boundary.
LFc23-A.3			33	46	Greyish brown (2.5Y 5/1) medium sand with two diffuse, dark layers at 34 and 42 cm.
LFc24-A.1	**Lower Finniss -** Approximately 125 m offshore. **Subaqueous (1.2**	Vibrating	0	15	Black (5Y 2.5/1) hard and desiccated/crumbly clay crust (0-2 cm)

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
	m).	UWS			overlying less desiccated crust.
LFc24-A.2			15	30	Reddish black (2.5YR 2.5/1) fibric peat with some silty clay.
LFc24-A.3			30	55	Dark grey (5Y 4/1) medium heavy clay with some rootlets; yellow (2.5Y 8/6) mottles associated with rootlets (< 5 %).
LFc24-A.4			55	70	Dark bluish grey (Gley 2 4/5B) medium clay.
LFc24-B.1			0	15	Black (5Y 2.5/1) hard and desiccated/crumbly clay crust (0-2 cm) overlying less desiccated crust.
LFc24-B.2	Approximately 60 m offshore. **Subaqueous (0.7 m).**		15	50	Dark greenish grey (Gley 1 4/10 Y) medium clay with few (≈ 10 %) diffuse, greenish grey (Gley 1 5/10Y) mottles and a few fine rootlets.
LFc24-B.3			50	70	Dark greenish grey (Gley 4/10Y) light clay.

March 2010 sampling

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
LFb01-A.1	**Wallys Landing and Wetland -** Middle of drainage ditch located to the north east of the Finniss River in approximately 30 cm of water. Reeds growing from water near banks. Bed of ditch comprised polygonally cracked soils (cracks > 15 cm). Significant Phragmites growth since first sampling and water level had fallen from 1.1 m. **Subaqueous.**	Spade/ Gouge Auger	0	10	Dark brown to black light to medium clay gel containing very dark brown silty clay peds and sub-rounded quartz gravel (0.5 – 2 cm) (sampled from polygonally crack soil).
LFb01-A.2			10	40	Dark brown grey medium clay with vertical cracks commonly infilled with medium sand and coated with jarosite. Jarosite was more diffuse from 10 to 15 cm and more prominent and bright below 15 cm.
LFb01-A.3			40	90	Dark green grey medium clay.
LFb01-D.1	Southern side of Finniss River channel on western side of Wallys Jetty, approximately one metre from the bank. **Subaqueous.**	Spade	0	5	Dark grey to black silty clay with areas of black clay gel; distinct brown and orange brown mottles (20 %); many roots from 0 to 0.5 cm.
LFb01-D.2			5	15	Grey brown and brown sandy clay; common roots with yellow jarosite mottles and coatings (30 – 35 %) along root channels and on surfaces.
LFb02-A.1	**Point Sturt North -** An extensive area of beach, which extended from the pre-drought (pre 2006) shore to the waterline. The beach was sparsely revegetated with grasses. Soil profile located approximately 60 m north of the pre-drought shoreline. Water table at 80 cm.	Spade	0	4	Pale yellowish brown to brown medium sand with prominent pale yellow jarosite mottles (30 %), layered with dark brown organic woody material at base (2 cm thick).
LFb02-A.2			4	12	Pale greyish brown medium sand with diffuse pale yellow jarosite mottles (10 – 15 %).
LFb02-A.3			12	38	Pale greyish brown medium sand with prominent, strong yellow mottles (15 %) with some reddish brown cores along root channels.
LFb02-A.4			38	50	Grey brown loamy sand with pale grey mottles (20 %) in upper part becoming grey at depth; strong yellow jarosite mottles along root channels with red brown cores (5 %).
LFb02-A.5			50	80	Olive grey loamy sand with patches of bluish grey sandy clay (15 %); strong reddish brown mottles (5 %) along root channels.
LFb02-B.1	Soil profile located approximately 25 m south of the waterline.	Spade	0	5	Pale grey brown medium sand and very few shells to a depth of 1 cm; diffuse pale reddish brown mottles (10 %).
LFb02-B.2			5	28	Pale brown medium to coarse sand; diffuse layering of pale reddish brown and pale grey medium sand; reddish brown

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
					layer (up to 2 cm) at lower boundary.
LFb02-B.3			28	50	Grey medium sand with few pale grey brown mottles (10 %). Distinct very dark grey mottles increasing with depth.
LFb02-B.4			50	70	Dark grey medium sand with distinct dark grey mottles (40 %) with black cores; weak sulfidic smell and few shell fragments.
LFb03-A.1			0	5	Brownish yellow loamy sand with a thin (3 mm) organic accumulation on the surface.
LFb03-A.2			5	25	Yellow grey fine to medium loamy sand with weak diffuse brownish red mottles (10 %) from 5 to 12 cm and diffuse grey organic mottles (10 %) from 12 to 25 cm.
LFb03-A.3	**Milang -** South of the main Milang beach and jetty and comprised an extensive area of beach, which extended from the pre-drought (pre 2006) shore to the waterline, approximately 750 m east. Soil profile located 130 m east of the pre-drought shoreline.	Spade	25	40	Dark brown heavy clay with much organic matter. Vertical root channels (3 to 4 mm) associated with pale yellow jarosite mottles (15 – 20 %) and few brownish red mottles.
LFb03-A.4			40	62	Yellowish grey loamy sand with yellow jarosite mottles (30%) and reddish brown mottles associated with root channels; dark grey mottles in the lower half of the layer.
LFb03-A.5			62	100	Grey medium sand with pale yellow jarosite mottles (15 %) in the upper half of the layer and brownish red mottles associated with root channels.
LFb03-A.6			100	110	Sulfidic dark olive heavy clay high in organic matter; slightly spongy with plant remains (coorongite?).
LFb03-B.1			0	5	Yellowish brown loose medium sand with reddish brown mottles (15 %).
LFb03-B.2			5	10	Yellowish brown medium sand with diffuse reddish brown mottles (40 %).
LFb03-B.3	Soil profile located 130 m west of the waterline.	Spade	10	30	Yellowish grey medium sand with light yellow jarosite mottles (30 %) throughout.
LFb03-B.4			30	50	Grey medium sand with black mottles (20 %) along vertical root channels; no mottles below 40 cm; sulfidic smell.
LFb03-B.5			50	70	Olive grey medium to coarse sand with coarse shell fragments; distinct 5 cm shell and bluish grey sandy clay layer at 60 cm.
LFb04-A.1	**Tolderol -** Located approximately 16 km north east of Milang, within	Spade	0	15	Light brown sand (7 cm) overlying grey brown sand with

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
	the Tolderol Game Reserve (Figure 1). The area comprised an extensive area of beach, which extended from the pre-drought (pre 2006) shore to the waterline, approximately 700 m south. Soil profile located 50 m south of the pre-drought shoreline.				distinct orange brown mottles (5 %) associated with abundant very fine rye grass roots; diffuse yellow jarosite mottles (5 %).
LFb04-A.2			15	26	Light grey medium sand with prominent yellow jarosite mottles (15 – 20 %) and prominent yellow brown mottles (5 %) associated with very few very few fine roots.
LFb04-A.3			26	40	Grey sand with distinct yellow jarosite mottles (10 - 15 %) around red brown stained roots.
LFb04-A.4			40	58	Dark grey medium sand with diffuse very dark grey mottles (< 5 %).
LFb04-A.5			58	65	Blue grey medium to heavy clay.
LFB04-C.1			0	15	Light brown sand with distinct red brown mottles (10 %).
LFb04-C.2	Soil profile located directly at the water's edge.	Spade	15	35	Dark grey to black medium sand.
LFb04-C.3			35	50	Olive grey gleyed sand with some fine fibric material.
LFb06-A.1	**Poltalloch -** Approximately 4 km north east of The Narrows, on the Poltalloch Station. The area comprised an extensive area of beach, which extended from the pre-drought (pre 2006) shore to the waterline, approximately 400 m north. Soil profile located 200 m south of the waterline.	Spade	0	28	Pale brown medium sand with diffuse pale reddish brown mottles associated with fine roots; whole shells (to 5 mm) on surface and shell fragments throughout layer.
LFb06-A.2		Spade	28	55	Pale brownish grey medium sand with diffuse brown mottles (5 – 10 %) towards base of layer; few whole shells and shell fragments.
LFb06-A.3			45	80	Grey to olive grey medium to coarse sand with light grey and brown grey mottles (10 %); many shell fragments and whole shells in upper half of layer; strong sulfidic smell.
LFb06-B.1	Soil profile located directly at the water's edge.	Spade	0	10	Pale brown medium sand with some layering from 0 to 5 cm. 0.5 cm reddish brown layer at 5 cm.
LFb06-B.2			10	35	Pale greyish brown medium sand with layering at 10 to 20 cm; distinct reddish brown mottles (5 %) associated with vertical root channels; reddish brown layer from 34 to 35 cm.
LFb06-B.3			35	50	Black medium sand with few shells (small bivalves < 5 mm).
LFb07-A.1	**Waltowa -** The north eastern extent of Lake Albert, on Waltowa Beach. The area comprised both revegetated beach and beach. Soil profile located 80 m from the position of the waterline during the	Spade	0	2	Brown grey medium clay (wash).
LFb07-A.2			2	35	Pale grey medium sand; yellowish at top with few orange mottles along root channels.

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
LFb07-A.3	first sampling.		35	50	Dark grey fine sandy clay loam; common living roots with light brown mottles around roots.
LFb07-A.4			50	70	Dark grey light medium clay with sapric bands; few fine (< 2 mm) shells; weak moderate structure.
LFb07-A.5			70	80	Olive grey light medium clay with 4 5 % darker mottles; moderate blocky structure.
LFb07-B.1	Soil profile situated where the water's edge was located during the first sampling.	Spade	0	1	Brown grey medium clay (wash); many fine roots.
LFb07-B.2			1	35	Yellowish grey medium sand grading to grey medium sand; 5 % orange brown mottles along root channels.
LFb07-B.3			35	45	Grey to dark grey medium sand; few brown mottles along root channels.
LFb07-B.4			45	60	Saturated dark grey to bluish grey sapric sandy clay.
LFb08-A.1	**Meningie -** West of the Meningie jetty. The area comprised a beach, which extended from the pre-drought (pre 2006) shore to the waterline, approximately 350 m north. Soil profile located 270 m south of the waterline. Compared to the first sampling, the waterline was approximately 200 m further from the pre-drought shore. This was attributed to lower water level in Lake Albert and the possible affect of seiche caused by strong southerly winds.	Spade	0	18	Light brown medium sand with common medium brown and red brown mottles; few diffuse grey mottles.
LFb08-A.2			18	28	Grey medium sand with few medium red brown mottles associated with root channels and common diffuse dark grey mottles below 24 cm.
LFb08-A.3			28	45	Dark olive grey light to medium massive clay with common coarse to medium plant fragments; strong sulfidic smell and shell grit below 40 cm.
LFb08-A.4			45	60	Dark green grey heavy clay with strong subangular blocky structure; strong sulfidic smell and few fine relic roots.
LFb08-B.1	Soil profile located approximately 200 m south of the waterline (This location was at the water's edge during the first sampling).	Spade	0	25	Light brown medium sand with few small red brown mottles.
LFb08-B.2			25	32	Very dark grey medium sand with common large black mottles and a sulfidic smell.
LFb08-B.3			32	45	Dark grey light sandy clay; massive.
LFb08-B.4			45	65	Greenish olive grey light clay; massive.
LFb10-A.1	**Campbell Park -** Northern side of Campbell Park Peninsula. The area comprised a beach, which extended from the pre-drought (pre 2006) shore to the waterline, approximately 900 m north. Compared to the first sampling, the waterline was approximately 600 m further from the pre-drought shore. This was attributed to lower water level	Spade	0	50	Brown to orange brown fibric/hemic peat; decomposed reed roots and clay loam.
LFb10-A.2			50	75	Pale grey sand to loamy sand with much brown organic material and many fine roots with reddish brown oxidised coatings.

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
LFb10-A.3	in Lake Albert and the possible affect of seiche caused by strong southerly winds. Soil profile located in a reed bed, on the pre-drought shoreline.		75	80	Yellowish brown to reddish brown loamy sand with brown organic matter and some clay pellets (2 – 3 mm); common shells.
LFb10-A.4			80	100	Grey to olive grey heavy clay with columnar structure breaking to polyhedral; reddish brown staining on ped surfaces; few coarse Phragmites roots.
LFb10-C.1			0	0.5	White to pale yellow and reddish brown surface efflorescence and fine grey sand.
LFb10-C.2			0.5	5	Very dark brown sapric clay loam peat.
LFb10-C.3			5	20	Grey light clay with strong jarosite mottles (15 %) and brown sapric peat (30 %); sharp boundary to underlying layer.
LFb10-C.4	Soil profile located 120 m north of the pre-drought shore. Bare soil surface, probably a groundwater discharge area.	Spade	20	35	Brownish grey medium sand with dark grey (30 %), pale yellow (jarosite) (20 %) and reddish brown (10 %) mottles; few much degraded relic roots.
LFb10-C.5			35	50	Very dark grey loamy sand with light grey (20 %) and reddish brown mottles (5 %) mottles and pale yellow jarosite (3 %) along root channels.
LFb10-C.6			50	80	Grey medium sand with reddish brown mottles (3 %) along root channels; moist.
LFb10-D.1			0	0.5	Dry layered brownish grey heavy clay with some organic matter throughout and fine polygonal cracks.
LFb10-D.2			0.5	15	Pale brownish yellow medium sand with diffuse brownish red mottles (15 – 20 %); sharp boundary to underlying layer.
LFb10-D.3	Soil profile located 280 m north of the pre-drought shore. Sparse barley grass.	Spade	15	35	Grey medium loamy sand with distinct dark grey mottles (40 %), distinct brownish red and yellowish brown mottles (15 %) and black mottles (10 %); sharp wavy boundary to underlying layer.
LFb10-D.4			35	55	Grey sandy loam with diffuse black mottles (< 5 %); few relic roots with brown staining (hard carbonate layer at 55 cm).
LFb12-A.1	**Loveday Bay -** South eastern extent of Lake Alexandrina, on the northern side of Loveday Bay. The study area comprised a partially revegetated sandy spit, which separated a large (approximately 220 hectares) dried pond from the main body of Lake Alexandrina. The pond was full of water during the first sampling. Soil profile located in the dried area of previously ponded water, 90 m from the previous	Spade	0	0.5	Surface crust of light yellow grey sand cemented with salt (Fe-oxides and sideronatrite).
LFb12-A.2			0.5	1.5	Yellow sideronatrite and medium sand.
LFb12-A.3			1.5	7	Moist to wet grey loamy sand with both continuous and discontinuous bands of dark grey loamy sand.

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
LFb12-A.4	(first sampling) waterline.		7	23	Brownish grey loamy sand with reddish brown mottles (5 %); few relic roots with jarosite mottles along root channels; some clay lenses and organic matter near lower boundary.
LFb12-A.5			23	50	Olive grey sandy clay; reddish brown mottles (3 – 5 %) along root channels.
LFb12-A.6			50	100	Olive grey sandy clay with sulfidic smell.
LFb12-B.1			0	10	Loose pale yellowish brown medium sand.
LFb12-B.2	Soil profile located directly at the edge of the ponded water (first sampling).	Spade	100	35	Pale brown loamy sand with distinct reddish brown and greyish mottles (15 %).
LFb12-B.3			35	40	Black medium sand with rare reddish brown mottles along root channels.
LFb12-B.4			40	60	Grey sandy clay with strong sulfidic smell.
LFb12-C.1			0	10	Loose very pale brownish yellow fine sand with reddish brown mottles (5 %) associated with medium roots; irregular and wavy boundary to underlying layer.
LFb12-C.2	Soil profile located on the beach/spit that separated the dried pond from the lake.	Spade	10	23	Pale brownish grey medium sand with strong reddish brown mottles (5 %) mottles along root channels; some remnant roots associated with jarosite.
LFb12-C.3			23	36	Light brownish grey sand with yellow jarosite mottles (20 %) along sides of reddish brown root channels.
LFb12-C.4			36	48	Olive grey sand to loamy sand with yellow jarosite mottles (20%) along root channels.
LFb12-C.5			48	80	Grey to dark grey loamy sand grading to sandy loam; strong brown and yellowish brown mottles around root channels.
LFb13-A.1			0	12	Grey fibric silty heavy clay; reddish brown mottles (20 %) along root channels; strongly matted roots.
LFb13-A.2	**Tauwitchere -** Northern side of Tauwitchere Island in tall (> 2 m) reeds. No water was present.	Spade	12	20	Brown to pale brown loamy medium sand; common fine to medium roots.
LFb13-A.3			20	50	Olive grey loamy sand; diffuse jarosite mottles (< 5 %) and coarse roots present.
LFb15-B.1			0	5	Fluffy, brown organic loam with some clay nodules.
LFb15-B.2	Soil profile located on the northern side of the creek bed.	Spade	5	15	Greyish brown medium sand with some darker and lighter mottles.

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
LFb15-B.3			15	20	Grey brown sandy clay; pale yellow jarosite mottles.
LFb15-B.4			20	30	Greyish brown fine sandy clay; pale yellow jarosite mottles along root channels (20 %) with red brown cores (< 1 %); distinct bluish grey remnant mottles (10 %).
LFb15-B.5			30	45	Grey to dark grey sandy loam with distinct yellowish brown to olive mottles (20 %) (possibly old root channels).
LFb15-B.6			45	70	Bluish grey sandy clay with diffuse large black mottles (< 3 %); moist; approximately 5 % paler grey bleached root channels; Sulfidic smell.
LFb15-C.1			0	10	Grey brown sandy clay that breaks to medium polyhedral structure; gypsum and jarosite coatings.
LFb15-C.2			10	20	Brownish grey to grey heavy clay; pale yellow jarosite mottles (15 – 20 %) around fine root channels and on ped faces; coarse prismatic or columnar structure.
LFb15-C.3	Soil profile located in the middle of the creek bed.	Spade	20	35	Pale brown sandy clay with diffuse yellow jarosite mottles (30 %); brownish red coatings on vertical ped faces.
LFb15-C.4			35	60	Bluish grey sandy clay with yellow and pale brownish red mottles (10 %) associated with root channels.
LFb15-C.5			60	70	Grey sandy clay with some small shells (< 2 mm) and a sulfidic smell.
LFb17-A.1			0	2	Light brownish grey medium sand crust with common distinct bright yellow jarosite mottles and reddish brown mottles.
LFb17-A.2	**Point Sturt South -** Southern side of Point Sturt on the south western side of Lake Alexandrina. The area comprised an extensive beach, which extended from the pre-drought (pre 2006) shore to the waterline, approximately 220 m south. Soil profile located 50 m south of the pre-drought shoreline. Approximately 15 cm of light brown medium sand had been lost to wind erosion across most of the beach.	Spade	2	30	Brownish grey medium sand with lenses of dark grey light clay; bright yellow (15 %) jarosite and reddish brown (5 – 10 %) mottles associated with clay lenses.
LFb17-A.3			30	38	Brownish grey medium sand with more lenses of dark grey light clay; bright yellow (15 %) jarosite and reddish brown (5 – 10 %) mottles associated with clay lenses; few relic Phragmites roots.
LFb17-A.4			38	58	Dark grey medium clay loam with lenses of dark grey light clay and red brown mottles associated with few relic roots.
LFb17-A.5			58	68	Dark grey sandy clay loam with reddish brown mottles associated with few relic roots (recovered moist).
LFb17-B.1	Soil profile located 70 north of the waterline. Water table at 90 cm.	Spade	0	20	Light grey sand with diffuse bright yellow jarosite mottles (30

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
					%), some associated with few fine roots.
LFb17-B.2			20	40	Grey medium sand with diffuse yellow jarosite mottles (15 %) and few yellowish brown mottles (< 5 %) associated with few root channels and relic roots.
LFb17-B.3			40	68	Dark greenish grey medium sand with distinct olive brown mottles (10 %) associated with root channels; few dark grey clayey sand lenses (2 to 5 cm).
LFb17-B.4			68	90	Dark greenish grey clayey sand with diffuse grey mottles (10 %).

October and November 2009 sampling

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
LFa01-A.1	**Wallys Landing and Wetland -** Middle of drainage ditch located to the north east of the Finniss River in approximately 1.1 m of water. Reeds growing from water near banks. Bed of ditch comprised polygonally cracked soils (cracks > 15 cm). **Subaqueous.**	Spade/ Gouge Auger	0	10	Black medium clay (sampled from polygonally crack soil).
LFa01-A.2			10	40	Dark grey medium clay with vertical cracks commonly infilled with medium sand and coated with jarosite; upper 2-5 cm contained fine quartz gravel.
LFa01-A.3			40	60	Very dark grey medium clay.
LFa01-D.1	Southern side of Finniss River channel on western side of Wallys Jetty, approximately one metre from the bank, in approximately 0.6 m of water. **Subaqueous.**	Spade	0	5	Dark brown silty clay; common roots.
LFa01-D.2			5	15	Grey brown sandy clay; common roots with jarosite coatings along root channels.
LFa02-A.1	**Point Sturt North -** An extensive area of beach, which extended from the pre-drought (pre 2006) shore to the waterline. The beach was sparsely revegetated with grasses. Soil profile located approximately 60 m north of the pre-drought shoreline.	Spade	0	8	Sideronatrite crust (3 mm) on soil surface overlying loose pale greyish brown medium sand; thin (< 0.5 cm) layers of brown sapric material.
LFa02-A.2			8	25	Pale grey medium to coarse sand with horizontal banding of darker grey medium to coarse sand; 10 to 15 % yellow mottles (possibly sideronatrite).
LFa02-A.3			25	40	Grey medium to coarse sand with 5 to 10 % yellow mottles with orange cores.
LFa02-A.4			40	70	Olive grey loamy sand with 5 % orange brown mottles along root channels.
LFa02-A.5			40	77	Recovered saturated olive grey loamy sand; few relic coarse roots.
LFa02-B.1	Soil profile located approximately 25 m south of the waterline.	Spade	0	8	Dry loose pale grey brown medium sand (possibly windblown).
LFa02-B.2			8	25	Pale brown medium to coarse sand with thin orange and grey layers of medium to coarse sand; common small dark brown mottles.
LFa02-B.3			25	32	Pale grey medium to coarse sand; few small black mottles; orange brown band of medium coarse sand at lower boundary.
LFa02-B.4			32	65	Dark grey sapric medium sand with bands or horizontal mottles of black medium sand more common from 45 to 65 cm. Sulfuric smell.

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
LFa02-B.5			65	75	Black medium to coarse sand with 20 % large grey mottles with diffuse edges; few small bivalves and shell fragments.
LFa03-A.1	**Milang -** South of the main Milang beach and jetty and comprised an extensive area of beach, which extended from the pre-drought (pre 2006) shore to the waterline, approximately 750 m east. Soil profile located 130 m east of the pre-drought shoreline.	Spade	0	30	Pale yellowish grey fine sand with 10 to 15 % dark brown grey and yellow mottles; mussel shells at 25 cm.
LFa03-A.2			30	40	Very dark olive grey medium clay; many roots
LFa03-A.3			40	50	Grey medium to coarse sand with 20 % orange and yellow mottles especially along root channels.
LFa03-A.4			50	70	Dark grey medium to coarse sand.
LFa03-B.1	Soil profile located 130 m west of the waterline.	Spade	0	15	Yellow grey medium to coarse sand with thin bands of orange brown medium to coarse sand.
LFa03-B.2			15	30	Light grey medium to coarse sand with 15 to 20 % orange brown mottles.
LFa03-B.3			30	60	Grey medium to coarse sand with 10 % bluish grey medium clay.
LFa03-B.4			60	65	Bluish grey medium clay.
LFa04-A.1	**Tolderol -** Located approximately 16 km north east of Milang, within the Tolderol Game Reserve (Figure 1). The area comprised an extensive area of beach, which extended from the pre-drought (pre 2006) shore to the waterline, approximately 700 m south. Soil profile located 50 m south of the pre-drought shoreline.	Spade	0	25	Thin layer of oxidised, dry loose light brown medium to coarse sand overlying pale grey medium to coarse sand with 5 % orange mottles along root channels.
LFa04-A.2			25	35	Grey medium sand with 10 to 15 % yellow jarosite mottles.
LFa04-A.3			35	42	Greenish grey sandy clay with few orange mottles along root channels.
LFa04-A.4			42	55	Grey medium sand with few orange mottles along root channels.
LFa04-C.1	Soil profile located directly at the water's edge.	Spade	0	3	Pale brown medium to coarse sand with bright orange mottles.
LFa04-C.2			3	10	Grey to dark grey medium sand with 10 % brownish orange mottles and few black mottles.
LFa04-C.3			10	35	Recovered saturated very dark grey to black medium to coarse sand.
LFa06-A.1	**Poltalloch -** Approximately 4 km north east of The Narrows, on the Poltalloch Station. The area comprised an extensive area of beach, which extended from the pre-drought (pre 2006) shore to the	Spade	0	20	Pale brown medium sand, loose; few orange mottles around plant roots.
LFa06-A.2			20	45	Pale yellowish grey medium sand; 5 % brown mottles along

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
	waterline, approximately 400 m north. Soil profile located 200 m south of the waterline.				root channels; few small shell fragments.
LFa06-A.3			45	80	Grey medium sand with 10 % black diffuse mottles in upper 10 cm; few shell fragments.
LFa06-B.1	Soil profile located directly at the water's edge.	Spade	0	5	Brown (oxidised) medium sand (~ 1 cm) overlying black to grey layered medium sand.
LFa06-B.2			5	25	Brownish grey medium to coarse sand with brown and black medium to coarse sand.
LFa06-B.3			25	45	Black clayey sand with 10 to 15 % grey sandy mottles.
LFa06-B.4			45	60	Grey medium sand with few diffuse grey mottles; many small (< 5 mm) bivalves.
LFa07-A.1	**Waltowa -** The north eastern extent of Lake Albert, on Waltowa Beach. The area comprised a beach, which extended from the pre-drought (pre 2006) shore to the waterline, approximately 200 m south west. Soil profile located 80 m from the waterline.	Spade	0	2	Brown grey medium clay (wash).
LFa07-A.2			2	35	Pale grey medium sand, yellowish at top with few orange mottles along root channels.
LFa07-A.3			35	50	Dark grey fine sandy clay loam; common living roots with light brown mottles around roots.
LFa07-A.4			50	70	Dark grey light medium clay with sapric bands; weak moderate structure, few fine (< 2 mm) shells.
LFa07-A.5			70	80	Olive grey light medium clay with 4 5 % darker mottles; moderate blocky structure.
LFa07-B.1	Soil profile located directly at the water's edge.	Spade	0	1	Brownish grey medium clay (wash); many fine roots.
LFa07-B.2			1	35	Yellowish grey medium sand grading to grey medium sand with 5 % orange brown mottles along root channels.
LFa07-B.3			35	45	Grey to dark grey medium sand with few brown mottles along root channels.
LFa07-B.4			45	60	Dark grey to bluish grey sapric sandy clay; recovered saturated.
LFa08-A.1	**Meningie -** West of the Meningie jetty. The area comprised a beach, which extended from the pre-drought (pre 2006) shore to the waterline, approximately 150 m north. Soil profile located 70 m south of the waterline.	Spade	0	8	Pale yellow brown medium sand with 20 % grey mottles and an orange band of medium sand at 7 cm.
LFa08-A.2			8	18	Grey becoming pale brownish grey medium sand with depth with 10 % dark grey mottles and 5 % orange mottles.
LFa08-A.3			18	25	Grey medium sand with 5 to 10 % black mottles, some shell fragments and roots; strong sulfidic smell.

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
LFa08-A.4			25	50	Dark grey medium clay; many Phragmites roots and small gastropods (< 3 mm); sulfidic smell.
LFa08-A.5			50	60	Greenish grey medium clay; coarse Phragmites roots; strong sulfidic smell.
LFa08-B.1			0	10	Surface brown algal crust (<5 mm) overlying grey medium sand with 10 % black mottles.
LFa08-B.2		Spade	10	20	Yellowish grey medium sand with 15 % orange mottles.
LFa08-B.3	Soil profile located directly at the water's edge.		20	35	Grey and dark grey medium sand bands; strong sulfidic smell.
LFa08-B.4			35	55	Greenish olive grey medium clay with grey medium sand infills planar voids or cracks; strong sulfidic smell.
LFa10-A.1			0	50	Brown to orange brown fibric peat with decomposed reed roots and clay loam.
LFa10-A.2	Campbell Park - Northern side of Campbell Park Peninsula. The area comprised a beach, which extended from the pre-drought (pre 2006) shore to the waterline, approximately 300 m north. Soil profile located in a reed bed, on the pre-drought shoreline.	Spade	50	75	Grey medium sand with 10 to 15 % reddish brown mottles along plant rootlets.
LFa10-A.3			75	80	Brown medium to coarse sand.
LFa10-A.4			80	100	Recovered moist light grey medium to heavy clay.
LFa10-C.1			0	0.5	Pale yellow brown crust (possibly sideronatrite).
LFa10-C.2			0.5	5	Dark reddish brown fibric silty clay; many relic Phragmites roots.
LFa10-C.3	Soil profile located 190 m south of the waterline.	Spade	5	20	Light brown medium to coarse sand with 15 % yellow brown mottles.
LFa10-C.4			20	50	Grey clayey sand with 10 % yellow mottles with orange hollows.
LFa10-C.5			50	80	Grey fine to medium clay.
LFa10-D.1			0	5	Grey light clay (oxidised < 2 cm) overlying black light clay gel.
LFa10-D.2	Soil profile located 20 m south of the waterline.	Spade	5	20	Light brown medium sand with 5 to 10 % orange mottles.
LFa10-D.3			20	50	Dark grey clayey sand becoming grey.
LFa12-A.1	Loveday Bay - South eastern extent of Lake Alexandrina, on the northern side of Loveday Bay. The study area comprised a partially	Spade	0	1	Light yellow algal crust or mat (2 mm).
LFa12-A.2			1	15	Grey medium sand.

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
LFa12-A.3	revegetated sandy spit, which separated a large (approximately 220 hectares) pond of water from the main body of Lake Alexandrina. Soil profile located in the pool of ponded water, 90 m from the waterline. **Subaqueous.**		15	40	Grey sandy clay.
LFa12-A.4			40	100	Dark grey light medium clay.
LFa12-A.5			100	130	Grey heavy clay.
LFa12-B.1	Soil profile located directly at the edge of the pool of ponded water.	Spade	0	2	Reddish orange cracked medium clay.
LFa12-B.2			0	2	Black cracked medium clay.
LFa12-B.3			2	16	Black medium sand.
LFa12-B.4			16	25	Light grey medium sand with 10 % brown mottles.
LFa12-C.1	Soil profile located on the beach/spit that separated the ponded water from the lake.	Gouge Auger	0	0.5	Yellow salt crust
LFa12-C.2			0.5	10	Light brown medium sand; many roots with orange brown coatings.
LFa12-C.3			10	40	Light brown medium sand.
LFa12-C.4			40	60	Light brown medium sand.
LFa12-C.5			60	80	Grey medium sand.
LFa13-A.1	**Tauwitchere -** Northern side of Tauwitchere Island in tall (> 2 m) reeds. No water was present.	Spade	0	13	Grey fibric silty clay with jarosite mottles and coatings along root channels; many matted roots.
LFa13-A.2			13	18	Brownish grey (buff) loamy medium sand with 10 to 15 % jarosite mottles and some fine roots.
LFa13-A.3			18	50	Grey loamy medium sand with some shell fragments and coarse roots present.
LFa15-B.1	Soil profile located on the northern side of the creek bed.	Spade	0	5	Fluffy, brown sandy clay (oxidised MBO?).
LFa15-B.2			5	20	Light brown medium sand with lenses of soft grey sandy clay.
LFa15-B.3			20	25	Grey sandy clay with 10 to 15 % light yellow mottles along root voids; root voids infilled with medium sand.
LFa15-B.4			25	35	Light brown sandy clay with 5 to 10 % reddish orange mottles along root voids.
LFa15-B.5			35	70	Grey clayey sand that grades to grey slightly sandy clay with depth.
LFa15-C.5	Soil profile located in the middle of the creek bed.	Spade	0	0.3	White salt efflorescences on soil surface.
LFa15-C.1			0.3	10	Soft brown sandy clay with 10 to 15 % yellow and orange

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
					mottles.
LFa15-C.2			10	20	Dark grey medium sand; moderate structure; fine to medium sand in root voids.
LFa15-C.3			20	30	Grey clayey sand with few cracks infilled with light brown sandy clay with central zones of orange red oxidation.
LFa15-C.4			30	70	Grey sandy clay.
LFa17-A.1		Spade	0	15	Light brown medium sand; few medium roots, 15 % common yellowish orange mottles associated with roots.
LFa17-A.2	**Point Sturt South -** Southern side of Point Sturt on the south western side of Lake Alexandrina. The area comprised an extensive beach, which extended from the pre-drought (pre 2006) shore to the waterline, approximately 220 m south. Soil profile located 50 m south of the pre-drought shoreline.	Spade	15	30	Dark grey sandy clay; common relic roots with associated light yellow mottles; root voids associated with red orange mottles.
LFa17-A.3			30	45	Light brown medium sand with lenses of grey light medium clay and common yellowish orange coarse mottles; few relic roots with orange coatings.
LFa17-A.4			45	60	Grey medium sand; coarse relic roots with red orange coatings; large pieces of wood present.
LFa17-B.1		Spade	0	15	Light brown medium sand with 10 to 15 % diffuse grey mottles; few fine roots.
LFa17-B.2	Soil profile located 70 north of the waterline.	Spade	15	30	Light brown medium sand; few live medium roots and relic roots, diffuse yellow mottles around root voids and red orange mottles around remnant roots.
LFa17-B.3			30	50	Grey fine to medium sand with red orange mottles along relic root channels.
LFa17-B.4			50	70	Grey medium sand with lenses of sapric material and few coarse diffuse black mottles.

Appendix 4 – Profile photographs

Wallys Landing & Wetland

LFa01-A	LFb01-A	LFc01-A	LFd01-A	LFe01-A	LFf01-A

LFa01-D	LFb01-D	LFc01-D	LFd01-D	LFe01-D	LFf01-D

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Point Sturt North

LFa02-A

LFb02-A

LFc02-A

LFd02-A

LFe02-A

LFf02-A

LFa02-B

LFb02-B

LFc02-B
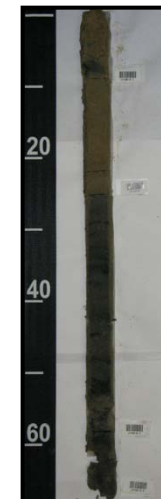
LFd02-B

LFe02-B

LFf02-B

Milang

LFa03-A

LFb03-A

LFc03-A

LFd03-A

LFe03-A

LFf03-A

LFa03-B

LFb03-B

LFc03-B

LFd03-B

LFe03-B

LFf03-B

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Tolderol

| LFa04-A | LFb04-A | LFc04-A | LFd04-A | LFe04-A | LFf04-A |

| LFa04-C | LFb04-C | LFc04-C | LFd04-C | LFe04-C | LFf04-C |
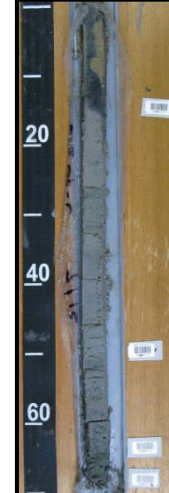
Poltalloch

LFa06-A	LFb06-A	LFc06-A	LFd06-A	LFe06-A	LFf06-A
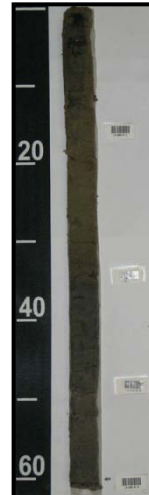
LFa06-B	LFb06-B	LFc06-B	LFd06-B	LFe06-B	LFf06-B

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Waltowa

LFa07-A	LFb07-A	LFc07-A	LFd07-A	LFe07-A	LFf07-A
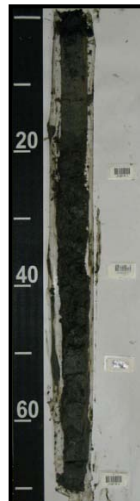
LFa07-B	LFb07-B	LFc07-B	LFd07-B	LFe07-B	LFf07-B

Meningie

LFa08-A	LFb08-A	LFc08-A	LFd08-A	LFe08-A	LFf08-A
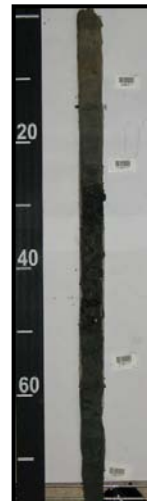
LFa08-B	LFb08-B	LFc08-B	LFd08-B	LFe08-B	LFf08-B

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Campbell Park

LFa10-A

LFb10-A

LFc10-A

LFd10-A

LFe10-A

LFf10-A

LFa10-C

LFb10-C

LFc10-C

LFd10-C

LFe10-C

LFf10-C

LFa10-D

LFb10-D

LFc10-D
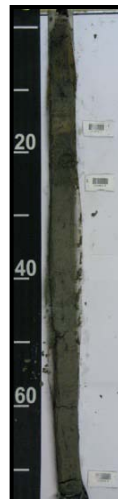
LFd10-D

LFe10-D

LFf10-D

Loveday Bay

LFa12-A

LFb12-A

LFc12-A

LFd12-A

LFe12-A

LFf12-A

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

LFa12-B

LFb12-B

LFc12-B

LFd12-B
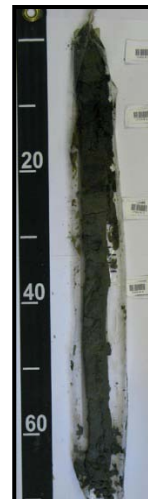
LFe12-B
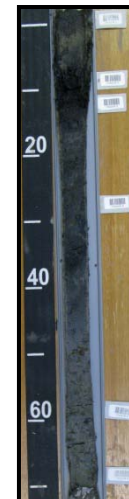
LFf12-B

LFa12-C

LFb12-C

LFc12-C

LFd12-C

LFe12-C

LFf12-C

Tauwitchere

LFa13-A	LFb13-A	LFc13-A	LFd13-A	LFe13-A	LFf13-A

Boggy Creek

LFa15-B	LFb15-B	LFc15-B	LFd15-B	LFe15-B	LFf15-B

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia
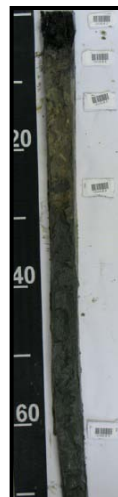
LFa15-C LFb15-C LFc15-C LFd15-C LFe15-C LFf15-C

Point Sturt South
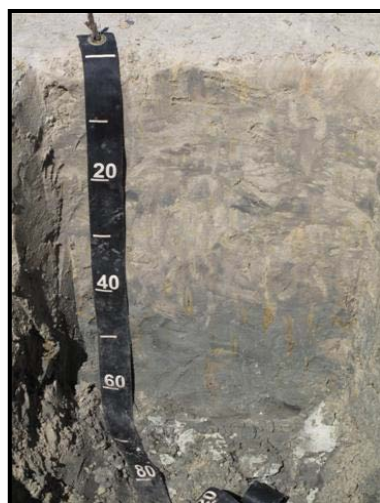
LFa17-A LFb17-A LFc17-A LFd17-A LFe17-A LFf17-A
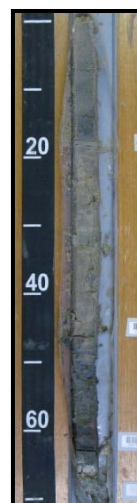
LFa17-B   LFb17-B   LFc17-B   LFd17-B   LFe17-B   LFf17-B

Dog Lake

LFb19-A   LFc19-A   LFd19-A   LFe19-A   LFf19-A

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

LFe19-B

LFf19-B

Boggy Lake

LFb20-A

LFc20-A

LFd20-A

LFe20-A

LFf20-A

LFe20-B

LFf20-B

Windmill Site

LFc21-A

LFd21-A

LFe21-A

LFf21-A

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia
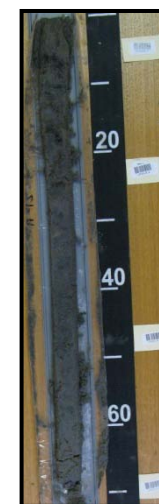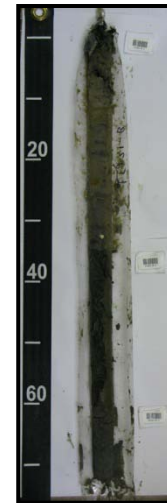
LFc21-B LFd21-B LFe21-B LFf21-B

Lower Currency
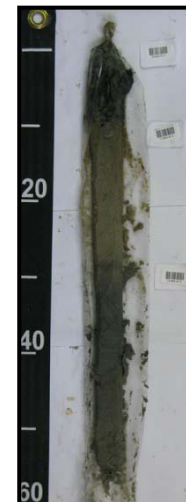
LFc23-A LFd23-A LFe23-A LFf23-A

Lower Finniss

LFc24-A LFd24-A LFe24-A LFf24-A

LFc24-B LFd24-B LFe24-B LFf24-B

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Appendix 5 – Soil moisture, bulk density, EC and pH

Notes: pH incubation values between 4 and 5.5 are highlighted in orange and values less than 4 are highlighted in bold red.

June 2012 sampling

Sample ID	Wet weight (g)	Dry weight (g)	Moisture (%)	Bulk density (g cm^{-3})	pH Water	EC (ms cm^{-1})	pH peroxide	pH incubation, Time = 0 weeks	pH incubation, Time > 10 weeks
LFf01-A.1	117.90	71.38	79.01	1.02	5.80	0.69	2.12	6.60	4.12
LFf01-A.2	109.27	70.56	66.67	1.01	4.46	2.58	1.67	5.89	**3.18**
LFf01-A.3	98.33	51.84	118.17	0.74	4.60	3.99	1.86	4.56	**2.90**
LFf01-A.4	88.72	38.01	198.78	0.54	5.91	5.30	1.64	4.39	**1.89**
LFf01-A.5				0.00				5.84	**1.86**
LFf01-D.1	87.66	33.62	255.87	0.48	5.23	3.08	1.47	5.19	**3.65**
LFf01-D.2	86.60	37.97	190.93	0.54	4.45	4.42	1.05	4.39	**2.12**
LFf01-D.3	117.88	76.18	65.48	1.09	5.50	2.67	1.24	5.30	**1.93**
LFf01-D.4	106.77	63.09	86.34	0.90	7.01	3.38	1.36	6.57	**1.81**
LFf02-A.1	121.81	100.70	23.93	1.44	6.29	0.12	3.08	6.75	**3.71**
LFf02-A.2	120.51	100.07	23.34	1.43	5.72	0.18	2.53	6.71	**2.81**
LFf02-A.3	114.46	96.30	21.67	1.38	4.64	0.19	2.14	5.98	**2.99**
LFf02-A.4	137.63	110.44	27.76	1.58	4.34	0.38	1.55	4.28	**1.90**
LFf02-B.1	115.37	97.31	21.29	1.39	7.84	0.11	4.00	8.16	**3.55**
LFf02-B.2	108.82	91.98	21.19	1.31	8.10	0.13	4.49	7.66	5.96
LFf02-B.3	116.76	98.84	20.76	1.41	8.23	0.13	4.73	8.05	5.45
LFf02-B.4	40.70	35.95	18.96	1.80	8.27	0.15	3.27	8.07	6.73
LFf02-D.1	131.52	104.74	29.03	1.50	5.59	0.10	2.97	6.32	**3.94**
LFf02-D.2	134.05	106.56	29.23	1.52	4.12	0.18	2.14	**3.82**	**3.26**
LFf02-D.3	119.01	96.07	27.45	1.37	3.90	0.28	1.85	**3.70**	**3.25**
LFf02-D.4	117.50	99.55	20.62	1.42	4.20	0.51	1.55	4.28	**1.97**

Sample ID	Wet weight (g)	Dry weight (g)	Moisture (%)	Bulk density (g cm^{-3})	pH Water	EC (ms cm^{-1})	pH peroxide	pH incubation, Time = 0 weeks	pH incubation, Time > 10 weeks
LFf03-A.1	126.52	99.04	31.75	1.41	5.76	0.28	2.00	6.00	3.41
LFf03-A.2	115.54	92.03	29.56	1.31	4.81	0.39	1.98	5.73	3.13
LFf03-A.3	111.37	66.18	84.18	0.95	4.41	2.52	1.46	4.08	2.86
LFf03-A.4	134.62	108.44	27.29	1.55	3.86	0.94	1.70	3.64	2.47
LFf03-A.5					3.63	0.79	2.07	3.66	1.87
LFd03-B.1	129.84	108.32	22.46	1.55	4.50	0.13	2.35	5.89	2.73
LFd03-B.2	126.73	107.89	19.75	1.54	4.69	0.14	2.67	5.96	3.75
LFd03-B.3	125.60	106.89	19.82	1.53	4.40	0.10	2.47	5.56	3.02
LFd03- B.4	118.14	100.08	20.62	1.43	4.32	0.23	2.13	5.93	2.18
LFd03- B.5	117.44	99.87	20.11	1.43	6.84	0.36	2.28	6.43	2.27
LFf04-A.1	116.41	92.90	29.24	1.33	4.99	0.14	2.16	5.88	2.55
LFf04-A.2	122.94	96.86	30.92	1.38	4.51	0.48	2.29	4.34	2.88
LFf04-A.3	126.34	91.11	44.82	1.30	4.45	0.55	1.93	4.00	2.15
LFf04-A.4	115.73	93.93	26.77	1.34	4.99	0.38	2.04	4.47	1.89
LFf04-A.5	119.92	89.67	39.20	1.28	7.76	0.32	2.00	6.29	1.91
LFf04-C.1					8.38	0.13	3.04	8.20	2.90
LFf04-C.2	103.87	85.44	25.27	1.22	8.72	0.26	2.28	8.28	2.38
LFf04-C.3	103.15	84.82	25.35	1.21	8.14	0.16	2.02	8.35	5.47
LFf04-C.4								8.11	5.72
LFf06-A.1	120.64	100.22	23.28	1.43	8.13	0.17	4.62	7.43	4.95
LFf06-A.2	117.13	99.07	20.86	1.42	8.33	0.19	6.94	7.74	7.33
LFf06-A.3	120.61	101.88	20.96	1.46	8.08	0.32	3.11	8.35	7.47
LFf06-A.4	116.72	98.34	21.41	1.40	8.28	0.23	2.35	8.38	2.05
LFf06-B.1	126.00	102.44	26.20	1.46	7.96	0.13	6.67	7.12	7.14
LFf06-B.2	126.37	95.08	37.89	1.36	8.04	0.32	6.92	7.48	7.16
LFf06-B.3	133.02	108.09	26.08	1.54	8.31	0.73	5.05	7.93	7.42

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Sample ID	Wet weight (g)	Dry weight (g)	Moisture (%)	Bulk density (g cm^{-3})	pH Water	EC (ms cm^{-1})	pH peroxide	pH incubation, Time = 0 weeks	pH incubation, Time > 10 weeks
LFf06-B.4								7.21	5.03
LFf07-A.1	130.13	101.19	32.63	1.45	7.77	0.41	2.61	7.18	2.62
LFf07-A.2	140.49	107.81	34.29	1.54	6.89	0.62	3.12	6.72	3.94
LFf07-A.3	129.45	97.06	38.30	1.39	6.74	0.91	1.87	6.48	2.41
LFf07-A.4	97.90	39.28	218.89	0.56	7.24	4.04	1.46	6.46	2.07
LFf07-A.5	99.75	42.92	186.82	0.61	8.47	1.90	1.69	7.34	1.89
LFf07-B.1	140.97	113.22	27.55	1.62	7.89	0.27	3.63	7.18	3.70
LFf07-B.2	132.12	106.11	27.79	1.52	7.57	0.47	3.49	7.29	4.77
LFf07-B.3	114.96	78.76	54.63	1.13	7.13	0.82	3.19	6.98	6.14
LFf07-B.4	107.66	55.84	119.57	0.80	7.77	2.35	1.75	7.08	1.89
LFf08-A.1	137.66	108.69	30.12	1.55	7.81	0.49	3.17	7.14	3.10
LFf08-A.2	138.92	110.51	28.99	1.58	8.17	2.72	2.83	7.50	2.48
LFf08-A.3	104.10	48.39	155.22	0.69	7.77	3.60	1.73	6.98	2.53
LFf08-A.4	96.34	39.67	208.58	0.57	8.00	9.29	1.84	7.07	1.98
LFf08-B.1	138.98	112.40	26.61	1.61	7.99	0.44	6.42	7.31	7.03
LFf08-B.2	131.73	105.29	28.49	1.50	8.10	0.85	6.06	7.85	7.34
LFf08-B.3	102.45	45.58	171.92	0.65	8.18	3.82	4.28	7.23	5.19
LFf08-B.4	95.49	32.60	312.89	0.47	8.32	8.01	1.95	7.38	2.09
LFf10-A.1	104.59	59.95	94.08	0.86	6.44	1.47	2.42	6.74	5.24
LFf10-A.2	124.64	84.48	55.79	1.21	7.30	0.68	6.93	7.35	7.26
LFf10-A.3	104.88	56.32	110.82	0.80	4.12	5.50	2.34	3.68	2.35
LFf10-A.4	93.16	37.51	222.51	0.54	4.63	0.41	1.64	4.00	1.82
LFf10-C.1	118.73	83.29	50.06	1.19	6.63	3.50	2.67	7.21	3.77
LFf10-C.2	126.07	89.06	48.34	1.27	5.32	0.65	1.46	5.96	3.03
LFf10-C.3	125.74	100.55	28.61	1.44	4.86	0.45	1.39	5.73	2.76
LFf10-C.4	108.14	89.99	23.42	1.29	3.90	0.31	1.45	4.13	1.98

Sample ID	Wet weight (g)	Dry weight (g)	Moisture (%)	Bulk density (g cm^{-3})	pH Water	EC (ms cm^{-1})	pH peroxide	pH incubation, Time = 0 weeks	pH incubation, Time > 10 weeks
LFf10-D.1	123.37	100.38	26.16	1.43	7.71	0.33	1.66	6.88	7.25
LFf10-D.2	131.33	104.45	29.23	1.49	7.73	0.20	5.56	7.44	7.52
LFf10-D.3	127.22	100.18	30.84	1.43	7.61	0.25	2.02	6.99	7.08
LFf10-D.4	135.57	104.93	33.15	1.50	7.53	0.65	6.59	6.89	7.38
LFf10-D.4A	139.54	111.16	28.77	1.59	7.61	0.41	2.92	6.63	4.12
LFf10-D.5	144.09	117.50	25.32	1.68	7.95	0.38	2.86	7.18	1.72
LFf12-A.1	137.78	102.64	38.98	1.47	5.22	0.46	2.00	6.06	3.22
LFf12-A.2	130.67	92.42	47.86	1.32	4.79	0.88	1.76	5.84	3.63
LFf12-A.3	136.80	99.57	42.76	1.42	5.08	0.69	1.69	5.46	2.35
LFf12-A.4	127.96	85.97	57.15	1.23	6.04	1.45	1.95	6.17	2.19
LFf12-A.5	135.30	97.70	44.13	1.40	8.02	0.83	1.69	6.92	2.42
LFf12-A.6	112.90	62.23	101.89	0.89	8.34	1.20	2.30	7.16	1.94
LFf12-B.1	137.45	113.04	24.28	1.61	7.81	0.13	3.24	7.46	4.07
LFf12-B.2	130.42	104.10	28.73	1.49	7.84	0.38	3.30	7.60	2.76
LFf12-B.3	133.22	108.54	25.70	1.55	7.82	0.26	3.84	7.43	4.45
LFf12-B.4	136.99	112.46	24.54	1.61	7.97	0.50	3.22	7.58	2.78
LFf12-B.5	139.33	113.49	25.59	1.62	7.96	0.44	1.94	7.60	2.58
LFf12-B.6	138.96	102.64	40.29	1.47	7.93	0.70	1.68	7.93	2.51
LFf12-C.1	134.59	110.56	24.51	1.58	5.78	0.06	2.64	6.00	3.16
LFf12-C.2	138.36	113.41	24.73	1.62	4.39	0.14	2.31	4.33	3.12
LFf12-C.3	144.06	117.06	25.82	1.67	4.57	0.24	1.82	4.40	2.06
LFf13-A.1	90.88	35.93	234.53	0.51	7.59	1.85	2.74	6.81	2.15
LFf13-A.2	125.21	97.52	32.57	1.39	7.93	0.39	6.02	7.46	3.42
LFf13-A.3	130.92	105.35	27.54	1.51	7.92	0.37	6.62	7.35	7.11
LFf13-A.4	120.55	98.51	25.62	1.41	7.92	0.44	6.70	7.28	7.42
LFf15-B.1					6.63	0.59	2.16	6.21	3.46

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Sample ID	Wet weight (g)	Dry weight (g)	Moisture (%)	Bulk density (g cm^{-3})	pH Water	EC (ms cm^{-1})	pH peroxide	pH incubation, Time = 0 weeks	pH incubation, Time > 10 weeks
LFf15-B.2	134.44	99.09	40.82	1.42	5.57	0.28	2.73	5.41	3.53
LFf15-B.3	128.68	92.41	45.39	1.32	5.45	0.62	2.67	4.47	2.96
LFf15-B.4	124.79	87.14	50.44	1.24	7.84	0.57	6.39	7.08	7.16
LFf15-B.5	129.41	91.70	47.61	1.31	8.63	0.55	7.48	7.94	7.39
LFf15-C.1	110.48	66.37	81.88	0.95	5.69	1.78	4.54	6.05	3.50
LFf15-C.2	122.69	81.98	58.59	1.17	5.08	2.08	2.45	4.65	2.50
LFf15-C.3	125.56	89.04	47.71	1.27	7.04	0.99	5.61	5.56	2.64
LFf15-C.4	123.24	86.13	50.40	1.23	8.36	0.55	6.47	6.95	7.14
LFf15-C.5	123.65	88.22	46.79	1.26	8.25	1.28	6.75	7.60	7.48
LFf17-A.1	133.35	110.39	23.45	1.58	5.00	0.04	3.16	5.08	4.55
LFf17-A.2	139.02	108.19	32.22	1.55	3.76	0.23	2.03	3.67	3.25
LFf17-A.3	142.30	111.65	30.91	1.60	4.19	0.42	1.66	4.40	1.91
LFf17-B.1	119.24	96.54	27.01	1.38	4.39	0.64	2.43	4.98	3.47
LFf17-B.2	119.19	97.38	25.70	1.39	3.97	0.31	2.15	4.15	3.15
LFf17-B.3	108.59	89.57	24.68	1.28	4.40	0.58	2.04	4.88	2.57
LFf17-B.4	45.09	37.37	29.17	1.87	7.36	0.53	1.50	7.52	2.32
LFf19-A.1	115.21	86.60	38.61	1.24	3.60	0.86	1.68	3.60	2.88
LFf19-A.2	130.22	108.23	22.97	1.55	3.48	1.12	2.02	3.30	2.77
LFf19-A.3	138.66	111.30	27.69	1.59	6.86	1.81	6.89	5.88	2.56
LFf19-B.1	117.79	75.71	66.57	1.08	6.34	0.26	3.48	6.33	4.12
LFf19-B.2	118.12	76.04	66.23	1.09	5.00	0.34	2.59	5.01	3.82
LFf19-B.3	90.00	84.75	7.27	1.21	6.58	2.20	4.20	5.42	3.90
LFf19-B.4	138.24	108.95	30.37	1.56	7.73	1.04	7.32	6.83	7.46
LFf20-A.1	104.87	55.44	115.11	0.79	6.50	0.32	2.91	6.26	2.98
LFf20-A.2	100.54	46.16	161.56	0.66	5.10	1.29	2.04	5.77	3.02
LFf20-A.3	115.90	69.66	80.90	1.00	4.04	0.97	1.57	4.10	2.44

Sample ID	Wet weight (g)	Dry weight (g)	Moisture (%)	Bulk density (g cm^{-3})	pH Water	EC (ms cm^{-1})	pH peroxide	pH incubation, Time = 0 weeks	pH incubation, Time > 10 weeks
LFf20-A.4	102.20	51.87	127.84	0.74	4.45	1.35	2.85	3.95	1.70
LFf20-A.5	107.82	53.76	131.02	0.77	6.52	1.34	2.04	6.54	1.60
LFf20-B.1	102.32	49.39	143.48	0.71	5.69	1.36	3.21	6.14	3.00
LFf20-B.2	87.94	40.13	173.04	0.57	5.50	0.64	1.60	5.13	2.25
LFf20-B.3	106.00	58.28	104.24	0.83	4.89	1.57	1.69	4.49	1.65
LFf20-B.4	111.09	64.88	88.22	0.93	4.69	1.04	2.11	4.38	1.60
LFf20-B.5	126.11	103.84	24.38	1.48	7.30	1.64	2.15	5.83	2.53
LFf21-A.1					6.65	0.34	1.54	6.42	2.16
LFf21-A.2	119.15	93.64	31.44	1.34	6.02	0.32	1.35	6.61	2.14
LFf21-A.3	116.19	96.06	24.09	1.37	6.65	0.47	1.62	6.52	1.79
LFf21-A.4	122.20	102.20	22.30	1.46	6.99	0.77	1.63	6.86	1.61
LFf21-B.1					7.57	0.71	4.20	7.60	4.48
LFf21-B.2	109.60	90.09	25.14	1.29	7.27	0.38	4.58	7.48	6.51
LFf21-B.3	98.69	52.10	117.65	0.74	7.42	2.65	2.12	6.96	2.95
LFf21-B.4					7.91	0.72	1.91	7.70	2.34
LFf23-A.1	141.65	116.20	24.54	1.66	5.25	0.59	2.14	6.30	2.70
LFf23-A.2	119.86	100.79	21.60	1.44	4.90	0.45	2.49	5.98	3.50
LFf23-A.3	111.97	93.85	22.27	1.34	4.40	0.74	1.98	4.34	3.17
LFf23-A.4	142.64	110.65	32.59	1.58	6.95	1.44	1.51	6.15	1.96
LFf23-A.5	141.00	116.37	23.71	1.66	7.24	0.36	1.61	7.05	2.09
LFf24-A.1	89.71	32.18	292.33	0.46	5.88	1.93	1.73	5.99	4.90
LFf24-A.2	103.57	50.43	140.10	0.72	4.99	3.52	1.30	5.13	2.72
LFf24-A.3	104.92	45.55	179.64	0.65	4.64	5.17	1.69	4.50	1.96
LFf24-A.4	103.67	39.29	240.31	0.56	7.70	1.73	1.51	5.76	1.84
LFf24-B.1	98.96	44.52	170.02	0.64	6.99	0.94	1.66	6.85	3.23
LFf24-B.2	96.53	37.67	233.85	0.54	6.42	3.95	1.55	6.23	2.12

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Sample ID	Wet weight (g)	Dry weight (g)	Moisture (%)	Bulk density (g cm^{-3})	pH Water	EC (ms cm^{-1})	pH peroxide	pH incubation, Time = 0 weeks	pH incubation, Time > 10 weeks
LFf24-B.3	123.65	31.06	498.87	0.44	6.82	4.08	1.61	6.88	**2.11**

November and December 2011 sampling

Sample ID	Wet weight (g)	Dry weight (g)	Moisture (%)	Bulk density (g cm^{-3})	pH Water	EC (ms cm^{-1})	pH peroxide	pH incubation, Time = 0 weeks	pH incubation, Time > 10 weeks
LFe01-A.1	112.60	59.05	115.04	0.84	6.62	0.36	2.72	6.54	4.05
LFe01-A.2								5.44	3.47
LFe 01-A.3	126.71	63.39	124.43	0.91	4.65	2.20	1.45	4.17	2.18
LFe 01-A.4	103.74	38.45	251.60	0.55	4.90	2.09	1.45	4.69	1.87
LFe01-A.5	100.33	36.46	266.57	0.52	6.01	2.11	1.40	6.85	1.92
LFe01-D.1	99.25	46.68	153.80	0.67	5.90	1.60	1.55	6.10	3.99
LFe01-D.2	103.19	37.01	270.01	0.53	4.74	1.90	1.48	4.19	2.00
LFe01-D.3	120.62	57.23	141.72	0.82	6.32	1.30	1.65	6.13	1.85
LFe02-A.1	100.18	87.62	16.72	1.25	6.12	0.08	3.40	5.90	5.30
LFe02-A.2	96.18	83.76	17.43	1.20	5.17	0.15	2.41	6.27	3.36
LFe02-A.3	103.18	91.70	14.49	1.31	4.15	0.49	1.33	4.64	2.81
LFe02-A.4	94.99	85.44	13.09	1.22	5.57	0.50	1.77	4.23	1.83
LFe02-A.5	120.84	98.27	26.31	1.40	7.94	0.37	2.22	7.89	3.14
LFe02-B.1	88.38	76.64	18.30	1.09	7.56	0.16	4.18	7.25	5.31
LFe02-B.2	94.64	81.54	18.97	1.16	7.56	0.26	4.43	7.35	6.78
LFe02-B.3	92.35	80.74	17.01	1.15	7.80	0.35	4.62	7.39	7.71
LFe02-B.4	92.59	79.78	19.04	1.14	7.59	0.26	4.27	7.59	8.03
LFe02-D.1	101.52	90.07	14.76	1.29	6.77	0.11	3.82	6.84	4.37
LFe02-D.2	109.29	96.98	14.57	1.39	4.45	0.17	2.41	4.09	3.54
LFe02-D.3	107.07	93.17	17.23	1.33	3.80	0.38	1.88	3.71	3.13
LFe02-D.4	101.29	89.06	15.97	1.27	4.53	0.67	1.99	3.98	2.14
LFe02-D.5	119.31	97.57	25.56	1.39	8.25	0.49	7.25	7.71	8.01
LFe03-A.1	105.50	71.18	58.49	1.02	5.73	0.67	2.53	6.28	3.17
LFe03-A.2	100.15	68.27	57.16	0.98	4.75	0.77	2.02	4.45	3.26
LFe03-A.3	90.75	48.75	115.86	0.70	3.79	2.04	1.34	3.76	2.82

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Sample ID	Wet weight (g)	Dry weight (g)	Moisture (%)	Bulk density (g cm^{-3})	pH Water	EC (ms cm^{-1})	pH peroxide	pH incubation, Time = 0 weeks	pH incubation, Time > 10 weeks
LFe03-A.4	101.33	63.98	72.55	0.91	3.80	1.20	1.40	3.77	2.40
LFe03-A.5	59.10	24.42	290.94	0.35	6.28	1.02	1.13	6.08	1.92
LFe03-B.1	105.94	73.49	53.21	1.05	6.87	0.35	4.63	6.15	4.12
LFe03-B.2	98.71	68.83	53.04	0.98	6.25	0.38	2.29	5.39	2.35
LFe03-B.3	101.21	72.58	47.65	1.04	4.85	0.66	1.68	4.27	2.27
LFe03-B.4	108.04	81.36	38.75	1.16	6.28	0.62	1.45	5.59	2.07
LFe03-B.5	112.86	77.91	53.43	1.11	7.30	0.58	1.35	6.37	1.81
LFe04-A.1	91.26	75.62	24.78	1.08	5.40	0.32	3.32	6.32	3.15
LFe04-A.2	85.45	70.60	25.56	1.01	4.38	0.73	2.02	4.63	3.59
LFe04-A.3	92.59	74.95	28.25	1.07	7.82	0.79	1.48	6.92	2.10
LFe04-A.4	88.43	63.52	48.82	0.91	8.25	1.38	5.77	7.42	2.31
LFe04-C.1	87.48	72.46	25.05	1.04	8.61	0.27	5.25	8.29	5.49
LFe04-C.2	106.32	87.92	24.40	1.26	8.62	0.64	2.55	8.31	2.31
LFe04-C.3	91.88	74.66	27.70	1.07	8.50	0.72	5.02	8.17	6.63
LFe04-C.4								7.77	2.90
LFe06-A.1	98.50	83.12	21.78	1.19	7.96	0.41	5.51	7.65	7.00
LFe06-A.2	101.68	85.68	21.86	1.22	8.15	0.70	5.78	7.39	7.91
LFe06-A.3	95.92	80.42	22.82	1.15	8.24	1.14	1.97	8.11	1.81
LFe06-A.4	96.14	81.87	20.57	1.17	8.43	1.02	1.74	8.29	1.88
LFe06-A.5	101.83	85.40	22.54	1.22	8.61	1.04	1.59	8.34	1.96
LFe06-B.1	107.37	90.91	20.99	1.30	7.89	0.34	5.32	7.78	6.32
LFe06-B.2	116.86	94.78	26.84	1.35	8.40	0.33	4.20	7.67	7.34
LFe06-B.3	74.14	48.99	68.92	0.70	7.90	0.53	2.17	8.28	2.08
LFe07-A.1	104.47	69.49	61.38	0.99	7.49	0.69	3.5	7.12	2.88
LFe07-A.2	102.02	66.77	64.95	0.95	6.8	0.93	1.78	6.94	3.47
LFe07-A.3	63.13	27.79	231.13	0.40	6.97	2.30	2.52	7.21	2.18
LFe07-A.4								7.64	1.99

Sample ID	Wet weight (g)	Dry weight (g)	Moisture (%)	Bulk density (g cm^{-3})	pH Water	EC (ms cm^{-1})	pH peroxide	pH incubation, Time = 0 weeks	pH incubation, Time > 10 weeks
LFe07-A.5	57.84	20.37	476.11	0.29	7.98	1.80	1.63	8.40	7.37
LFe07-B.1	104.35	71.28	56.26	1.02	7.32	0.80	4.74	7.56	7.02
LFe07-B.2	101.11	60.56	84.37	0.87	7.23	0.90	2.94	7.07	4.86
LFe07-B.3	68.45	31.96	187.51	0.46	7.44	2.04	1.96	7.34	1.82
LFe07-B.4	113.31	73.27	65.89	1.05	8.33	0.88	6.88	7.68	7.41
LFe07-B.5	94.77	78.53	24.59	1.12	7.98	0.81	7.51	8.10	7.78
LFe08-A.1	120.78	97.50	27.39	1.39	7.42	1.45	5.22	7.30	3.72
LFe08-A.2	90.79	74.83	25.61	1.07	7.25	3.20	4.46	7.70	4.40
LFe08-A.3	74.88	37.47	149.82	0.54	7.54	5.05	1.80	7.29	3.31
LFe08-A.4	99.18	47.46	147.94	0.68	7.41	2.90	1.67	7.26	2.85
LFe08-A.5								8.40	1.71
LFe08-B.1	102.45	83.94	25.91	1.20	7.99	0.86	5.26	7.51	7.56
pLFe08-B.2	107.20	85.71	29.35	1.22	7.96	1.40	6.04	7.50	7.49
LFe08-B.3	76.35	37.05	160.08	0.53	7.43	2.10	4.41	7.13	7.07
LFe08-B.4	65.34	26.82	268.99	0.38	7.63	2.44	1.73	7.11	2.11
LFe10-A.1	70.73	58.99	25.25	0.84	6.69	1.32	2.16	6.76	4.14
LFe10-A.2	87.12	56.91	68.03	0.81	3.92	1.60	1.98	3.55	2.86
LFe10-A.3	82.69	63.65	37.22	0.91	3.28	1.65	1.78	3.20	2.44
LFe10-A.4	73.85	38.51	135.87	0.55	3.49	2.45	1.43	3.35	1.65
LFe10-C.1	88.00	62.22	51.85	0.89	6.90	0.90	2.38	6.54	4.58
LFe10-C.2	96.34	74.28	35.71	1.06	6.24	0.86	1.72	6.20	3.00
LFe10-C.3	107.78	89.49	23.76	1.28	5.02	0.60	1.86	4.93	1.90
LFe10-C.4	86.92	72.70	23.62	1.04	4.24	0.66	1.74	4.41	1.84
LFe10-D.1	96.58	79.01	26.42	1.13	7.95	0.53	6.26	7.72	7.05
LFe10-D.2	102.04	84.67	24.07	1.21	7.65	0.79	6.32	6.96	7.65
LFe10-D.3	96.62	74.13	36.49	1.06	7.01	1.21	6.47	6.84	7.71
LFe12-A.1	143.60	117.27	25.13	1.68	5.24	0.54	2.08	5.17	3.25

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Sample ID	Wet weight (g)	Dry weight (g)	Moisture (%)	Bulk density (g cm^{-3})	pH Water	EC (ms cm^{-1})	pH peroxide	pH incubation, Time = 0 weeks	pH incubation, Time > 10 weeks
LFe12-A.2	139.44	106.69	34.77	1.52	4.34	0.92	1.97	4.22	2.38
LFe12-A.3	143.70	106.97	38.88	1.53	4.74	1.35	2.07	4.38	2.30
LFe12-A.4	141.86	101.86	44.76	1.46	6.14	1.20	2.21	5.82	2.10
LFe12-A.5	140.52	102.13	42.83	1.46	7.48	1.10	1.90	7.07	2.02
LFe12-B.1	146.18	115.99	29.17	1.66	7.57	0.86	4.08	7.60	2.95
LFe12-B.2								7.51	2.24
LFe12-B.3	140.50	116.10	23.55	1.66	7.99	1.95	4.73	8.06	3.40
LFe12-B.4	141.65	115.71	25.13	1.65	8.05	1.78	1.88	8.1	2.54
LFe12-B.5	144.65	108.82	37.20	1.55	7.89	1.41	1.70	7.81	2.24
LFe12-C.1	132.74	111.66	21.26	1.60	5.81	0.11	2.70	6.12	3.46
LFe12-C.2	135.00	114.36	20.26	1.63	4.68	0.21	2.50	4.84	3.11
LFe12-C.3	93.00	76.35	26.08	1.09	4.13	0.25	2.57	4.05	3.20
LFe13-A.1								6.84	3.35
LFe13-A.2	61.34	27.08	234.98	0.39	7.32	0.89	4.50	7.44	3.66
LFe13-A.3	98.48	83.22	21.58	1.19	7.75	0.90	5.65	7.22	6.52
LFe13-A.4	111.2	84.15	37.75	1.20	8.14	1.61	5.64	7.30	7.53
LFe13-A.5	104.53	80.53	35.28	1.15	8.24	2.00	5.51	7.45	6.78
LFe15-A.1	96.43	62.84	66.73	0.90	7.33	0.36	6.44	7.25	7.66
LFe15-A.2	125.61	92.22	41.88	1.32	7.30	0.33	6.19	7.37	7.46
LFe15-B.1	100.53	60.00	85.33	0.86	6.29	0.68	4.65	6.37	3.87
LFe15-B.2								5.85	3.89
LFe15-B.3	150.21	94.20	68.56	1.35	4.66	1.60	2.73	4.18	3.09
LFe15-B.4								4.78	3.01
LFe15-B.5	142.28	93.59	60.04	1.34	8.18	1.28	5.59	6.79	7.19
LFe15-B.6	140.33	97.66	50.11	1.40	8.63	1.09	5.80	7.80	7.71
LFe15-C.1	110.11	62.39	95.65	0.89	6.15	1.17	2.60	6.04	3.65
LFe15-C.2	109.91	70.02	69.35	1.00	4.88	2.79	1.68	4.34	2.92

Sample ID	Wet weight (g)	Dry weight (g)	Moisture (%)	Bulk density (g cm⁻³)	pH Water	EC (ms cm⁻¹)	pH peroxide	pH incubation, Time = 0 weeks	pH incubation, Time > 10 weeks
LFe15-C.3	130.42	91.86	48.59	1.31	6.47	2.95	5.89	6.04	7.19
LFe15-C.4	150.21	97.81	61.42	1.40	8.40	2.68	5.55	7.49	7.81
LFe17-A.1	101.41	69.17	56.89	0.99	7.87	0.07	5.45	6.88	5.51
LFe17-A.2	117.05	82.50	49.36	1.18	4.13	0.27	2.71	**3.65**	**3.10**
LFe17-A.3	116.52	70.24	80.15	1.00	4.92	0.58	1.37	4.66	**2.05**
LFe17-A.4	101.54	71.14	51.84	1.02	5.92	0.61	7.24	7.85	**3.00**
LFe17-A.5	77.08	47.14	86.43	0.67	6.04	0.77	6.81	7.83	7.50
LFe17-B.1	106.99	65.19	79.33	0.93	5.42	0.61	3.21	6.00	4.49
LFe17-B.2	111.94	92.63	24.10	1.32	4.08	0.91	2.20	4.04	**3.16**
LFe17-B.3	106.79	85.00	30.06	1.21	7.36	2.00	2.15	7.10	**2.52**
LFe17-B.4	102.00	76.94	38.89	1.10	8.24	1.94	2.60	7.28	**2.18**
LFe19-A.1	96.65	75.09	34.45	1.07	3.73	1.35	1.80	**3.96**	**3.53**
LFe19-A.2	112.58	94.57	21.94	1.35	3.22	1.40	2.05	**3.30**	**2.75**
LFe19-A.3	116.69	95.69	25.24	1.37	6.30	1.10	7.16	6.36	7.45
LFe19-A.4	119.45	97.84	25.32	1.40	7.05	1.21	7.46	7.19	7.90
LFe19-B.1	89.32	59.71	62.72	0.85	7.60	0.31	2.44	6.56	4.20
LFe19-B.2	89.56	60.51	60.51	0.86	5.28	0.35	2.46	4.35	**3.69**
LFe19-B.3	87.14	56.36	70.18	0.81	4.24	0.63	2.16	4.50	**3.70**
LFe19-B.4	109.1	87.77	28.34	1.25	7.00	0.84	6.93	7.07	7.90
LFe20-A.1	69.92	38.54	120.51	0.55	6.18	0.95	2.35	6.30	**3.02**
LFe20-A.2	78.39	40.79	132.91	0.58	4.72	1.71	1.95	4.24	**2.85**
LFe20-A.3	94.25	60.13	71.64	0.86	3.70	1.90	1.87	**3.72**	**1.98**
LFe20-A.4	89.51	53.38	88.38	0.76	3.90	2.04	1.74	**3.92**	**1.63**
LFe20-A.5	70.99	40.00	112.69	0.57	7.02	1.70	1.90	6.70	**1.68**
LFe20-B.1	83.99	45.12	119.16	0.64	6.01	0.85	1.87	6.32	**3.02**
LFe20-B.2	84.21	44.83	121.81	0.64	4.90	2.04	2.30	4.97	**2.60**
LFe20-B.3	80.83	44.99	110.31	0.64	4.34	2.46	2.09	**3.97**	**1.73**

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Sample ID	Wet weight (g)	Dry weight (g)	Moisture (%)	Bulk density (g cm^{-3})	pH Water	EC (ms cm^{-1})	pH peroxide	pH incubation, Time = 0 weeks	pH incubation, Time > 10 weeks
LFe20-B.4	89.96	57.88	70.69	0.83	5.35	2.06	2.12	4.22	1.64
LFe20-B.5	106.78	86.78	26.93	1.24	6.85	1.13	2.62	6.43	2.98
LFe20-B.6	115.69	92.89	28.36	1.33	7.51	0.96	7.10	6.60	7.54
LFe21-A.1	94.62	78.44	24.54	1.12	6.95	0.64	1.50	6.70	2.36
LFe21-A.2	101.00	84.02	23.74	1.20	7.04	1.79	1.42	5.05	1.49
LFe21-A.3	100.84	86.06	20.09	1.23	8.28	2.22	1.92	7.32	1.69
LFe21-B.1	95.00	80.62	21.11	1.15	8.28	0.76	4.80	8.26	5.29
LFe21-B.2	74.40	42.01	109.76	0.60	7.21	1.53	2.45	7.10	3.00
LFe21-B.3	76.44	74.32	3.43	1.06	7.81	1.40	1.58	8.35	2.04
LFe23-A.1	81.01	77.89	4.77	1.11	6.52	0.67	2.20	6.84	2.63
LFe23-A.2	82.01	80.12	2.80	1.14	4.77	1.21	1.80	4.21	2.92
LFe23-A.3	82.02	79.19	4.24	1.13	4.41	1.77	1.55	4.17	2.04
LFe23-A.4	84.66	79.94	7.00	1.14	5.42	1.71	1.50	5.90	2.06
LFe24-A.1	62.24	30.99	169.01	0.44	5.93	0.74	2.46	6.32	4.97
LFe24-A.2	51.14	29.68	124.91	0.42	4.65	4.48	1.80	4.52	3.01
LFe24-A.3	43.09	25.88	128.62	0.37	5.30	5.06	3.68	4.65	1.75
LFe24-A.4	47.05	25.10	174.21	0.36	6.56	5.83	2.28	6.49	2.03
LFe24-B.1	80.09	42.15	127.96	0.60	6.48	1.43	1.50	6.55	3.65
LFe24-B.2	57.70	20.87	440.02	0.30	6.14	4.01	1.60	5.89	2.03
LFe24-B.3	41.18	20.88	242.24	0.30	6.66	5.95	4.60	6.09	1.97

May and June 2011 sampling

Sample ID	Wet weight (g)	Dry weight (g)	Moisture (%)	Bulk density (g cm^{-3})	pH Water	EC (ms cm^{-1})	pH peroxide	pH incubation, Time = 0 weeks	pH incubation, Time > 10 weeks
LFd01-A.1	97.39	63.93	65.06	0.91	5.99	1.13	2.48	6.21	4.66
LFd01-A.2	91.39	60.18	65.46	0.86	4.20	2.67	1.35	4.49	2.65
LFd01-A.3	75.69	38.10	146.84	0.54	4.89	3.34	1.14	5.27	2.48
LFd01-D.1	86.30	43.12	141.02	0.62	6.60	0.68	2.80	6.84	4.86
LFd01-D.2	72.87	36.08	156.02	0.52	6.75	1.27	3.45	6.91	6.10
LFd01-D.3	70.09	33.07	179.97	0.47	6.90	1.30	1.95	7.03	4.57
LFd02-A.1	95.50	79.70	23.51	1.14	4.76	0.19	2.22	5.02	3.23
LFd02-A.2	96.59	81.46	21.94	1.16	3.91	0.63	2.01	4.20	2.46
LFd02-A.3	99.33	83.15	22.90	1.19	4.13	0.81	1.78	4.15	1.91
LFd02-A.4	90.05	73.17	27.82	1.05	6.42	0.59	2.98	6.55	7.58
LFd02-B.1	79.30	69.03	18.17	0.99	6.74	0.15	3.80	6.76	6.47
LFd02-B.2	89.30	76.66	19.70	1.10	6.70	0.18	4.20	6.88	5.02
LFd02-B.3	96.06	81.93	20.35	1.17	6.69	0.26	4.80	6.87	6.84
LFd02-B.4								6.90	6.90
LFd02-B.5	94.01	79.90	20.93	1.14	6.85	0.36	4.42	7.10	6.08
LFd03-A.1	81.07	65.68	28.94	0.94	6.40	0.52	2.52	5.67	3.56
LFd03-A.2	104.95	84.20	28.94	1.20	4.65	1.34	1.83	4.54	3.10
LFd03-A.3	28.17	23.21	46.31	0.33	3.74	1.79	1.47	3.65	2.75
LFd03-A.4	107.20	88.29	24.95	1.26	3.65	1.30	1.58	3.46	2.21
LFd03-A.5	60.98	31.39	156.64	0.45	5.75	1.30	1.30	6.06	4.21
LFd03-B.1	75.67	64.76	20.88	0.93	6.96	0.16	2.85	5.70	3.37
LFd03-B.2	102.03	87.46	19.44	1.25	6.08	0.29	2.86	5.47	3.24
LFd03-B.3	90.61	78.05	19.16	1.12	5.82	0.60	1.70	5.64	2.16
LFd03-B.4	80.45	70.63	16.89	1.01	6.44	0.58	5.80	6.35	2.18
LFd04-A.1	123.35	72.75	83.98	1.04	6.11	0.38	4.55	5.93	3.76

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Sample ID	Wet weight (g)	Dry weight (g)	Moisture (%)	Bulk density (g cm^{-3})	pH Water	EC (ms cm^{-1})	pH peroxide	pH incubation, Time = 0 weeks	pH incubation, Time > 10 weeks
LFd04-A.2	123.73	81.34	61.58	1.16	4.55	0.60	1.88	4.18	**2.40**
LFd04-A.3	126.34	85.73	55.46	1.22	5.73	0.78	1.72	5.61	**2.30**
LFd04-A.4	93.77	64.48	56.35	0.92	8.43	1.62	1.67	7.47	7.29
LFd04-C.1	86.95	72.85	23.36	1.04	8.49	0.38	4.70	8.14	**3.90**
LFd04-C.2	88.56	74.17	23.33	1.06	8.43	0.55	1.76	8.24	**2.28**
LFd04-C.3	99.57	80.61	27.84	1.15	8.67	0.55	1.78	8.03	**3.43**
LFd06-A.1	92.56	78.54	21.23	1.12	7.15	0.41	4.71	7.21	6.05
LFd06-A.2	96.43	82.96	19.12	1.19	7.60	0.69	6.53	7.63	7.77
LFd06-A.3	96.43	82.38	20.11	1.18	7.60	0.96	2.81	7.67	7.56
LFd06-A.4	85.45	73.44	19.71	1.05	7.78	1.09	1.71	8.09	**2.16**
LFd06-A.5	99.18	83.59	21.93	1.19	8.12	1.29	1.77	8.09	**2.17**
LFd06-B.1	106.74	89.76	21.98	1.28	7.50	0.40	6.35	7.03	7.15
LFd06-B.2	93.55	77.51	24.67	1.11	7.88	1.38	6.61	7.50	7.22
LFd06-B.3	102.44	81.08	31.15	1.16	7.95	0.96	5.97	7.56	7.39
LFd06-B.4	95.35	62.00	67.37	0.89	8.00	0.79	2.20	7.67	4.62
LFd07-A.1	99.72	78.12	32.92	1.12	6.27	1.42	3.18	6.51	4.06
LFd07-A.2	76.94	38.12	151.52	0.54	6.20	3.29	1.63	6.34	**3.47**
LFd07-A.3	74.18	36.60	155.93	0.52	8.02	1.84	2.75	7.73	4.09
LFd07-A.4	101.47	80.02	31.77	1.14	9.05	0.88	8.35	8.27	7.78
LFd07-B.1	110.14	88.67	28.19	1.27	7.62	1.08	4.03	7.07	6.24
LFd07-B.2	85.71	63.86	42.54	0.91	7.32	1.51	3.76	7.05	6.35
LFd07-B.3	81.45	50.36	82.12	0.72	7.96	1.53	1.77	7.56	**2.68**
LFd07-B.4	111.07	89.64	27.78	1.28	8.75	1.00	7.55	8.07	7.47
LFd07-B.5	97.11	79.38	26.51	1.13	8.58	1.01	7.14	7.85	7.56
LFd08-A.1	102.69	83.76	26.56	1.20	7.12	2.02	5.15	6.80	6.95
LFd08-A.2	99.07	81.26	25.90	1.16	7.60	3.23	2.50	7.18	**2.89**
LFd08-A.3	74.54	39.45	130.20	0.56	8.10	5.62	2.31	7.49	6.34

Sample ID	Wet weight (g)	Dry weight (g)	Moisture (%)	Bulk density (g cm^{-3})	pH Water	EC (ms cm^{-1})	pH peroxide	pH incubation, Time = 0 weeks	pH incubation, Time > 10 weeks
LFd08-A.4	68.80	34.32	158.02	0.49	7.82	6.00	1.85	7.55	2.88
LFd08-B.1	101.48	83.49	25.34	1.19	7.76	1.17	5.85	7.15	7.29
LFd08-B.2	93.10	76.44	26.06	1.09	8.09	2.02	6.37	7.80	7.10
LFd08-B.3	68.69	28.15	259.04	0.40	7.78	3.61	1.94	7.31	3.29
LFd10-A.1	78.47	40.34	136.96	0.58	6.49	1.28	2.17	6.39	5.54
LFd10-A.2	95.73	69.49	46.04	0.99	6.04	1.01	4.07	6.34	5.58
LFd10-A.3	80.79	50.48	79.81	0.72	3.50	2.72	1.83	3.38	3.00
LFd10-C.1	77.49	49.83	74.10	0.71	5.62	1.15	1.80	5.72	3.88
LFd10-C.2	102.55	79.26	34.89	1.13	4.08	1.12	1.14	4.29	2.04
LFd10-C.3	97.70	82.93	20.97	1.18	3.48	0.85	1.24	3.74	1.81
LFd10-C.4	103.93	88.98	19.55	1.27	4.04	0.65	1.66	4.14	1.94
LFd10-D.1	101.72	85.42	22.35	1.22	8.26	0.57	6.10	7.65	7.24
LFd10-D.2	100.04	84.13	22.21	1.20	8.28	0.49	6.23	7.65	7.32
LFd10-D.3	97.31	80.63	24.48	1.15	7.72	1.23	6.42	7.16	7.34
LFd12-A.1	115.26	94.35	25.55	1.35	5.14	0.82	2.24	5.15	3.50
LFd12-A.2	99.58	73.54	42.66	1.05	4.63	1.82	1.55	4.59	2.93
LFd12-A.3	93.16	67.51	46.63	0.96	5.18	2.29	2.11	4.58	3.11
LFd12-A.4	93.63	67.38	47.83	0.96	7.14	1.80	1.97	6.50	3.53
LFd12-A.5	78.09	46.65	92.06	0.67	7.15	1.60	1.50	6.96	3.50
LFd12-A.6								7.36	4.95
LFd12-B.1	102.81	85.67	23.42	1.22	7.15	0.50	3.66	6.94	4.48
LFd12-B.2	105.27	87.22	24.16	1.25	7.46	1.04	4.14	7.12	3.95
LFd12-B.3	103.69	86.00	24.07	1.23	7.70	1.48	1.73	7.50	2.81
LFd12-B.4	100.71	74.48	42.32	1.06	7.96	1.34	1.55	7.65	2.02
LFd12-C.1	106.25	85.87	27.78	1.23	6.08	0.43	2.49	5.99	3.79
LFd12-C.2	104.43	85.99	25.09	1.23	4.36	0.34	2.14	4.10	3.11
LFd12-C.3	105.93	87.29	24.92	1.25	4.58	0.35	1.54	4.10	2.06

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Sample ID	Wet weight (g)	Dry weight (g)	Moisture (%)	Bulk density (g cm^{-3})	pH Water	EC (ms cm^{-1})	pH peroxide	pH incubation, Time = 0 weeks	pH incubation, Time > 10 weeks
LFd12-C.4	96.89	83.63	18.64	1.19	7.05	0.40	1.92	6.35	**1.98**
LFd13-A.1	84.79	51.29	86.36	0.73	6.90	2.46	4.54	6.64	6.91
LFd13-A.2	102.44	82.45	28.58	1.18	7.76	1.22	6.07	7.62	7.64
LFd13-A.3	102.18	83.61	26.11	1.19	7.91	1.17	6.17	7.60	7.55
LFd15-B.1	73.48	41.25	112.10	0.59	6.35	0.85	1.89	6.22	**3.8**
LFd15-B.2	106.43	77.17	45.25	1.10	5.04	1.03	1.99	4.86	**2.82**
LFd15-B.3	97.42	68.98	50.35	0.99	4.14	1.39	1.75	**3.93**	**3.53**
LFd15-B.4	98.97	73.78	41.11	1.05	7.24	1.26	6.18	7.00	6.84
LFd15-B.5	100.09	73.94	42.56	1.06	8.71	0.65	6.54	8.10	7.43
LFd15-C.1	73.89	43.50	98.03	0.62	6.00	2.11	2.32	5.81	**3.89**
LFd15-C.2	91.93	62.35	59.34	0.89	4.83	2.28	1.72	4.51	**2.98**
LFd15-C.3	97.05	69.99	47.07	1.00	5.82	3.14	2.57	6.04	4.49
LFd15-C.4	115.01	85.69	40.06	1.22	7.52	2.22	6.36	6.85	7.03
LFd15-C.5	91.32	65.87	47.69	0.94	8.37	2.16	6.48	7.75	7.56
LFd17-A.1	114.67	83.19	44.53	1.19	6.85	0.09	4.10	7.15	6.75
LFd17-A.2	90.51	67.09	42.90	0.96	3.96	0.35	2.05	**3.59**	**3.01**
LFd17-A.3	109.63	82.83	38.11	1.18	4.17	0.60	1.63	**3.80**	**2.4**
LFd17-A.4	105.33	74.61	49.46	1.07	5.83	0.74	1.69	5.08	**2.29**
LFd17-B.1	112.03	83.94	39.32	1.20	4.84	0.57	2.29	5.20	**3.62**
LFd17-B.2	105.22	73.22	52.70	1.05	3.83	0.96	2.10	**3.92**	**3.09**
LFd17-B.3	94.70	67.94	48.27	0.97	6.84	0.99	1.70	6.71	**2.64**
LFd17-B.4	96.39	70.61	44.36	1.01	8.20	2.08	1.62	7.58	**3.19**
LFd19-A.1	135.94	84.47	71.52	1.21	3.92	1.67	1.98	**3.49**	**2.78**
LFd19-A.2	129.45	96.57	39.11	1.38	3.08	2.28	1.88	**2.99**	**2.50**
LFd19-A.3	128.20	86.59	56.16	1.24	6.42	2.59	6.40	5.69	7.25
LFd19-A.4	125.85	96.47	34.99	1.38	7.34	1.16	7.11	6.56	7.61
LFd20-A.1	70.13	43.31	87.05	0.62	5.92	0.98	2.12	6.04	**3.13**

Sample ID	Wet weight (g)	Dry weight (g)	Moisture (%)	Bulk density (g cm^{-3})	pH Water	EC (ms cm^{-1})	pH peroxide	pH incubation, Time = 0 weeks	pH incubation, Time > 10 weeks
LFd20-A.2	85.11	35.21	219.73	0.50	4.23	1.35	1.46	4.10	2.94
LFd20-A.3	82.18	52.74	73.16	0.75	3.47	1.89	2.07	3.48	2.53
LFd20-A.4	85.20	50.45	91.57	0.72	3.67	2.21	2.21	3.57	2.08
LFd20-A.5	75.11	45.79	88.07	0.65	5.18	1.79	2.62	4.35	2.35
LFd21-A.1	92.77	76.27	25.87	1.09	6.45	1.79	1.35	6.26	3.75
LFd21-A.2	92.75	78.83	20.99	1.13	7.05	0.44	2.97	6.90	1.65
LFd21-A.3	98.99	84.66	19.86	1.21	7.78	2.00	1.85	7.20	1.77
LFd21-B.1	92.41	77.24	23.43	1.10	7.74	1.10	5.65	8.02	5.51
LFd21-B.2	71.62	41.25	105.63	0.59	7.02	2.49	2.00	7.17	4.03
LFd21-B.3	94.32	79.25	22.58	1.13	7.86	0.81	1.35	7.90	3.25
LFd23-A.1	144.34	116.61	26.64	1.67	6.03	0.87	2.41	6.09	2.91
LFd23-A.2	140.60	117.32	22.21	1.68	4.73	1.48	2.28	4.42	3.12
LFd23-A.3	131.43	109.24	22.94	1.56	6.22	1.77	1.73	5.86	2.10
LFd24-A.1	70.83	33.76	174.37	0.48	6.10	1.12	1.61	5.91	5.42
LFd24-A.2	81.16	39.85	151.04	0.57	5.18	3.81	1.40	5.28	3.03
LFd24-A.3	72.71	32.88	195.44	0.47	5.10	5.15	1.93	4.56	2.89
LFd24-B.1	73.23	36.46	153.46	0.52	6.30	1.72	1.50	6.34	4.06
LFd24-B.2	72.44	32.95	193.11	0.47	5.50	2.99	1.62	5.59	2.80
LFd24-B.3	70.84	29.97	233.94	0.43	6.75	3.82	1.70	6.45	2.79

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

January and February 2011 sampling

Sample ID	Wet weight (g)	Dry weight (g)	Moisture (%)	Bulk density (g cm^{-3})	pH Water	EC (ms cm^{-1})	pH peroxide	pH incubation, Time = 0 weeks	pH incubation, Time > 10 weeks
LFc01-A.1	81.74	53.95	67.04	0.77	6.59	0.554	3.95	6.40	4.03
LFc01-A.2	65.06	44.18	65.91	0.63	5.47	2.078	2.36	4.78	1.95
LFc01-A.3	69.01	40.29	103.35	0.58	6.87	1.986	3.25	4.65	1.84
LFc01-D.1	123.56	46.08	230.73	0.66	6.60	1.131	3.33	6.50	7.17
LFc01-D.2	95.74	43.09	172.12	0.62	4.68	2.720	1.38	5.25	3.98
LFc01-D.3	89.78	68.06	39.09	0.97	4.36	3.490	1.12	4.26	2.17
LFc02-A.1	80.46	77.09	5.22	1.10	4.89	0.362	1.97	5.56	3.27
LFc02-A.2	90.62	83.93	9.37	1.20	3.31	0.685	1.89	3.45	2.89
LFc02-A.3	101.32	68.46	58.72	0.98	4.95	0.694	1.66	4.79	1.97
LFc02-A.4	84.48	62.87	42.90	0.90	8.33	0.532	2.48	7.73	2.67
LFc02-B.1	71.54	56.23	35.01	0.80	7.82	0.129	3.70	7.45	6.64
LFc02-B.2	86.91	68.89	31.96	0.98	7.51	0.209	4.37	7.29	6.73
LFc02-B.3	68.41	58.70	21.02	0.84	7.82	0.517	4.54	7.61	6.52
LFc02-B.4	78.45	67.20	20.57	0.96	8.04	0.545	2.85	8.07	3.92
LFc03-A.1	74.72	58.87	34.18	0.84	5.76	0.818	2.70	6.23	3.92
LFc03-A.2	91.92	75.25	26.57	1.08	6.19	1.322	1.84	4.19	3.11
LFc03-A.3	59.46	41.03	64.60	0.59	3.05	2.640	1.42	3.22	2.55
LFc03-A.4	83.94	69.44	25.47	0.99	3.03	1.578	1.54	3.14	2.50
LFc03-A.5	67.95	56.29	26.63	0.80	3.28	1.629	1.55	3.46	1.96
LFc03-B.1	87.00	74.08	20.98	1.06	5.08	0.287	2.59	5.20	4.14
LFc03-B.2	76.33	65.85	19.64	0.94	4.09	0.786	2.32	3.90	3.20
LFc03-B.3	71.10	61.23	20.25	0.87	6.28	0.746	2.12	5.62	5.49
LFc03-B.4	90.00	77.55	19.14	1.11	7.24	0.692	1.52	7.48	1.98
LFc04-A.1	87.99	74.28	22.19	1.06	6.39	0.847	2.95	5.41	4.11
LFc04-A.2	99.58	81.78	25.69	1.17	3.77	1.080	1.85	3.90	2.32

Sample ID	Wet weight (g)	Dry weight (g)	Moisture (%)	Bulk density (g cm⁻³)	pH Water	EC (ms cm⁻¹)	pH peroxide	pH incubation, Time = 0 weeks	pH incubation, Time > 10 weeks
LFc04-A.3	85.72	70.87	25.44	1.01	5.04	1.177	1.77	5.39	**2.11**
LFc04-A.4	87.44	72.53	24.84	1.04	7.28	1.186	1.78	7.88	**3.11**
LFc04-A.5	77.98	57.82	44.48	0.83	8.33	2.105	3.84	7.97	6.46
LFc04-C.1	104.28	81.62	32.78	1.17	7.53	0.447	3.47	7.16	**3.94**
LFc04-C.2	93.13	64.09	56.29	0.92	7.20	0.597	2.20	6.98	**2.93**
LFc04-C.3	88.59	63.34	49.67	0.90	7.43	0.418	2.38	7.10	**2.47**
LFc06-A.1	85.26	72.50	21.27	1.04	8.09	0.383	5.20	7.86	6.13
LFc06-A.2	77.70	66.67	20.36	0.95	8.31	0.678	6.92	8.11	6.97
LFc06-A.3	80.93	69.24	20.60	0.99	8.07	0.960	2.10	8.03	**2.23**
LFc06-A.4	81.77	69.84	20.81	1.00	8.37	1.187	3.78	7.96	**2.21**
LFc06-B.1	101.19	84.65	22.92	1.21	7.68	0.703	1.91	7.51	7.02
LFc06-B.2	101.24	80.42	30.65	1.15	8.07	1.276	6.64	7.46	7.26
LFc06-B.3	105.80	83.54	31.33	1.19	8.32	1.018	6.41	7.57	7.22
LFc06-B.4	79.76	53.46	64.21	0.76	6.79	0.927	3.13	7.71	**2.98**
LFc07-A.1	99.72	77.12	34.97	1.10	6.44	1.217	1.83	5.85	**3.08**
LFc07-A.2	67.75	31.32	193.57	0.45	6.98	2.140	2.50	6.48	**2.46**
LFc07-A.3	72.21	33.63	182.58	0.48	7.72	1.717	1.48	7.23	**2.31**
LFc07-A.4	72.66	36.16	154.27	0.52	8.30	1.599	1.59	7.34	**2.04**
LFc07-B.1	107.11	84.89	30.69	1.21	7.17	1.153	3.96	6.97	**1.95**
LFc07-B.2	88.34	61.81	53.80	0.88	7.19	1.748	3.54	6.66	5.26
LFc07-B.3	67.31	35.64	136.86	0.51	7.55	2.370	1.58	6.67	4.37
LFc08-A.1	114.32	94.71	23.85	1.35	6.62	2.310	3.49	6.39	6.41
LFc08-A.2	109.57	90.34	24.70	1.29	6.55	3.070	1.97	7.53	4.55
LFc08-A.3	70.74	54.23	39.56	0.77	7.54	5.730	3.74	7.58	4.81
LFc08-A.4	62.53	31.56	162.49	0.45	8.13	33.500	2.53	7.66	**1.82**
LFc08-B.1	106.26	88.39	23.55	1.26	7.84	35.900	6.75	7.56	7.09
LFc08-B.2	72.81	40.87	112.58	0.58	7.76	35.800	6.16	7.22	6.94

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Sample ID	Wet weight (g)	Dry weight (g)	Moisture (%)	Bulk density (g cm^{-3})	pH Water	EC (ms cm^{-1})	pH peroxide	pH incubation, Time = 0 weeks	pH incubation, Time > 10 weeks
LFc08-B.3	75.41	39.83	130.19	0.57	8.06	2.930	3.17	7.37	3.00
LFc08-B.4	66.38	26.95	272.87	0.39	7.89	3.140	1.56	7.62	2.27
LFc10-A.1	87.72	54.23	80.25	0.77	6.11	1.091	2.23	5.89	4.90
LFc10-A.2	102.66	58.23	97.16	0.83	5.02	1.666	3.50	4.35	4.80
LFc10-A.3	112.91	64.44	93.32	0.92	2.97	1.973	1.83	2.78	2.35
LFc10-A.4	100.32	78.43	33.20	1.12	3.44	2.610	1.73	3.24	1.73
LFc10-C.1	93.93	68.95	44.25	0.99	5.62	0.934	1.77	5.85	3.72
LFc10-C.2	128.75	101.23	31.02	1.45	4.12	0.739	1.46	4.01	2.37
LFc10-C.3	77.23	65.43	22.29	0.93	3.64	0.655	1.72	3.34	1.96
LFc10-C.4	110.51	86.23	32.93	1.23	3.92	0.797	1.92	3.75	2.04
LFc10-D.1	130.42	105.58	26.69	1.51	7.23	0.983	4.80	6.68	4.51
LFc10-D.2	139.78	112.03	27.88	1.60	7.65	1.270	6.79	7.25	7.01
LFc10-D.3	134.47	111.72	22.93	1.60	8.13	1.351	7.08	7.48	7.23
LFc10-D.4	185.43	106.40	84.16	1.52	8.33	0.941	3.51	8.35	1.97
LFc12-A.1	133.54	107.59	27.29	1.54	4.44	1.204	2.09	4.35	3.29
LFc12-A.2	111.48	79.97	46.70	1.14	4.01	2.640	1.72	3.94	2.15
LFc12-A.3	121.76	86.36	47.93	1.23	5.22	2.450	2.69	4.73	2.13
LFc12-A.4	124.21	98.23	30.30	1.40	7.59	1.992	2.59	6.94	2.78
LFc12-A.5	92.93	45.50	143.73	0.65	7.68	1.593	1.46	7.21	2.26
LFc12-B.1	124.05	103.75	22.25	1.48	7.63	1.087	5.91	7.68	5.17
LFc12-B.2	113.17	92.53	25.79	1.32	7.48	1.562	2.51	7.23	2.98
LFc12-B.3	135.83	104.75	33.69	1.50	8.13	1.479	2.05	7.43	1.99
LFc12-B.4	126.87	88.16	51.16	1.26	7.83	1.081	1.95	7.48	1.94
LFc12-C.1	116.74	96.50	24.10	1.38	7.87	0.184	2.83	6.06	3.59
LFc12-C.2	128.28	107.37	22.04	1.53	4.45	0.359	2.10	3.71	3.08
LFc12-C.3	78.21	67.43	19.62	0.96	4.35	0.592	1.71	4.15	2.06
LFc12-C.4	126.93	109.35	18.15	1.56	7.08	0.559	2.31	6.31	2.69

Sample ID	Wet weight (g)	Dry weight (g)	Moisture (%)	Bulk density (g cm^{-3})	pH Water	EC (ms cm^{-1})	pH peroxide	pH incubation, Time = 0 weeks	pH incubation, Time > 10 weeks
LFa13-A.1	98.23	54.67	103.30	0.78	6.49	0.620	2.55	6.58	5.82
LFa13-A.2	134.03	106.35	29.49	1.52	7.64	1.272	6.20	7.28	7.33
LFa13-A.3	134.87	100.23	39.48	1.43	8.06	2.024	6.26	7.64	7.38
LFa15-B.1	76.43	54.01	54.01	0.77	6.09	0.360	2.13	6.36	5.12
LFa15-B.2	88.76	73.34	25.35	1.05	4.62	0.863	2.10	4.54	3.45
LFa15-B.3	98.12	77.16	32.42	1.10	4.00	1.105	1.98	3.73	3.10
LFa15-B.4	84.56	66.39	33.72	0.95	7.20	1.212	6.03	6.42	7.22
LFa15-B.5	90.43	70.76	-157.36	1.01	8.82	0.490	6.44	7.61	7.41
LFc15-C.1	73.45	54.33	45.71	0.78	5.96	0.755	2.28	6.02	3.68
LFc15-C.2	78.65	62.57	32.12	0.89	4.27	1.868	1.93	4.00	3.28
LFc15-C.3	79.65	65.94	25.65	0.94	4.93	2.820	1.91	4.63	2.47
LFc15-C.4	89.65	74.42	24.60	1.06	7.35	2.560	6.19	6.84	7.20
LFc15-C.5	86.78	72.54	23.72	1.04	8.33	1.736	6.33	7.47	7.46
LFc17-A.1	112.00	56.43	126.50	0.81	3.96	1.026	1.57	4.25	5.18
LFc17-A.2	137.10	107.94	30.55	1.54	5.95	1.267	4.56	6.72	3.20
LFc17-A.3	143.37	112.69	30.62	1.61	8.32	1.388	4.12	2.89	2.49
LFc17-A.4	136.82	107.04	31.50	1.53	8.47	1.179	3.61	4.82	2.16
LFc17-A.5	116.27	92.36	29.94	1.32	5.73	1.986	2.05	7.83	7.31
LFc17-B.1	91.99	76.91	23.41	1.10	8.02	1.260	1.90	8.03	3.38
LFc17-B.2	112.62	91.32	27.02	1.30	8.36	1.495	1.79	7.51	2.13
LFc17-B.3	109.78	84.40	35.30	1.21	8.61	2.079	1.89	8.26	2.52
LFc17-B.4	106.00	82.68	33.23	1.18	8.12	1.850	1.98	7.80	2.83
LFc19-A.1	69.17	64.46	9.06	0.92	7.03	1.484	2.62	4.10	2.57
LFc19-A.2	91.78	59.61	68.29	0.85	2.73	1.648	1.75	3.26	2.65
LFc19-A.3	118.07	72.23	76.75	1.03	3.63	2.150	1.62	4.28	2.75
LFc19-A.4	66.37	62.79	7.12	0.90	7.10	0.970	7.25	5.99	7.02
LFc20-A.1	78.32	59.32	40.58	0.85	NA	1.216	1.67	4.17	3.32

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Sample ID	Wet weight (g)	Dry weight (g)	Moisture (%)	Bulk density (g cm^{-3})	pH Water	EC (ms cm^{-1})	pH peroxide	pH incubation, Time = 0 weeks	pH incubation, Time > 10 weeks
LFc20-A.2	53.21	35.22	79.18	0.50	NA	0.761	1.75	4.16	2.93
LFc20-A.3	115.81	44.35	224.36	0.63	NA	0.552	2.02	6.45	2.49
LFc20-A.4	68.54	35.82	140.31	0.51	NA	3.540	2.40	5.67	2.04
LFc20-A.5	56.32	40.96	53.97	0.59	NA	3.470	2.35	5.48	1.63
LFc21-A.1	115.95	97.93	21.09	1.40	6.31	0.670	2.66	6.30	3.67
LFc21-A.2	92.32	85.45	9.42	1.22	5.37	1.256	1.48	5.79	2.66
LFc21-A.3	115.90	96.15	23.61	1.37	6.68	2.129	1.40	6.47	1.74
LFc21-A.4	117.95	100.18	20.27	1.43	8.15	1.927	1.86	7.74	2.03
LFc21-B.1	100.08	68.21	57.21	0.97	7.30	0.872	3.67	7.93	5.98
LFc21-B.2	81.82	56.74	56.69	0.81	6.86	2.189	2.31	6.90	3.03
LFc21-B.3	97.23	85.32	16.36	1.22	7.78	0.922	1.89	7.66	2.86
LFc23-A.1	100.54	87.97	16.66	1.26	7.12	1.562	6.32	6.93	3.56
LFc23-A.2	98.23	74.73	37.76	1.07	6.30	1.781	6.00	6.75	3.29
LFc23-A.3	98.54	79.46	28.49	1.14	6.72	2.860	6.50	7.82	2.22
LFc24-A.1	95.25	42.56	175.28	0.61	5.87	1.570	1.76	5.61	4.75
LFc24-A.2	85.75	38.42	182.60	0.55	4.58	2.980	1.35	4.64	3.67
LFc24-A.3	99.73	51.12	125.87	0.73	4.09	4.020	1.69	3.90	2.08
LFc24-A.4	93.61	43.98	157.66	0.63	4.18	4.020	1.62	4.19	1.88
LFc24-B.1	85.76	46.65	114.52	0.67	7.23	4.100	1.73	5.89	3.20
LFc24-B.2	125.87	42.94	272.44	0.61	5.07	2.920	1.46	4.98	1.96
LFc24-B.3	134.03	33.79	470.83	0.48	5.61	1.574	2.55	6.00	1.95

March 2010 sampling

Sample ID	Wet weight (g)	Dry weight (g)	Moisture (%)	Bulk density (g cm^{-3})	pH Water	EC (ms cm^{-1})	pH peroxide	pH incubation, Time = 0 weeks	pH incubation, Time > 10 weeks
LFb01-A.1	81.24	52.93	70.02	0.76	6.12	1.64	1.79	5.77	**3.57**
LFb01-A.2	83.48	58.41	54.61	0.83	3.64	3.26	1.43	**3.50**	**1.85**
LFb01-A.3	67.35	37.23	121.80	0.53	6.26	3.80	1.88	4.90	**1.86**
LFb01-D.1	66.57	41.58	85.94	0.59	6.41	2.80	4.92	5.97	**3.84**
LFb01-D.2	76.43	44.18	101.80	0.63	3.96	2.97	1.24	**3.45**	**2.58**
LFb02-A.1	90.31	77.75	19.25	1.11	4.64	3.42	1.69	**2.71**	**2.58**
LFb02-A.2	97.08	85.57	15.75	1.22	3.02	0.98	2.14	**2.80**	**2.70**
LFb02-A.3	94.78	86.46	11.25	1.24	3.15	0.50	2.42	**2.72**	**2.80**
LFb02-A.4	122.33	104.81	18.98	1.50	2.78	1.06	1.64	**2.41**	**2.08**
LFb02-A.5	109.74	89.35	26.53	1.28	4.79	0.95	1.66	4.95	**1.95**
LFb02-B.1	88.34	85.82	3.44	1.23	5.16	0.28	3.95	5.96	5.14
LFb02-B.2	98.33	88.1	13.53	1.26	4.86	0.19	4.39	5.34	5.13
LFb02-B.3	111.45	93.88	21.59	1.34	7.11	0.27	4.94	7.50	6.60
LFb02-B.4	122.19	104.17	19.66	1.49	7.62	0.35	4.52	7.73	**3.83**
LFb03-A.1	94.72	86.08	11.74	1.23	4.33	3.02	3.08	7.28	5.87
LFb03-A.2	93.38	81.16	17.80	1.16	2.8	1.57	1.71	**2.57**	**2.63**
LFb03-A.3	80.84	46.96	98.32	0.67	2.28	3.62	1.23	**2.17**	**2.17**
LFb03-A.4	101.27	83.05	25.83	1.19	2.44	1.64	1.54	**2.28**	**2.32**
LFb03-A.5	108.51	90.6	22.93	1.29	2.91	1.53	1.84	**2.35**	**1.87**
LFb03-A.6	72.69	32.58	199.75	0.47	7.05	1.04	1.46	7.90	**2.14**
LFb03-B.1	93.05	90	3.94	1.29	7.07	0.59	5.55	7.46	6.24
LFb03-B.2	101.66	96.11	6.64	1.37	4.57	0.36	3.64	4.08	4.35
LFb03-B.3	103.42	89.99	17.33	1.29	2.88	0.95	2.21	**2.60**	**2.55**
LFb03-B.4	122.5	103.57	20.79	1.48	3.9	0.88	1.9	**2.87**	**1.81**

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Sample ID	Wet weight (g)	Dry weight (g)	Moisture (%)	Bulk density (g cm^{-3})	pH Water	EC (ms cm^{-1})	pH peroxide	pH incubation, Time = 0 weeks	pH incubation, Time > 10 weeks
LFb03-B.5	112.98	96.01	20.32	1.37	6.82	0.81	2.98	7.11	4.07
LFb04-A.1	93.05	84.38	12.06	1.21	4.23	1.29	3.49	**3.95**	**3.73**
LFb04-A.2	89.72	84.41	7.38	1.21	3.16	1.01	2.36	**3.28**	**2.95**
LFb04-A.3	102.72	86.28	22.28	1.23	3.44	1.31	1.81	**2.85**	**1.93**
LFb04-A.4	105.84	86	26.99	1.23	3.72	1.08	1.79	**3.45**	**1.83**
LFb04-A.5	114.19	93.02	26.29	1.33	6.89	1.90	2.36	7.38	**2.06**
LFb04-C.1	110	90.22	25.45	1.29	8.1	1.29	6.56	8.33	7.35
LFb04-C.2	120.29	95.18	30.37	1.36	7.83	1.21	4.5	8.04	4.97
LFb04-C.3	116.75	89.4	35.57	1.28	8.59	0.57	1.8	8.40	**1.88**
LFb06-A.1	86.91	81.69	7.54	1.17	7.27	0.46	5.95	7.74	7.52
LFb06-A.2	98.37	84.84	18.70	1.21	7.62	1.25	6.49	7.77	7.72
LFb06-A.3	106.3	89.36	22.04	1.28	7.7	1.00	2.07	8.15	**2.58**
LFb06-B.1	81.5	73.1	13.86	1.04	7.9	1.53	6.52	7.83	7.79
LFb06-B.2	103.9	88.76	19.85	1.27	7.94	1.58	7.46	8.00	7.87
LFb06-B.3	107.39	86.42	28.37	1.23	7.73	1.05	5.46	7.52	7.10
LFb07-A.1	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	6.86	6.80
LFb07-A.2	95.64	79.19	24.67	1.13	3.41	2.28	2.09	4.65	4.36
LFb07-A.3	83.15	46.38	108.53	0.66	5.12	2.32	1.51	4.52	**2.05**
LFb07-A.4	79.68	43	120.26	0.61	6.03	2.34	1.49	6.31	**2.35**
LFb07-A.5	72.85	36.5	151.46	0.52	8.3	1.07	1.65	7.78	**2.36**
LFb07-B.1	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	4.61	7.70
LFb07-B.2	91.2	84.44	9.40	1.21	5.35	1.92	3.68	6.60	5.45
LFb07-B.3	94.01	65.94	52.53	0.94	7.13	1.46	3.43	6.90	6.49
LFb07-B.4	84.42	57.27	60.64	0.82	6.62	1.58	3.24	7.12	5.44
LFb08-A.1	81.62	75.59	9.56	1.08	6.56	6.86	4.78	7.15	5.52
LFb08-A.2	83.56	68.89	26.02	0.98	5.75	10.18	2.67	7.90	**2.40**

Sample ID	Wet weight (g)	Dry weight (g)	Moisture (%)	Bulk density (g cm^{-3})	pH Water	EC (ms cm^{-1})	pH peroxide	pH incubation, Time = 0 weeks	pH incubation, Time > 10 weeks
LFb08-A.3	68.9	39.26	110.76	0.56	7.85	6.50	5.34	7.88	4.39
LFb08-A.4	63.33	32.07	159.73	0.46	8.11	2.85	3.12	8.24	6.87
LFb08-B.1	88.25	79.48	13.09	1.14	7.91	0.02	4.34	8.41	6.94
LFb08-B.2	105.39	84.35	29.28	1.21	7.46	2.04	6.67	7.80	6.92
LFb08-B.3	62.45	30.08	184.13	0.43	7.83	4.02	6.32	7.95	6.37
LFb08-B.4	61.85	30.21	178.66	0.43	8.06	3.58	2.96	8.12	**2.08**
LFb10-A.1	28.34	27.42	6.17	0.39	5.05	1.87	2.13	5.82	5.63
LFb10-A.2	40.13	35.63	19.46	0.51	4.6	0.63	2.57	5.03	4.76
LFb10-A.3	75.93	70.94	8.54	1.01	6.95	0.31	6.19	7.22	7.07
LFb10-A.4	55.46	42.35	43.92	0.61	6.86	2.33	6.82	6.91	7.07
LFb10-C.1	40.79	37.27	14.21	0.53	2.57	235.35	2.34	7.08	**3.06**
LFb10-C.2	71.92	39.49	120.16	0.56	2.11	10.57	1.22	**2.89**	**2.38**
LFb10-C.3	88.63	55.98	75.09	0.80	2.21	2.15	1.11	**2.23**	**2.41**
LFb10-C.4	97.33	83.82	18.94	1.20	2.27	1.32	1.29	**2.32**	**2.28**
LFb10-C.5	103.42	77.07	40.81	1.10	2.34	1.53	1.1	**2.32**	**1.90**
LFb10-C.6	101.21	84.02	24.04	1.20	3.21	0.75	1.82	4.06	**1.90**
LFb10-D.1	57.64	55.02	6.16	0.79	7.27	7.19	6.18	7.53	7.33
LFb10-D.2	84.65	82.97	2.38	1.19	7.4	2.00	5.5	5.17	5.37
LFb10-D.3	115.93	94.19	26.61	1.35	2.71	2.29	1.57	**2.89**	**1.61**
LFb10-D.4	113	95.69	20.81	1.37	6.64	1.03	1.98	7.34	6.97
LFb12-A.1	47.97	45.94	6.07	0.66	3.15	361.20	2.71	**3.18**	**2.94**
LFb12-A.2	76.67	75.98	1.09	1.09	3.5	5.99	2.61	**3.18**	**3.03**
LFb12-A.3	92.3	82.27	14.38	1.18	3.06	1.95	2.43	**3.11**	**3.00**
LFb12-A.4	109.93	84.36	35.58	1.21	3.02	1.32	2.03	**2.99**	**2.80**
LFb12-A.5	99.01	73.6	41.59	1.05	7.58	1.22	1.99	6.65	**2.32**
LFb12-A.6	77.74	47.33	87.31	0.68	8.34	1.31	2.07	8.07	**2.24**

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Sample ID	Wet weight (g)	Dry weight (g)	Moisture (%)	Bulk density (g cm^{-3})	pH Water	EC (ms cm^{-1})	pH peroxide	pH incubation, Time = 0 weeks	pH incubation, Time > 10 weeks
LFb12-B.1	67.86	66.93	1.71	0.96	4.54	2.22	3.05	4.13	4.06
LFb12-B.2	81.26	72.97	13.71	1.04	6.06	1.95	3.93	6.23	4.84
LFb12-B.3	111.94	92.83	23.79	1.33	4.12	2.04	2.05	7.37	2.30
LFb12-B.4	117.74	94.77	27.92	1.35	7.84	2.67	1.81	8.05	1.92
LFb12-C.1	72.53	71.21	2.25	1.02	3.11	0.90	2.68	3.37	3.14
LFb12-C.2	75.39	71.23	7.08	1.02	3.18	0.39	2.56	3.36	3.25
LFb12-C.3	90.2	81.84	12.06	1.17	3.06	0.39	2.51	3.25	3.02
LFb12-C.4	109.28	91.74	22.14	1.31	2.69	1.06	2.09	2.81	1.97
LFb12-C.5	104.69	88.64	21.08	1.27	7.28	0.68	2.01	6.28	2.02
LFb13-A.1	78.64	42.42	121.06	0.61	3.48	4.28	1.81	3.46	3.17
LFb13-A.2	106.71	88.33	24.24	1.26	3.81	2.16	2.43	4.03	6.13
LFb13-A.3	106.69	85.96	28.22	1.23	7.39	2.26	6.59	7.45	7.30
LFb15-A.4	107.31	81.27	37.87	1.16	7.59	0.89	6.66	7.42	7.54
LFb15-B.1	57.66	51.84	14.79	0.74	2.82	8.03	1.07	2.97	3.25
LFb15-B.2	109.05	89.4	25.55	1.28	3.12	1.32	1.78	3.07	3.22
LFb15-B.3	109.53	81.86	39.89	1.17	3	1.64	1.68	2.90	3.36
LFb15-B.4	104.31	78.62	38.85	1.12	2.98	1.61	1.57	2.89	2.26
LFb15-B.5	95.5	70.12	44.05	1.00	3.82	1.44	1.62	3.30	2.44
LFb15-B.6	106.63	77.55	44.70	1.11	8.14	0.62	5.95	7.78	7.54
LFb15-C.1	60.62	55.85	11.00	0.80	2.74	10.53	1.1	2.91	2.58
LFb15-C.2	95.9	61.56	70.00	0.88	2.71	5.58	1.01	2.90	2.78
LFb15-C.3	102.89	70.2	56.66	1.00	3.02	4.18	1.05	2.98	2.84
LFb15-C.4	101.69	75.59	41.37	1.08	4.69	3.52	1.66	3.95	2.95
LFb15-C.5	98.25	70.76	47.19	1.01	8.02	2.29	6.54	8.02	7.23
LFb17-A.1	89.45	86.05	4.62	1.23	3.15	0.99	1.89	2.98	2.97
LFb17-A.2	104.96	86.23	25.40	1.23	2.98	1.03	1.83	2.76	2.72

Sample ID	Wet weight (g)	Dry weight (g)	Moisture (%)	Bulk density (g cm^{-3})	pH Water	EC (ms cm^{-1})	pH peroxide	pH incubation, Time = 0 weeks	pH incubation, Time > 10 weeks
LFb17-A.3	106.16	83.73	31.49	1.20	2.67	1.80	1.61	**2.63**	**2.65**
LFb17-A.4	99.32	77.61	33.34	1.11	4.09	1.00	1.74	**3.71**	**2.30**
LFb17-A.5	113.14	92.58	25.67	1.32	7.59	0.75	2.05	7.74	**2.63**
LFb17-B.1	90.68	79.25	17.12	1.13	3.05	1.26	2.01	**3.00**	5.76
LFb17-B.2	107.37	89.72	22.86	1.28	2.79	1.65	1.99	**2.66**	5.22
LFb17-B.3	115.21	94.66	25.01	1.35	3.87	1.66	1.87	6.31	**2.54**
LFb17-B.4	110.2	85.57	33.71	1.22	8.5	1.84	1.9	7.86	**2.31**

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

October and November 2009 sampling

Sample ID	Wet weight (g)	Dry weight (g)	Moisture (%)	Bulk density (g cm^{-3})	pH Water	EC (ms cm^{-1})	pH peroxide	pH incubation, Time = 0 weeks	pH incubation, Time > 10 weeks
LFa01-A.1	69.3	42.62	62.60	0.79	6.01	2.46	2.28	4.64	4.13
LFa01-A.2	92.4	59.79	54.54	1.03	2.98	6.62	1.35	2.59	2.09
LFa01-A.3	79.08	36.23	118.27	0.70	6.39	5.7	1.26	6.55	1.97
LFa01-D.1	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	3.48	3.03
LFa01-D.2	81.56	42.83	90.43	0.79	2.73	4.76	1.1	2.58	2.32
LFa02-A.1	99.77	85.52	16.66	1.40	2.98	0.00298	2.86	2.73	2.65
LFa02-A.2	90.55	82.97	9.14	1.36	3.26	0.00326	6.42	2.92	2.89
LFa02-A.3	117.16	96.39	21.55	1.56	2.99	0.00299	6.81	2.74	2.59
LFa02-A.4	115.49	90.88	27.08	1.48	4.94	0.00494	6.69	5.61	2.03
LFa02-A.5	118.25	94.63	24.96	1.53	4.54	0.00454	1.75	5.89	2.44
LFa02-B.1	83.48	78.59	6.22	1.30	6.32	0.00632	1.77	7.56	6.38
LFa02-B.2	93.74	80.54	16.39	1.33	6.34	0.00634	2	7.36	6.58
LFa02-B.3	103.21	87.07	18.54	1.42	6.57	0.00657	1.86	7.58	6.66
LFa02-B.4	100.83	81.9	23.11	1.35	7.68	0.00768	2.12	7.68	5.82
LFa02-B.5	111.87	91.39	22.41	1.48	7.74	0.00774	1.91	7.75	7.68
LFa03-A.1	87.99	75.6	16.39	1.26	3.81	2.207	2.08	3.69	3.83
LFa03-A.2	84.59	47.56	77.86	0.86	2.79	2.82	1.21	2.07	1.91
LFa03-A.3	97.83	79.84	22.53	1.32	2.87	2.043	1.39	2.19	2.24
LFa03-A.4	111.41	81.4	36.87	1.34	4.72	1.402	1.37	2.04	2.06
LFa03-B.1	90.17	85.07	6.00	1.39	5.03	0.523	3.52	4.43	4.34
LFa03-B.2	99.32	84.49	17.55	1.39	3.33	1.386	1.74	2.23	2.48
LFa03-B.3	112.86	89.14	26.61	1.45	7.49	1.568	2.07	2.59	2.78
LFa03-B.4	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
LFa04-A.1	75.59	69.07	9.44	1.17	4.21	0.683	3.36	3.94	4.02
LFa04-A.2	107.87	86.12	25.26	1.41	3.49	2.88	2.16	2.28	2.68

Sample ID	Wet weight (g)	Dry weight (g)	Moisture (%)	Bulk density (g cm^{-3})	pH Water	EC (ms cm^{-1})	pH peroxide	pH incubation, Time = 0 weeks	pH incubation, Time > 10 weeks
LFa04-A.3	94.74	56.49	67.71	0.99	4.97	3.1	1.69	**2.71**	**2.07**
LFa04-A.4	110.29	86.97	26.81	1.42	7.25	2.67	1.69	**2.56**	**2.74**
LFA04-C.1	93.14	75.42	23.50	1.26	8.46	9.5	7.7	7.82	7.42
LFA04-C.2	103.31	80.81	27.84	1.33	7.74	4.46	5.82	7.93	6.51
LFA04-C.3	105.74	81.99	28.97	1.35	7.95	2.47	5.2	5.65	5.86
LFa06-A.1	83.73	79.33	5.55	1.31	8.13	0.299	5.39	7.94	7.53
LFa06-A.2	96.94	80.96	19.74	1.34	7.8	0.709	5.83	7.77	7.23
LFa06-A.3	102.24	82.45	24.00	1.36	7.78	0.962	2.69	7.42	**2.66**
LFa06-B.1	101.14	82.09	23.21	1.35	7.92	2.124	7.44	7.72	8.19
LFa06-B.2	97.76	81.54	19.89	1.34	8.18	0.65	6.93	8.12	8.07
LFa06-B.3	91.25	63.84	42.94	1.09	7.86	1.309	6.8	7.65	7.49
LFa06-B.4	95.66	77.07	24.12	1.28	7.89	0.467	4.93	7.96	**3.65**
LFa07-A.1	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	5.14	7.19
LFa07-A.2	95.43	77.69	22.83	1.29	3.84	1.144	2.19	**3.27**	**2.85**
LFa07-A.3	66.85	26.48	152.45	0.56	7.8	1.342	1.96	7.04	**2.35**
LFa07-A.4	64.25	20.25	217.28	0.47	8.09	1.074	1.82	7.47	**2.14**
LFa07-A.5	69.3	26.73	159.26	0.56	8.58	0.955	1.82	7.51	**1.95**
LFa07-B.1	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	7.27	7.60
LFa07-B.2	97.1	78.18	24.20	1.30	7.3	1.95	3.4	6.53	6.78
LFa07-B.3	100.65	72.43	38.96	1.21	6.93	0.858	3.46	6.62	5.32
LFa07-B.4	89.23	58.89	51.52	1.02	7.14	0.525	3.01	N.A.	4.07
LFa08-A.1	87.6	76.39	14.67	1.27	5.86	8.65	3.34	5.19	6.96
LFa08-A.2	99.28	56.27	76.44	0.98	6.04	2.44	2.98	**3.89**	**3.66**
LFa08-A.3	100.57	79.22	26.95	1.31	7.29	2.78	2.65	6.61	**2.38**
LFa08-A.4	74.34	39.13	89.98	0.74	8.28	3.42	5.43	7.32	7.82
LFa08-A.5	72.28	35.3	104.76	0.68	7.98	4.8	2.13	8.09	**2.96**

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Sample ID	Wet weight (g)	Dry weight (g)	Moisture (%)	Bulk density (g cm^{-3})	pH Water	EC (ms cm^{-1})	pH peroxide	pH incubation, Time = 0 weeks	pH incubation, Time > 10 weeks
LFa08-B.1	98.51	79.51	23.90	1.31	8.18	1.508	6.82	7.53	7.81
LFa08-B.2	103.32	83.28	24.06	1.37	7.67	0.572	6.83	7.66	7.93
LFa08-B.3	101.92	79.57	28.09	1.32	7.91	1.72	7.05	8.02	7.82
LFa08-B.4	62.9	23.61	166.41	0.52	8.3	2.81	1.92	N.A.	1.91
LFa10-A.1	29.77	19.92	49.45	0.46	3.42	3.64	1.42	5.16	4.86
LFa10-A.2	73.93	19.92	271.13	0.46	4.07	0.45	2.12	3.9	3.91
LFa10-A.3	94.04	56.27	67.12	0.98	6.59	0.44	5.34	6.24	6.24
LFa10-A.4	80.85	68.03	18.84	1.15	6.96	2.2	6.34	7.25	6.94
LFa10-C.1	114.04	91.31	24.89	1.48	2.45	4.8	1.36	2.15	2.37
LFa10-C.2	83.3	90.8	-8.26	1.48	2.35	7.26	1.2	2.11	1.98
LFa10-C.3	93.08	48.12	93.43	0.87	2.69	2.82	1.37	2.62	2.09
LFa10-C.4	108.61	71.18	52.58	1.20	2.7	2.024	1.34	2.82	1.71
LFa10-C.5	107.37	87.94	22.09	1.43	2.98	1.785	1.34	3.05	1.74
LFa10-D.1	73.96	85.46	-13.46	1.40	7.61	4.03	7.04	7.28	7.31
LFa10-D.2	106.91	29.64	260.70	0.60	7.16	1.411	4.5	7.32	7.32
LFa10-D.3	123.18	88.91	38.54	1.45	4.96	1.939	1.46	6.99	2.59
LFa12-A.1	124.25	100.44	23.71	1.61	4.19	1.663	2.88	4.67	4.87
LFa12-A.2	114.71	92.63	23.84	1.50	3.1	1.483	2.56	3.32	3.10
LFa12-A.3	108.43	77.07	40.69	1.28	4.48	2.77	1.65	2.61	2.12
LFa12-A.4	98.32	58.93	66.84	1.02	7.2	2.094	1.66	2.42	2.11
LFa12-A.5	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	7.36
LFa12-B.1	63.88	17.53	264.40	0.43	6.31	5.16	3.23	7.82	4.29
LFa12-B.2	68.44	24.4	180.49	0.53	6.46	3.35	3.24	8.34	3.49
LFa12-B.3	116.13	94.98	22.27	1.54	7.05	2.086	2.9	7.65	5.24
LFa12-B.4	65.26	51.91	25.72	0.92	7.54	0.946	3.32	6.14	5.40
LFa12-C.1	64.51	58.33	10.59	1.01	2.88	11.52	7.06	2.10	2.20

Sample ID	Wet weight (g)	Dry weight (g)	Moisture (%)	Bulk density (g cm^{-3})	pH Water	EC (ms cm^{-1})	pH peroxide	pH incubation, Time = 0 weeks	pH incubation, Time > 10 weeks
LFa12-C.2	78.34	70.93	10.45	1.19	3.14	0.348	6.93	**2.79**	**2.77**
LFa12-C.3	83.2	68.64	21.21	1.16	3.01	0.00642	5.63	**2.88**	**2.80**
LFa12-C.4	85.25	68.85	23.82	1.16	3.37	0.00641	4.63	**2.58**	**2.41**
LFa12-C.5	111.47	91	22.49	1.48	6.62	0.0064	4.33	**2.37**	**2.49**
LFa13-A.1	66.29	25.91	155.85	0.55	3.29	0.00639	4.76	**3.22**	**2.20**
LFa13-A.2	92.7	70.63	31.25	1.19	3.27	0.00638	1.73	**3.86**	**3.12**
LFa13-A.3	95.48	75.82	25.93	1.26	6.96	0.973	2.1	7.12	7.30
LFa15-B.1	53.22	44.38	19.92	0.81	2.77	10.15	1.16	**2.77**	**2.72**
LFa15-B.2	103.31	81.11	27.37	1.34	3.26	1.155	2.06	**3.18**	**3.37**
LFa15-B.3	95.55	70.67	35.21	1.19	3.12	1.095	2.07	**3.12**	**3.02**
LFa15-B.4	84.5	53.64	57.53	0.94	3.12	1.151	1.56	**3.38**	**2.55**
LFa15-B.5	107.22	78.78	36.10	1.30	8.1	0.412	6.15	6.66	7.09
LFa15-C.1	62.19	44.4	40.07	0.81	2.76	11.21	1.36	**2.64**	**2.36**
LFa15-C.2	74.79	52.66	42.02	0.93	2.8	3.18	1.63	**3.69**	**2.29**
LFa15-C.3	70.23	41.96	67.37	0.78	3.12	4.07	1.58	**3.42**	**1.86**
LFa15-C.4	82.97	52.69	57.47	0.93	8.08	1.84	5.9	5.63	**2.36**
LFa15-C.5	18.41	15.53	18.54	0.40	3.02	18.59	1.28	**3.00**	**2.65**
LFa17-A.1	89.97	71.3	26.19	1.20	3.27	0.315	2.24	**2.96**	**2.90**
LFa17-A.2	88.98	65.73	35.37	1.12	2.66	1.393	1.66	**2.68**	**2.26**
LFa17-A.3	104.58	83.95	24.57	1.38	2.81	0.966	1.76	**2.97**	**2.41**
LFa17-A.4	92.47	62.43	48.12	1.07	4.29	0.979	1.21	7.03	**2.22**
LFa17-B.1	90.46	82.04	10.26	1.35	3.11	0.643	2.33	**3.13**	**2.72**
LFa17-B.2	91.3	75.75	20.53	1.26	3.18	0.902	2.56	**3.20**	**3.02**
LFa17-B.3	97.31	76.72	26.84	1.27	2.83	1.665	2.01	**3.39**	**2.31**
LFa17-B.4	103.05	81.08	27.10	1.34	7.79	1.37	1.77	5.73	**2.41**

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Appendix 6 – Acid – base accounting data

* NOTE:

1 - All analysis is Dry Weight (DW) - samples dried and ground immediately upon arrival (unless supplied dried and ground)

2 - Samples analysed by SPOCAS method 23 (ie Suspension Peroxide Oxidation Combined Acidity & sulfate) and 'Chromium Reducible Sulfur' technique (S_{CR} - Method 22B)

3 - Methods from Ahern, CR, McElnea AE , Sullivan LA (2004). *Acid Sulfate Soils Laboratory Methods Guidelines.* QLD DNRME.

4 - Bulk Density is required for liming rate calculations per soil volume. Lab. Bulk Density is no longer applicable - field bulk density rings can be used and dried/ weighed in the laboratory.

5 - **ABA Equation**: **Net Acidity = Potential Sulfidic Acidity (ie. Scrs or Sox) + Actual Acidity + Retained Acidity - measured ANC/FF   (with FF currently defaulted to 1.5)**

6 - The neutralising requirement, lime calculation, includes a 1.5 safety margin for acid neutralisation (an increased safety factor may be required in some cases)

7 - For Texture: coarse = sands to loamy sands: medium = sandy loams to light clays: fine = medium to heavy clays and silty clays

8 - .. denotes not requested or required

9 - SCREENING, CRS, TAA and ANC are NATA accredited but other SPOCAS segments are currently not NATA accredited

10- Results at or below detection limits are replaced with '0' for calculation purposes.

11 - Projects that disturb >1000 tonnes of soil, the ≥0.03% S classification guideline would apply (refer to acid sulfate management guidelines).

(Classification of potential acid sulfate material if: coarse Sc≥0.03%S or 19mole H $^+$/t: medium Scr≥0.06%S or 37mole H$^+$/t: fine Scr≥0.1%S or 62mole H$^+$/t) - as per QUASSIT Guidelines

June 2012 sampling

I.D.	Texture	Total Organic Carbon %C (LECO after acid)	Titratable actual acidity (TAA) pH$_{KCl}$	(To pH 6.5) mole H+/tonne	Reduced inorganic sulfur % chromium reducible %S$_{CR}$	mole H+/tonne	Retained acidity — Required if pH$_{KCL}$ <4.5 — HCL extract as %S$_{HCL}$ - %S$_{kcl}$ %S$_{NAG}$	S$_{NAS}$ mole H+/tonne	Acid neutralising capacity (ANC$_{BT}$) — Required if pH$_{Kcl}$ > 6.5 — % CaCO$_3$	mole H+/tonne	Net acidity Chromium suite mole H+/tonne based on %Scrs	Lime calculation Chromium suite kg CaCO$_3$/tonne DW (includes 1.5 safety Factor when liming rate is +ve)
	Note 6										Note 5	Notes 4 & 6
LFf01-A.1	Fine	3.84	4.92	22	0.11	69	..	0	..	0	90	6.8
LFf01-A.2	Fine	1.71	3.93	101	0.23	143	0.19	89	..	0	333	25.0
LFf01-A.3	Fine	3.26	3.53	143	1.19	742	0.00	0	..	0	885	66.4
LFf01-A.4	Fine	4.75	4.22	93	1.73	1079	0.00	0	..	0	1172	87.9
LFf01-D.1	Fine	11.52	4.66	105	0.44	274	..	0	..	0	380	28.5
LFf01-D.2	Fine	8.61	4.33	112	1.15	717	0.00	0	..	0	829	62.2
LFf01-D.3	Fine	2.04	4.63	29	0.82	511	..	0	..	0	540	40.5
LFf01-D.4	Fine	2.36	5.62	22	1.22	761	..	0	..	0	782	58.7
LFf02-A.1	Coarse	0.10	5.91	5	0.01	6	..	0	..	0	11	0.8
LFf02-A.2	Coarse	0.12	5.94	6	0.01	6	..	0	..	0	12	0.9
LFf02-A.3	Coarse	0.06	5.55	8	<0.01	0	..	0	..	0	8	0.6
LFf02-A.4	Medium	0.16	5.11	49	0.12	75	..	0	..	0	124	9.3
LFf02-B.1	Coarse	0.06	7.22	0	0.01	6	..	0	0.00	0	6	0.5
LFf02-B.2	Coarse	0.02	6.78	0	<0.01	0	..	0	0.00	0	0	0.0
LFf02-B.3	Coarse	0.02	7.00	0	0.01	6	..	0	0.02	4	4	0.3
LFf02-B.4	Coarse	0.02	6.66	0	<0.01	0	..	0	0.02	4	-3	-0.1
LFf02-D.1	Medium	0.07	6.42	3	<0.01	0	..	0	..	0	3	0.2
LFf02-D.2	Medium	0.14	5.05	18	<0.01	0	..	0	..	0	18	1.3
LFf02-D.3	Medium	0.30	4.63	17	0.01	6	..	0	..	0	24	1.8
LFf02-D.4	Medium	0.16	4.76	24	0.10	62	..	0	..	0	86	6.5
LFf03-A.1	Medium	0.25	5.47	9	0.04	25	..	0	..	0	34	2.6
LFf03-A.2	Medium	0.26	5.21	19	0.01	6	..	0	..	0	25	1.9
LFf03-A.3	Fine	1.80	3.48	113	0.03	19	0.05	21	..	0	153	11.5
LFf03-A.4	Medium	0.23	4.83	31	<0.01	0	..	0	..	0	31	2.3
LFd03-B.1	Coarse	0.07	5.92	8	0.01	6	..	0	..	0	15	1.1
LFd03-B.2	Medium	0.06	5.81	7	0.01	6	..	0	..	0	13	1.0
LFd03-B.3	Medium	0.02	5.54	7	<0.01	0	..	0	..	0	7	0.5
LFd03- B.4	Medium	0.04	5.31	9	0.03	19	..	0	..	0	28	2.1
LFd03-B.5	Medium	0.03	6.56	0	0.03	19	..	0	0.00	0	19	1.4
LFf04-A.1	Medium	0.07	6.33	7	0.02	12	..	0	..	0	20	1.5
LFf04-A.2	Medium	0.08	5.31	12	0.03	19	..	0	..	0	30	2.3
LFf04-A.3	Medium	0.30	4.89	55	0.26	162	..	0	..	0	217	16.2

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

I.D.	Texture	Total Organic Carbon %C (LECO after acid)	Titratable actual acidity (TAA) pH$_{KCl}$	Titratable actual acidity (TAA) (To pH 6.5) mole H+/tonne	Reduced inorganic sulfur % chromium reducible %S$_{CR}$	Reduced inorganic sulfur % chromium reducible mole H+/tonne	Retained acidity Required if pH$_{KCL}$<4.5 HCL extract as %S$_{HCL}$ - %S$_{kcl}$ %S$_{NAG}$	Retained acidity Required if pH$_{KCL}$<4.5 S$_{NAS}$ mole H+/tonne	Acid neutralising capacity (ANC$_{BT}$) Required if pH$_{KCL}$ > 6.5 % CaCO$_3$	Acid neutralising capacity (ANC$_{BT}$) Required if pH$_{KCL}$ > 6.5 mole H+/tonne	Net acidity Chromium suite mole H+/tonne based on %Scrs	Lime calculation Chromium suite kg CaCO$_3$/tonne DW (includes 1.5 safety Factor when liming rate is +ve)
	Note 6										Note 5	Notes 4 & 6
LFf04-A.4	Medium	0.09	5.23	12	0.06	37	..	0	..	0	49	3.7
LFf04-A.5	Medium	0.07	6.15	8	0.12	75	..	0	..	0	83	6.2
LFf04-C.1	Coarse	0.07	5.99	11	0.02	12	..	0	..	0	24	1.8
LFf04-C.2	Coarse	0.05	6.59	0	0.04	25	..	0	0.00	0	25	1.9
LFf04-C.3	Coarse	0.05	6.97	0	0.04	25	..	0	0.00	0	25	1.9
LFf06-A.1	Coarse	0.05	6.95	0	0.01	6	..	0	0.00	0	6	0.5
LFf06-A.2	Coarse	0.04	8.54	0	0.02	12	..	0	0.28	56	-25	-1.2
LFf06-A.3	Coarse	0.00	8.17	0	0.07	44	..	0	0.00	0	44	3.3
LFf06-A.4	Coarse	0.00	7.93	0	0.07	44	..	0	0.10	20	30	2.3
LFf06-B.1	Coarse	0.07	8.32	0	0.01	6	..	0	0.00	0	6	0.5
LFf06-B.2	Coarse	0.36	8.71	0	0.06	37	..	0	0.21	42	9	0.7
LFf06-B.3	Coarse	0.12	9.31	0	0.11	69	..	0	6.24	1247	-763	-38.1
LFf07-A.1	Medium	0.17	8.62	0	0.04	25	..	0	0.00	0	25	1.9
LFf07-A.2	Medium	0.19	6.33	2	0.02	12	..	0	..	0	14	1.1
LFf07-A.3	Medium	0.36	6.15	4	0.07	44	..	0	..	0	47	3.6
LFf07-A.4	Fine	3.76	6.44	4	1.17	730	..	0	..	0	733	55.0
LFf07-A.5	Fine	2.27	7.48	0	1.14	711	..	0	0.53	106	640	48.0
LFf07-B.1	Coarse	0.07	7.14	0	0.01	6	..	0	0.00	0	6	0.5
LFf07-B.2	Medium	0.14	6.77	0	0.01	6	..	0	0.00	0	6	0.5
LFf07-B.3	Fine	0.69	6.64	0	0.08	50	..	0	0.41	82	-5	-0.2
LFf07-B.4	Fine	1.48	6.55	0	0.84	524	..	0	0.19	38	499	37.4
LFf08-A.1	Fine	0.13	6.72	0	0.04	25	..	0	0.00	0	25	1.9
LFf08-A.2	Medium	0.15	7.11	0	0.07	44	..	0	0.00	0	44	3.3
LFf08-A.3	Fine	2.98	7.93	0	1.02	636	..	0	1.55	310	430	32.2
LFf08-A.4	Fine	2.51	7.72	0	1.48	923	..	0	1.36	272	742	55.6
LFf08-B.1	Medium	0.08	9.18	0	0.04	25	..	0	0.38	76	-26	-1.3
LFf08-B.2	Medium	0.15	9.38	0	0.05	31	..	0	0.28	56	-6	-0.3
LFf08-B.3	Fine	2.14	8.10	0	0.92	574	..	0	1.12	224	425	31.8
LFf08-B.4	Fine	2.68	7.98	0	1.99	1241	..	0	1.61	322	1027	77.0
LFf10-A.1	Fine	5.56	5.73	0	0.13	81	..	0	..	0	81	6.1
LFf10-A.2	Fine	1.23	7.05	0	0.03	19	..	0	2.20	440	-274	-13.7
LFf10-A.3	Fine	1.24	3.78	81	0.35	218	0.10	47	..	0	346	26.0
LFf10-A.4	Fine	2.84	3.82	135	1.44	898	0.05	21	..	0	1054	79.1

I.D.	Texture	Total Organic Carbon %C (LECO after acid)	Titratable actual acidity (TAA) pH$_{KCl}$	Titratable actual acidity (TAA) (To pH 6.5) mole H+/tonne	Reduced inorganic sulfur % chromium reducible %S$_{CR}$	Reduced inorganic sulfur mole H+/tonne	Retained acidity Required if pH$_{KCL}$ <4.5 HCL extract as %S$_{HCL}$ - %S$_{kcl}$ %S$_{NAG}$	Retained acidity S$_{NAS}$ mole H+/tonne	Acid neutralising capacity (ANC$_{BT}$) Required if pH$_{KCl}$ > 6.5 % CaCO$_3$	Acid neutralising capacity mole H+/tonne	Net acidity Chromium suite mole H+/tonne based on %Scrs	Lime calculation Chromium suite kg CaCO$_3$/tonne DW (includes 1.5 safety Factor when liming rate is +ve)
	Note 6										Note 5	Notes 4 & 6
LFf10-C.1	Medium	0.81	5.18	9	0.04	25	..	0	..	0	34	2.6
LFf10-C.2	Medium	1.26	4.28	29	0.14	87	0.01	3	..	0	120	9.0
LFf10-C.3	Medium	0.29	4.54	19	0.09	56	..	0	..	0	75	5.6
LFf10-C.4	Medium	0.10	5.00	13	0.10	62	..	0	..	0	75	5.7
LFf10-D.1	Medium	0.06	9.41	14	0.07	44	..	0	0.39	78	5	0.4
LFf10-D.2	Medium	0.08	8.41	0	0.02	12	..	0	0.00	0	12	0.9
LFf10-D.3	Medium	0.15	7.59	0	0.05	31	..	0	0.13	26	14	1.0
LFf10-D.4	Fine	0.23	8.88	0	0.23	143	..	0	7.13	1425	-806	-40.3
LFf10-D.4-A	Fine	0.15	8.43	0	0.13	81	..	0	0.12	24	65	4.9
LFf10-D.5	Fine	0.41	9.00	0	0.24	150	..	0	0.87	174	34	2.5
LFf12-A.1	Fine	0.26	6.01	8	0.02	12	..	0	..	0	21	1.6
LFf12-A.2	Fine	0.29	5.66	14	0.03	19	..	0	..	0	33	2.5
LFf12-A.3	Fine	0.23	4.52	22	0.12	75	..	0	..	0	97	7.3
LFf12-A.4	Fine	0.26	4.68	15	0.23	143	..	0	..	0	159	11.9
LFf12-A.5	Fine	0.30	5.21	10	0.19	119	..	0	..	0	128	9.6
LFf12-A.6	Fine	0.96	5.87	7	0.49	306	..	0	..	0	313	23.4
LFf12-B.1	Coarse	0.18	6.64	0	0.04	25	..	0	0.01	2	24	1.8
LFf12-B.2	Coarse	0.26	6.64	0	0.07	44	..	0	0.00	0	44	3.3
LFf12-B.3	Coarse	0.11	6.61	0	0.01	6	..	0	0.00	0	6	0.5
LFf12-B.4	Coarse	0.06	6.73	0	<0.01	0	..	0	0.00	0	0	0.0
LFf12-B.5	Medium	0.09	6.54	0	0.06	37	..	0	0.00	0	37	2.8
LFf12-B.6	Fine	0.30	6.51	0	0.04	25	..	0	0.02	4	22	1.7
LFf12-C.1	Medium	0.07	6.12	4	<0.01	0	..	0	..	0	4	0.3
LFf12-C.2	Medium	0.03	5.36	8	<0.01	0	..	0	..	0	8	0.6
LFf12-C.3	Medium	0.06	4.72	14	0.07	44	..	0	..	0	58	4.3
LFf13-A.1	Fine	4.08	6.66	0	0.21	131	..	0	0.20	40	104	7.8
LFf13-A.2	Medium	0.22	9.43	0	0.06	37	..	0	1.42	284	-152	-7.6
LFf13-A.3	Medium	0.11	9.56	0	0.07	44	..	0	6.36	1271	-803	-40.2
LFf13-A.4	Medium	0.13	9.44	0	0.09	56	..	0	5.31	1061	-651	-32.6
LFf15-B.2	Medium	0.44	6.13	8	0.02	12	..	0	..	0	21	1.6
LFf15-B.3	Medium	0.30	4.56	24	0.06	37	..	0	..	0	62	4.6
LFf15-B.4	Fine	0.23	8.84	0	0.18	112	..	0	5.26	1051	-588	-29.4
LFf15-B.5	Fine	0.24	9.15	0	0.22	137	..	0	8.34	1666	-974	-48.7
LFf15-C.1	Fine	2.53	4.24	65	0.18	112	0.02	9	..	0	186	14.0

I.D.	Texture	Total Organic Carbon %C (LECO after acid)	pH$_{KCl}$	TAA (To pH 6.5) mole H+/tonne	%S$_{CR}$	mole H+/tonne	HCL extract as %S$_{HCL}$ - %S$_{kcl}$ %S$_{NAG}$	S$_{NAS}$ mole H+/tonne	% CaCO$_3$	mole H+/tonne	Net acidity Chromium suite mole H+/tonne based on %Scrs	Lime calculation Chromium suite kg CaCO$_3$/tonne DW (includes 1.5 safety Factor when liming rate is +ve)
	Note 6										Note 5	Notes 4 & 6
LFf15-C.2	Fine	0.66	4.31	38	0.08	50	0.03	12	..	0	100	7.5
LFf15-C.3	Fine	0.36	8.41	0	0.23	143	..	0	0.10	20	130	9.8
LFf15-C.4	Fine	0.23	9.12	0	0.23	143	..	0	10.22	2042	-1218	-60.9
LFf15-C.5	Fine	0.15	9.37	0	0.15	94	..	0	18.67	3730	-2393	-119.7
LFf17-A.1	Medium	0.04	7.25	0	0.05	31	..	0	0.00	0	31	2.3
LFf17-A.2	Medium	0.11	4.53	22	0.01	6	..	0	..	0	28	2.1
LFf17-A.3	Fine	0.15	4.35	28	0.01	6	0.01	5	..	0	39	3.0
LFf17-B.1	Medium	0.06	5.50	6	0.01	6	..	0	..	0	12	0.9
LFf17-B.2	Medium	0.06	5.53	7	<0.01	0	..	0	..	0	7	0.5
LFf17-B.3	Coarse	0.03	5.81	4	0.01	6	..	0	..	0	10	0.8
LFf17-B.4	Fine	0.12	5.43	7	0.07	44	..	0	..	0	50	3.8
LFf19-A.1	Fine	0.42	4.50	62	<0.01	0	..	0	..	0	62	4.7
LFf19-A.2	Fine	0.07	4.23	55	<0.01	0	0.10	46	..	0	101	7.6
LFf19-A.3	Fine	0.07	7.63	0	0.96	599	..	0	3.93	785	75	5.6
LFf19-B.1	Fine	0.72	5.65	10	0.04	25	..	0	..	0	35	2.6
LFf19-B.2	Fine	0.68	4.59	30	0.02	12	..	0	..	0	42	3.1
LFf19-B.3	Fine	0.34	7.60	0	0.51	318	..	0	0.43	86	261	19.6
LFf19-B.4	Fine	0.09	8.73	0	0.06	37	..	0	7.14	1427	-914	-45.7
LFf20-A.1	Fine	1.66	3.69	84	0.64	399	0.02	10	..	0	494	37.0
LFf20-A.2	Fine	2.64	3.69	167	0.09	56	0.16	74	..	0	297	22.3
LFf20-A.3	Fine	0.88	3.66	105	0.30	187	0.18	86	..	0	378	28.4
LFf20-A.4	Fine	0.90	4.10	128	1.80	1123	0.06	30	..	0	1281	96.1
LFf20-A.5	Fine	0.79	4.88	22	0.28	175	..	0	..	0	197	14.8
LFf20-B.1	Fine	2.62	3.79	119	0.08	50	0.04	19	..	0	188	14.1
LFf20-B.2	Fine	2.89	3.47	161	0.44	274	0.06	29	..	0	465	34.9
LFf20-B.3	Fine	1.05	4.15	109	0.80	499	0.03	16	..	0	624	46.8
LFf20-B.4	Fine	0.78	4.10	64	1.18	736	0.00	0	..	0	800	60.0
LFf20-B.5	Fine	0.05	6.17	8	0.72	449	..	0	..	0	457	34.3
LFf21-A.1	Coarse	0.10	5.77	12	0.06	37	..	0	..	0	49	3.7
LFf21-A.2	Medium	0.23	5.07	13	0.16	100	..	0	..	0	113	8.5
LFf21-A.3	Medium	0.15	5.11	13	0.21	131	..	0	..	0	143	10.8
LFf21-A.4	Medium	0.08	5.71	8	0.18	112	..	0	..	0	121	9.0
LFf21-B.1	Coarse	0.02	7.06	0	<0.01	0	..	0	0.00	0	0	0.0

I.D.	Texture	Total Organic Carbon %C (LECO after acid)	Titratable actual acidity (TAA) pH$_{KCl}$	(To pH 6.5) mole H+/tonne	Reduced inorganic sulfur % chromium reducible %S$_{CR}$	mole H+/tonne	Retained acidity Required if pH$_{KCL}$ <4.5 HCL extract as %S$_{HCL}$ - %S$_{kcl}$ %S$_{NAG}$	S$_{NAS}$ mole H+/tonne	Acid neutralising capacity (ANC$_{BT}$) Required if pH$_{KCl}$ > 6.5 % CaCO$_3$	mole H+/tonne	Net acidity Chromium suite mole H+/tonne based on %Scrs	Lime calculation Chromium suite kg CaCO$_3$/tonne DW (includes 1.5 safety Factor when liming rate is +ve)
	Note 6										Note 5	Notes 4 & 6
LFf21-B.2	Coarse	0.09	8.19	0	0.01	6	..	0	0.00	0	6	0.5
LFf21-B.3	Medium	1.78	7.43	0	0.30	187	..	0	0.39	78	135	10.1
LFf23-A.1	Medium	0.09	6.57	0	<0.01	0	..	0	0.00	0	0	0.0
LFf23-A.2	Medium	0.04	6.32	2	<0.01	0	..	0	..	0	2	0.2
LFf23-A.3	Medium	0.02	5.98	5	0.01	6	..	0	..	0	11	0.8
LFf23-A.4	Medium	0.17	4.70	16	0.12	75	..	0	..	0	91	6.8
LFf23-A.5	Medium	0.08	5.81	8	0.07	44	..	0	..	0	51	3.9
LFf24-A.1	Fine	15.80	5.73	24	0.24	150	..	0	..	0	174	13.1
LFf24-A.2	Fine	3.92	4.34	92	0.15	94	0.53	246	..	0	432	32.4
LFf24-A.3	Fine	1.73	3.46	146	0.74	462	0.14	67	..	0	674	50.6
LFf24-A.4	Fine	1.54	3.81	183	1.37	854	0.00	0	..	0	1037	77.8
LFf24-B.1	Fine	8.25	5.50	20	0.41	256	..	0	..	0	276	20.7
LFf24-B.2	Fine	2.72	4.84	52	1.36	848	..	0	..	0	900	67.5
LFf24-B.3	Fine	2.11	6.14	6	1.57	979	..	0	..	0	985	73.9

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

November and December 2011 sampling

I.D.	Texture	Total Organic Carbon %C (LECO after acid)	Titratable actual acidity (TAA) pH$_{KCl}$	Titratable actual acidity (TAA) (To pH 6.5) mole H+/tonne	Reduced inorganic sulfur % chromium reducible %S$_{CR}$	Reduced inorganic sulfur mole H+/tonne	Retained acidity Required if pH$_{KCL}$ <4.5 HCL extract as %S$_{HCL}$ - %S$_{kcl}$ %S$_{NAG}$	Retained acidity S$_{NAS}$ mole H+/tonne	Acid neutralising capacity (ANC$_{BT}$) Required if pH$_{KCl}$ > 6.5 % CaCO$_3$	ANC mole H+/tonne	Net acidity Chromium suite mole H+/tonne based on %Scrs	Lime calculation Chromium suite kg CaCO$_3$/tonne DW (includes 1.5 safety Factor when liming rate is +ve)
	Note 6										Note 5	Notes 4 & 6
LFe01 A.1	Fine		4.80	48	0.08	50	0.000	0	..	0	98	7.3
LFe01-A.3	Fine		3.54	99	0.29	181	0.087	41	..	0	321	24.1
LFe01-A.4	Fine		3.55	158	1.34	836	0.008	4	..	0	998	74.8
LFe01-A.5	Fine		3.91	77	1.61	1004	0.072	34	..	0	1114	83.6
LFe01-D.1	Fine		4.22	92	0.11	69	0.129	60	..	0	221	16.5
LFe01-D.2	Fine		3.93	150	1.11	692	0.009	4	..	0	847	63.5
LFe01-D.3	Fine		4.85	29	1.08	674	..	0	..	0	703	52.7
LFe02-A.1	Coarse	0.07	6.47	4	0.01	5	..	0	..	0	8	0.6
LFe02-A.2	Medium	0.11	6.43	5	0.01	3	..	0	..	0	8	0.6
LFe02-A.3	Medium	0.09	6.18	13	0.01	6	..	0	..	0	18	1.4
LFe02-A.4	Fine	0.15	5.71	17	0.09	56	..	0	..	0	74	5.5
LFe02-A.5	Fine	0.12	6.98	0	0.40	252	..	0	0.17	34	230	17.2
LFe02-B.1	Coarse	0.02	6.88	0	0.01	3	..	0	0.00	0	3	0.2
LFe02-B.2	Coarse	<0.01	6.80	0	<0.01	0	..	0	0.00	0	0	0.0
LFe02-B.3	Medium	0.13	9.29	0	0.05	29	..	0	0.48	96	-35	-1.7
LFe02-B.4	Medium	0.03	8.35	0	0.02	12	..	0	0.00	0	12	0.9
LFe02-D.1	Medium	0.10	8.49	0	0.01	6	..	0	0.00	0	6	0.5
LFe02-D.2	Medium	0.09	5.20	16	0.01	4	..	0	..	0	20	1.5
LFe02-D.3	Medium	0.18	5.54	24	0.02	13	..	0	..	0	36	2.7
LFe02-D.4	Medium	0.17	4.66	21	0.08	51	..	0	..	0	72	5.4
LFe02-D.5	Fine	0.08	8.54	0	0.19	117	..	0	6.33	1265	-726	-36.3
LFe03-A.1	Medium	0.25	6.83	0	0.03	17	..	0	0.00	0	17	1.3
LFe03-A.2	Medium	0.22	6.39	6	0.01	7	..	0	..	0	14	1.0
LFe03-A.3	Fine	1.81	3.64	108	0.25	155	0.029	14	..	0	276	20.7
LFe03-A.4	Medium	0.17	5.55	20	0.06	36	..	0	..	0	56	4.2
LFe03-A.5	Fine	3.04	6.25	14	0.52	323	..	0	..	0	337	25.3
LFe03-B.1	Coarse		6.28	2	0.01	6	..	0	..	0	8	0.6
LFe03-B.3	Medium		5.35	4	0.03	19	..	0	..	0	23	1.7
LFe03-B.4	Medium		4.94	6	0.08	50	..	0	..	0	56	4.2
LFe03-B.5	Fine		4.99	7	0.08	50	..	0	..	0	57	4.3
LFe04-A.1	Coarse		6.15	2	0.01	6	..	0	..	0	8	0.6
LFe04-A.2	Medium		5.89	3	0.03	19	..	0	..	0	22	1.6

I.D.	Texture	Total Organic Carbon %C (LECO after acid)	Titratable actual acidity (TAA) pH$_{KCl}$	Titratable actual acidity (TAA) (To pH 6.5) mole H+/tonne	Reduced inorganic sulfur % chromium reducible %S$_{CR}$	Reduced inorganic sulfur mole H+/tonne	Retained acidity Required if pH$_{KCL}$ <4.5 HCL extract as %S$_{HCL}$ - %S$_{kcl}$ %S$_{NAG}$	Retained acidity S$_{NAS}$ mole H+/tonne	Acid neutralising capacity (ANC$_{BT}$) Required if pH$_{kcl}$ > 6.5 % CaCO$_3$	Acid neutralising capacity mole H+/tonne	Net acidity Chromium suite mole H+/tonne based on %Scrs	Lime calculation Chromium suite kg CaCO$_3$/tonne DW (includes 1.5 safety Factor when liming rate is +ve)
		Note 6									Note 5	Notes 4 & 6
LFe04-A.3	Medium		6.60	0	0.11	69	..	0	0.17	34	46	3.4
11.4	Fine		7.79	0	0.40	249	..	0	0.73	146	152	11.4
LFe04-C.1	Coarse		7.08	0	0.01	6	..	0	0.09	18	-6	-0.3
LFe04-C.2	Medium		7.56	0	0.05	31	..	0	0.14	28	13	0.9
LFe04-C.3	Fine		9.33	0	0.14	87	..	0	1.35	270	-93	-4.6
LFe06-A.1	Coarse		8.38	0	0.01	6	..	0	0.14	28	-12	-0.6
LFe06-A.2	Medium		9.48	0	0.01	6	..	0	0.33	66	-38	-1.9
LFe06-A.3	Medium		8.47	0	0.05	31	..	0	0.18	36	7	0.5
LFe06-A.4	Medium		5.93	2	0.04	25	..	0	..	0	27	2.1
LFe06-A.5	Fine		5.44	4	0.09	56	..	0	..	0	61	4.5
LFe06-B.1	Coarse		9.20	0	0.01	6	..	0	0.19	38	-19	-1.0
LFe06-B.2	Fine		9.18	0	0.16	100	..	0	2.22	444	-196	-9.8
LFe06-B.3	Fine		8.34	0	0.88	549	..	0	1.15	230	396	29.7
LFe07-A.1	Medium	0.49	5.85	3	0.06	37	..	0	..	0	40	3.0
LFe07-A.2	Fine	0.47	6.59	0	0.08	51	..	0	0.00	0	51	3.8
49.3	Fine	3.41	6.21	9	1.04	649	..	0	..	0	657	49.3
LFe07-A.5	Fine	2.32	7.57	0	1.04	649	..	0	0.64	128	563	42.3
LFe07-B.1	Medium	0.14	7.37	0	0.01	6	..	0	0.00	0	6	0.5
LFe07-B.2	Medium	0.41	7.87	0	0.07	44	..	0	0.10	20	30	2.3
LFe07-B.3	Fine	1.18	8.06	0	0.90	561	..	0	0.22	44	532	39.9
LFe07-B.4	Fine	0.07	8.76	0	1.09	680	..	0	1.71	342	452	33.9
LFe07-B.5	Fine	0.08	8.80	0	1.17	730	..	0	7.19	1437	-228	-11.4
LFe08-A.1	Medium		8.47	0	0.02	12	..	0	0.24	48	-19	-1.0
LFe08-A.2	Medium		7.66	0	0.04	25	..	0	0.21	42	-3	-0.2
LFe08-A.3	Fine		7.45	0	1.00	624	..	0	1.79	358	385	28.9
36.5	Fine		7.65	0	1.17	730	..	0	1.82	364	487	36.5
LFe08-B.1	Medium		9.40	0	0.04	25	..	0	0.62	124	-58	-2.9
LFe08-B.2	Medium		9.32	0	0.07	44	..	0	0.87	174	-72	-3.6
LFe08-B.3	Fine		8.12	0	0.38	237	..	0	2.06	412	-37	-1.9
LFe08-B.4	Fine		7.28	0	2.03	1266	..	0	1.85	370	1020	76.5
LFe10-A.1	Fine		6.14	10	0.29	181	..	0	..	0	191	14.3
LFe10-A.2	Fine		3.75	69	0.04	25	0.165	77	..	0	171	12.8
LFe10-A.3	Fine		3.50	150	0.05	31	0.220	103	..	0	284	21.3

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

I.D.	Texture	Total Organic Carbon %C (LECO after acid)	Titratable actual acidity (TAA) pH$_{KCl}$	Titratable actual acidity (TAA) (To pH 6.5) mole H+/tonne	Reduced inorganic sulfur % chromium reducible %S$_{CR}$	Reduced inorganic sulfur mole H+/tonne	Retained acidity Required if pH$_{KCL}$ <4.5 HCL extract as %S$_{HCL}$ - %S$_{kcl}$ %S$_{NAG}$	Retained acidity S$_{NAS}$ mole H+/tonne	Acid neutralising capacity (ANC$_{BT}$) Required if pH$_{KCl}$ > 6.5 % CaCO$_3$	ANC mole H+/tonne	Net acidity Chromium suite mole H+/tonne based on %Scrs	Lime calculation Chromium suite kg CaCO$_3$/tonne DW (includes 1.5 safety Factor when liming rate is +ve)
		Note 6									Note 5	Notes 4 & 6
LFe10-A.4	Fine		3.60	219	0.95	593	0.344	161	..	0	972	72.9
LFe10-C.1	Medium		6.27	6	0.05	31	..	0	..	0	37	2.8
LFe10-C.2	Medium		4.98	17	0.03	19	..	0	..	0	36	2.7
LFe10-C.3	Medium		5.27	17	0.06	37	..	0	..	0	54	4.1
LFe10-C.4	Coarse		5.15	15	0.07	44	..	0	..	0	58	4.4
LFe10-D.1	Coarse		4.02	137	<0.01	0	..	0	..	0	137	10.2
LFe10-D.2	Medium		8.80	0	0.01	6	..	0	0.31	62	-35	-1.8
LFe10-D.3	Fine		9.10	0	0.21	131	..	0	16.53	3303	-2071	-103.5
LFe12-A.1	Medium		5.64	14	0.02	12	..	0	..	0	26	2.0
LFe12-A.2	Medium		6.69	0	0.05	31	..	0	0.27	54	-5	-0.2
LFe12-A.3	Medium		4.50	30	0.12	75	..	0	..	0	105	7.9
12.0¯	Medium		5.89	23	0.22	137	..	0	..	0	160	12.0¯
LFe12-A.5	Medium		5.05	14	0.18	112	..	0	..	0	126	9.5
LFe12-B.1	Coarse		6.85	0	0.05	31	..	0	0.23	46	1	0.0
LFe12-B.3	Coarse		6.72	0	0.02	12	..	0	0.22	44	-17	-0.8
LFe12-B.4	Medium		6.61	0	0.05	31	..	0	0.19	38	6	0.4
LFe12-B.5	Medium		6.41	3	0.15	94	..	0	..	0	96	7.2
LFe12-C.1	Coarse		6.50	0	<0.01	0	..	0	0.22	44	-29	-1.5
LFe12-C.2	Coarse		5.51	8	<0.01	0	..	0	..	0	8	0.6
LFe12-C.3	Coarse		6.44	4	<0.01	0	..	0	..	0	4	0.3
LFe13-A.2	Medium		6.69	0	0.09	56	..	0	0.53	106	-14	-0.7
LFe13-A.3	Coarse		9.34	0	0.06	37	..	0	2.35	470	-276	-13.8
LFe13-A.4	Coarse		9.46	0	0.08	50	..	0	5.95	1189	-743	-37.1
LFe13-A.5	Medium		9.33	0	0.10	62	..	0	4.70	939	-564	-28.2
LFe15-A.1	Fine	1.87	8.18	0	0.22	137	..	0	2.76	551	-230	-11.5
LFe15-A.2	Fine	1.08	8.07	0	0.12	75	..	0	1.71	342	-153	-7.6
LFe15-B.1	Fine	3.03	4.89	50	0.17	106	..	0	..	0	156	11.7
LFe15-B.3	Fine	0.44	4.40	31	0.02	12	0.031	15	..	0	58	4.4
LFe15-B.5	Fine	0.29	8.84	0	0.20	125	..	0	2.97	593	-271	-13.5
LFe15-B.6	Medium	0.34	8.28	0	0.17	106	..	0	7.22	1443	-856	-42.8
15-C.1	Fine	4.17	4.21	86	0.21	131	0.032	15	..	0	233	17.4
LFe15-C.2	Fine	0.78	3.82	57	0.06	37	0.040	18	..	0	113	8.5
LFe15-C.3	Fine	0.36	7.73	0	0.19	119	..	0	0.84	168	7	0.5
LFe15-C.4	Fine	0.22	8.82	0	0.16	100	..	0	11.53	2304	-1436	-71.8

I.D.	Texture	Total Organic Carbon %C (LECO after acid)	Titratable actual acidity (TAA) pH$_{KCl}$	Titratable actual acidity (TAA) (To pH 6.5) mole H+/tonne	Reduced inorganic sulfur % chromium reducible %S$_{CR}$	Reduced inorganic sulfur mole H+/tonne	Retained acidity Required if pH$_{KCL}$ <4.5 HCL extract as %S$_{HCL}$ - %S$_{kcl}$ %S$_{NAG}$	Retained acidity S$_{NAS}$ mole H+/tonne	Acid neutralising capacity (ANC$_{BT}$) Required if pH$_{kcl}$ > 6.5 % CaCO$_3$	Acid neutralising capacity mole H+/tonne	Net acidity Chromium suite mole H+/tonne based on %Scrs	Lime calculation Chromium suite kg CaCO$_3$/tonne DW (includes 1.5 safety Factor when liming rate is +ve)
		Note 6									Note 5	Notes 4 & 6
LFe17-A.1	Coarse	0.06	8.50	0	<0.01	0	..	0	0.00	0	0	0.0
LFe17-A.2	Medium	0.10	4.71	18	<0.01	0	..	0	..	0	18	1.4
LFe17-A.3	Fine	0.16	5.33	23	0.08	50	..	0	..	0	73	5.5
LFe17-A.4	Fine	0.18	8.25	0	0.36	225	..	0	3.06	611	-183	-9.2
LFe17-A.5	Fine	0.42	9.22	0	0.27	168	..	0	..	0	168	12.6
LFe17-B.1	Medium	0.13	6.57	0	<0.01	0	..	0	0.00	0	0	0.0
LFe17-B.2	Medium	0.03	6.31	4	0.01	6	..	0	..	0	10	0.8
LFe17-B.3	Fine	0.12	5.42	10	0.09	56	..	0	..	0	66	5.0
LFe17-B.4	Fine	0.26	5.65	15	0.20	125	..	0	..	0	140	10.5
LFe19-A.1	Medium		4.22	42	0.02	12	0.069	32	..	0	87	6.5
LFe19-A.2	Medium		4.29	59	0.01	6	0.106	49	..	0	114	8.6
LFe19-A.3	Fine		7.75	0	1.17	730	..	0	3.68	735	240	18.0
LFe19-A.4	Fine		8.69	0	0.72	449	..	0	6.35	1269	-397	-19.8
LFe19-B.1	Medium		7.20	0	0.06	37	..	0	0.37	74	-12	-0.6
LFe19-B.2	Medium		6.07	14	0.02	12	..	0	..	0	27	2.0
LFe19-B.3	Medium		4.18	38	0.03	19	0.090	42	..	0	99	7.4
LFe19-B.4	Fine		8.35	0	0.64	399	..	0	5.41	1081	-321	-16.1
LFe20-A.1	Fine		4.20	105	0.11	69	0.030	14	..	0	188	14.1
LFe20-A.2	Fine		3.44	167	0.04	25	0.171	80	..	0	272	20.4
LFe20-A.3	Fine		4.23	89	0.22	137	0.159	74	..	0	300	22.5
LFe20-A.4	Fine		3.94	118	1.34	836	0.000	0	..	0	954	71.6
LFe20-A.5	Fine		4.68	25	1.43	892	..	0	..	0	917	68.8
LFe20-B.1	Fine		3.67	93	0.06	37	0.021	10	..	0	140	10.5
LFe20-B.2	Fine		4.20	125	0.63	393	0.037	17	..	0	535	40.2
LFe20-B.3	Fine		3.62	125	0.62	387	0.081	38	..	0	550	41.2
LFe20-B.4	Fine		4.82	47	0.93	580	..	0	..	0	627	47.0
LFe20-B.5	Fine		7.77	0	1.01	630	..	0	0.58	116	553	41.5
LFe20-B.6	Fine		8.68	0	0.33	206	..	0	3.38	675	-244	-12.2
LFe21-A.1	Coarse		6.21	2	0.06	37	..	0	..	0	39	2.9
LFe21-A.2	Medium		5.09	13	0.24	150	..	0	..	0	163	12.2
LFe21-A.3	Coarse		6.01	2	0.18	112	..	0	..	0	114	8.6
LFe21-B.1	Coarse		8.34	0	0.01	6	..	0	0.15	30	-14	-0.7
LFe21-B.2	Fine		6.55	0	0.32	200	..	0	0.80	160	93	7.0
LFe21-B.3	Coarse		7.96	0	0.18	112	..	0	0.23	46	82	6.1

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

I.D.	Texture	Total Organic Carbon %C	Titratable actual acidity (TAA)		Reduced inorganic sulfur % chromium reducible		Retained acidity		Acid neutralising capacity (ANC_BT)		Net acidity Chromium suite	Lime calculation Chromium suite
							Required if pH_KCL <4.5		Required if pH_KCl > 6.5		mole H+/tonne	kg CaCO$_3$/tonne DW
		(LECO after acid)	pH_KCl	(To pH 6.5) mole H+/tonne	%S_CR	mole H+/tonne	HCL extract as %S_HCL - %S_kcl %S_NAG	S_NAS mole H+/tonne	% CaCO$_3$	mole H+/tonne	based on %Scrs	(includes 1.5 safety Factor when liming rate is +ve)
	Note 6										Note 5	Notes 4 & 6
LFe23-A.1	Coarse		5.94	3	0.02	12	..	0	..	0	16	1.2
LFe23-A.2	Coarse		6.27	4	0.01	6	..	0	..	0	11	0.8
LFe23-A.3	Medium		4.97	8	0.03	19	..	0	..	0	27	2.0
LFe23-A.4	Medium		6.14	5	0.05	31	..	0	..	0	36	2.7
LFe24-A.1	Fine		5.05	63	0.20	125	..	0	..	0	187	14.1
LFe24-A.2	Fine		4.29	154	0.58	362	0.087	40	..	0	556	41.7
LFe24-A.3	Fine		3.59	181	1.54	960	0.110	51	..	0	1193	89.5
LFe24-A.4	Fine		3.94	149	1.23	767	0.000	0	..	0	916	68.7
LFe24-B.1	Fine		5.34	31	0.45	281	..	0	..	0	312	23.4
LFe24-B.2	Fine		4.07	149	1.03	642	0.048	22	..	0	813	61.0
LFe24-B.3	Fine		4.24	89	1.30	811	0.089	42	..	0	941	70.6

May and June 2011 sampling

I.D.	Texture	Titratable actual acidity (TAA)		Extractable sulfate sulfur		Extractable Ca %Ca_kcl	Extractable Mg %Mg_kcl	Reduced inorganic sulfur % chromium reducible		Retained acidity		Acid neutralising capacity (ANC_BT)		Net acidity Chromium suite mole H+/tonne	Lime calculation Chromium suite kg CaCO_3/tonne DW
										Required if pH_KCL <4.5		Required if pH_KCl > 6.5			
		pH_{KCl}	(To pH 6.5) mole H+/tonne	$\%S_{kcl}$	mole H+/tonne (AASS acidity)			$\%S_{CR}$	mole H+/tonne	HCL extract as $\%S_{HCL}$ - $\%S_{kcl}$ $\%S_{NAG}$	S_{NAS} mole H+/tonne	% CaCO_3	mole H+/tonne	based on %Scrs	(includes 1.5 safety Factor when liming rate is +ve)
	Note 6													Note 5	Notes 4 & 6
LFd01-A.1	Fine	4.25	65	0.088	55	0.164	0.066	0.07	45	0.035	16	..	0	126	9.5
LFd01-A.2	Fine	3.47	109	0.281	175	0.152	0.088	0.39	243	0.101	47	..	0	400	30.0
LFd01-A.3	Fine	3.64	165	0.599	373	0.235	0.269	1.44	899	0.054	25	..	0	1089	81.7
LFd01-D.1	Fine	5.74	20	..	..	..	..	0.21	131	..	0	..	0	151	11.3
LFd01-D.2	Fine	6.09	9	..	..	..	..	0.25	155	..	0	..	0	165	12.3
LFd01-D.3	Fine	6.23	7	..	..	..	..	0.69	429	..	0	..	0	436	32.7
LFd02-A.1	Coarse	4.88	6	..	..	..	..	0.01	5	..	0	..	0	11	0.8
LFd02-A.2	Coarse	4.60	8	..	..	..	..	0.01	4	..	0	..	0	12	0.9
LFd02-A.3	Medium	4.27	18	0.059	37	0.017	0.025	0.11	68	0.005	2	..	0	88	6.6
LFd02-A.4	Fine	8.52	0	..	..	..	..	0.40	247	..	0	0.79	158	142	10.6
LFd02-B.1	Coarse	6.88	0	..	..	..	..	<0.01	0	..	0	0.00	0	0	0.0
LFd02-B.2	Coarse	6.96	0	..	..	..	..	0.01	3	..	0	0.00	0	3	0.3
LFd02-B.3	Coarse	7.15	0	..	..	..	..	<0.01	0	..	0	0.00	0	0	0.0
LFd02-B.4	Coarse	7.18	0	..	..	..	..	<0.01	0	..	0	0.00	0	0	0.0
LFd02-B.5	Coarse	7.02	0	..	..	..	..	0.01	7	..	0	0.00	0	7	0.5
LFd03-A.1	Medium	7.89	0	..	..	..	..	0.02	13	..	0	0.00	0	13	1.0
LFd03-A.2	Medium	4.42	26	0.075	46	0.033	0.025	<0.01	0	0.016	7	..	0	34	2.5
LFd03-A.3	Medium	4.41	30	0.074	46	0.021	0.026	0.03	19	0.028	13	..	0	62	4.6
LFd03-A.4	Fine	6.99	0	..	..	..	..	0.70	437	..	0	1.28	256	266	20.0
LFd03-B.1	Coarse	6.64	0	..	..	..	..	0.01	6	..	0	0.00	0	6	0.4
LFd03-B.2	Coarse	5.29	5	..	..	..	..	<0.01	0	..	0	..	0	5	0.4
LFd03-B.3	Medium	5.44	6	..	..	..	..	0.03	19	..	0	..	0	25	1.9
LFd04-A.1	Coarse	6.63	0	..	..	..	..	0.01	8	..	0	0.01	2	6	0.5
LFd04-A.2	Coarse	5.48	7	..	..	..	..	0.02	10	..	0	..	0	17	1.3
LFd04-A.3	Medium	5.51	7	..	..	..	..	0.08	49	..	0	..	0	55	4.1
LFd04-A.4	Fine	8.70	0	..	..	..	..	0.43	270	..	0	1.06	212	129	9.7
LFd04-C.1	Coarse	6.68	0	..	..	..	..	0.02	11	..	0	0.00	0	11	0.8
LFd04-C.2	Medium	7.66	0	..	..	..	..	0.03	21	..	0	0.06	12	13	1.0
LFd04-C.3	Medium	9.00	0	..	..	..	..	0.10	61	..	0	0.20	40	34	2.6
LFd06-A.1	Coarse	6.70	0	..	..	..	..	<0.01	0	..	0	0.10	20	-13	-0.7

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

APPENDIX 6 – ACID – BASE ACCOUNTING DATA

I.D.	Texture	Titratable actual acidity (TAA) pH$_{KCl}$	Titratable actual acidity (TAA) (To pH 6.5) mole H+/tonne	Extractable sulfate sulfur %S$_{kcl}$	Extractable sulfate sulfur mole H+/tonne (AASS acidity)	Extractable Ca %Ca$_{kcl}$	Extractable Mg %Mg$_{kcl}$	Reduced inorganic sulfur % chromium reducible %S$_{CR}$	Reduced inorganic sulfur mole H+/tonne	Retained acidity Required if pH$_{KCL}$<4.5 HCL extract as %S$_{HCL}$ - %S$_{kcl}$ %S$_{NAG}$	Retained acidity Required if pH$_{KCL}$<4.5 S$_{NAS}$ mole H+/tonne	Acid neutralising capacity (ANC$_{BT}$) Required if pH$_{kcl}$ > 6.5 % CaCO$_3$	ANC mole H+/tonne	Net acidity Chromium suite mole H+/tonne based on %Scrs	Lime calculation Chromium suite kg CaCO$_3$/tonne DW (includes 1.5 safety Factor when liming rate is +ve)
	Note 6													Note 5	Notes 4 & 6
LFd06-A.2	Coarse	9.11	0	..	..	..	..	<0.01	0	..	0	0.09	18	-12	-0.6
LFd06-A.3	Coarse	9.50	0	..	..	..	..	0.03	21	..	0	0.39	78	-31	-1.6
LFd06-A.4	Coarse	7.91	0	..	..	..	..	0.07	43	..	0	0.02	4	40	3.0
LFd06-A.5	Medium	6.58	0	..	..	..	..	0.07	41	..	0	0.00	0	41	3.1
LFd06-B.1	Coarse	7.48	0	..	..	..	..	<0.01	0	..	0	0.04	8	-5	-0.3
LFd06-B.2	Coarse	9.35	0	..	..	..	..	0.03	16	..	0	0.31	62	-26	-1.3
LFd06-B.3	Medium	9.31	0	..	..	..	..	0.18	109	..	0	2.18	436	-181	-9.1
LFd06-B.4	Fine	8.26	0	..	..	..	..	0.81	503	..	0	0.36	72	455	34.1
LFd07-A.1	Fine	8.00	0	..	..	..	..	0.03	17	..	0	0.12	24	1	0.1
LFd07-A.2	Fine	7.23	0	..	..	..	..	0.86	533	..	0	0.67	134	444	33.3
LFd07-A.3	Fine	8.09	0	..	..	..	..	1.05	658	..	0	1.23	246	494	37.0
LFd07-A.4	Fine	8.82	0	..	..	..	..	0.58	360	..	0	9.49	1896	-904	-45.2
LFd07-B.1	Medium	8.50	0	..	..	..	..	0.02	12	..	0	0.16	32	-9	-0.4
LFd07-B.2	Fine	7.94	0	..	..	..	..	0.09	56	..	0	0.44	88	-3	-0.1
LFd07-B.3	Fine	7.28	0	..	..	..	..	0.75	467	..	0	0.42	84	411	30.8
LFd07-B.4	Fine	8.84	0	..	..	..	..	0.86	536	..	0	1.56	312	329	24.6
LFd07-B.5	Fine	8.97	0	..	..	..	..	1.29	805	..	0	15.42	3081	-1249	-62.5
LFd08-A.1	Medium	9.26	0	..	..	..	..	0.01	8	..	0	0.07	14	-1	-0.1
LFd08-A.2	Medium	6.98	0	..	..	..	..	0.04	26	..	0	0.14	28	7	0.5
LFd08-A.3	Fine	8.00	0	..	..	..	..	1.11	694	..	0	2.72	543	332	24.9
LFd08-A.4	Fine	8.05	0	..	..	..	..	1.50	938	..	0	1.62	324	722	54.2
LFd08-B.1	Fine	9.56	0	..	..	..	..	0.01	8	..	0	0.45	90	-52	-2.6
LFd08-B.2	Fine	9.57	0	..	..	..	..	0.03	22	..	0	0.56	112	-53	-2.7
LFd08-B.3	Fine	8.18	0	..	..	..	..	1.59	992	..	0	1.78	356	755	56.6
LFd10-A.1	Fine	6.18	15	..	..	..	..	0.10	64	..	0	..	0	79	5.9
LFd10-A.2	Fine	5.67	14	..	..	..	..	0.02	11	..	0	..	0	25	1.8
LFd10-A.3	Fine	3.62	92	0.197	123	0.099	0.136	0.02	15	0.232	108	..	0	215	16.1
LFd10-C.1	Fine	4.27	39	0.034	21	0.057	0.070	0.03	19	0.027	13	..	0	70	5.2
LFd10-C.2	Fine	3.93	34	0.055	34	0.014	0.020	0.07	43	0.036	17	..	0	94	7.0
LFd10-C.3	Fine	4.50	18	..	..	..	..	0.11	66	..	0	..	0	84	6.3
LFd10-C.4	Fine	4.68	16	..	..	..	..	0.10	64	..	0	..	0	80	6.0
LFd10-D.1	Coarse	9.36	0	..	..	..	..	0.01	6	..	0	0.07	14	-3	-0.1
LFd10-D.2	Coarse	9.57	0	..	..	..	..	0.01	7	..	0	0.27	54	-29	-1.5
LFd10-D.3	Fine	9.48	0	..	..	..	..	0.30	184	..	0	30.23	6040	-3842	-192.1

I.D.	Texture	Titratable actual acidity (TAA)		Extractable sulfate sulfur		Extractable Ca %Ca$_{kcl}$	Extractable Mg %Mg$_{kcl}$	Reduced inorganic sulfur % chromium reducible		Retained acidity Required if pH$_{KCL}$ <4.5		Acid neutralising capacity (ANC$_{BT}$) Required if pH$_{Kcl}$ > 6.5		Net acidity Chromium suite mole H+/tonne	Lime calculation Chromium suite kg CaCO$_3$/tonne DW
		pH$_{KCl}$	(To pH 6.5) mole H+/tonne	%S$_{kcl}$	mole H+/tonne (AASS acidity)			%S$_{CR}$	mole H+/tonne	HCL extract as %S$_{HCL}$ - %S$_{kcl}$ %S$_{NAG}$	S$_{NAS}$ mole H+/tonne	% CaCO$_3$	mole H+/tonne	based on %Scrs	(includes 1.5 safety Factor when liming rate is +ve)
	Note 6													Note 5	Notes 4 & 6
LFd12-A.1	Coarse	5.12	7	..	..	..	..	0.01	6	..	0	..	0	13	1.0
LFd12-A.2	Fine	4.39	25	0.081	51	0.037	0.061	0.09	55	0.015	7	..	0	88	6.6
LFd12-A.3	Fine	4.47	23	0.111	69	0.046	0.075	0.18	111	0.000	0	..	0	134	10.1
LFd12-A.4	Fine	5.45	6	..	..	..	..	0.26	160	..	0	..	0	166	12.5
LFd12-A.5	Fine	6.60	0	..	..	..	..	0.58	363	..	0	0.49	98	298	22.3
LFd12-B.1	Coarse	6.56	0	..	..	..	..	0.01	6	..	0	0.00	0	6	0.5
LFd12-B.2	Coarse	6.68	0	..	..	..	..	0.02	12	..	0	0.00	0	12	0.9
LFd12-B.3	Fine	6.59	0	..	..	..	..	0.04	26	..	0	0.00	0	26	1.9
LFd12-B.4	Fine	6.42	2	..	..	..	..	0.21	133	..	0	..	0	136	10.2
LFd12-C.1	Coarse	5.47	4	..	..	..	..	0.07	43	..	0	..	0	47	3.5
LFd12-C.2	Medium	4.80	8	..	..	..	..	0.00	3	..	0	..	0	11	0.8
LFd12-C.3	Fine	4.72	20	..	..	..	..	0.13	82	..	0	..	0	102	7.7
LFd12-C.4	Fine	5.58	12	..	..	..	..	0.26	161	..	0	..	0	173	13.0
LFd13-A.1	Fine	9.04	0	..	..	..	..	0.06	38	..	0	1.03	206	-99	-5.0
LFd13-A.2	Medium	9.56	0	..	..	..	..	0.06	40	..	0	4.50	899	-560	-28.0
LFd13-A.3	Fine	9.47	0	..	..	..	..	0.09	57	..	0	3.30	659	-383	-19.1
LFd15-B.1	Fine	5.52	14	..	..	..	..	0.32	200	..	0	..	0	213	16.0
LFd15-B.2	Fine	4.30	20	0.041	26	0.044	0.034	0.01	6	0.057	26	..	0	52	3.9
LFd15-B.3	Fine	4.08	26	0.057	35	0.042	0.043	0.03	19	0.089	41	..	0	86	6.5
LFd15-B.4	Fine	8.96	0	..	..	..	..	0.25	156	..	0	3.23	645	-274	-13.7
LFd15-B.5	Fine	9.19	0	..	..	..	..	0.23	143	..	0	6.60	1319	-736	-36.8
LFd15-C.1	Fine	4.70	38	..	..	..	..	0.33	206	..	0	..	0	244	18.3
LFd15-C.2	Fine	4.09	32	0.140	87	0.086	0.095	0.07	44	0.089	41	..	0	117	8.8
LFd15-C.3	Fine	5.92	5	..	..	..	..	0.18	112	..	0	..	0	117	8.8
LFd15-C.4	Fine	9.19	0	..	..	..	..	0.20	125	..	0	4.65	929	-495	-24.7
LFd15-C.5	Fine	9.24	0	..	..	..	..	0.24	150	..	0	9.65	1928	-1136	-56.8
LFd17-A.1	Coarse	7.41	0	..	..	..	..	<0.01	0	..	0	0.00	0	0	0.0
LFd17-A.2	Fine	4.68	21	..	..	..	..	<0.01	0	..	0	..	0	21	1.6
LFd17-A.3	Fine	4.41	35	0.036	22	0.015	0.024	0.08	53	0.012	5	..	0	93	7.0
LFd17-A.4	Fine	4.96	17	..	..	..	..	0.15	95	..	0	..	0	113	8.5
LFd17-B.1	Fine	5.42	66	..	..	..	..	0.01	5	..	0	..	0	71	5.4
LFd17-B.2	Fine	5.21	8	..	..	..	..	<0.01	0	..	0	..	0	8	0.6
LFd17-B.3	Fine	6.27	5	..	..	..	..	0.04	26	..	0	..	0	31	2.3

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

APPENDIX 6 – ACID – BASE ACCOUNTING DATA

I.D.	Texture	Titratable actual acidity (TAA) pH$_{KCl}$	(To pH 6.5) mole H+/tonne	Extractable sulfate sulfur %S$_{kcl}$	mole H+/tonne (AASS acidity)	Extractable Ca %Ca$_{kcl}$	Extractable Mg %Mg$_{kcl}$	Reduced inorganic sulfur % chromium reducible %S$_{CR}$	mole H+/tonne	Retained acidity (Required if pH$_{KCL}$ <4.5) HCL extract as %S$_{HCL}$ - %S$_{kcl}$ %S$_{NAG}$	S$_{NAS}$ mole H+/tonne	Acid neutralising capacity (ANC$_{BT}$) (Required if pH$_{KCl}$ > 6.5) % CaCO$_3$	mole H+/tonne	Net acidity Chromium suite mole H+/tonne based on %Scrs	Lime calculation Chromium suite kg CaCO$_3$/tonne DW (includes 1.5 safety Factor when liming rate is +ve)
	Note 6													Note 5	Notes 4 & 6
LFd17-B.4	Fine	6.30	6	..	..	..	..	0.16	100	..	0	..	0	105	7.9
LFd19-A.1	Fine	4.54	44	..	..	..	..	0.01	5	..	0	..	0	49	3.6
LFd19-A.2	Fine	4.10	71	0.150	94	0.029	0.045	0.02	11	0.086	40	..	0	122	9.2
LFd19-A.3	Fine	7.94	0	..	..	..	..	0.97	602	..	0	2.94	587	211	15.8
LFd19-A.4	Fine	9.03	0	..	..	..	..	1.26	785	..	0	11.86	2370	-794	-39.7
LFd20-A.1	Fine	4.63	86	..	..	..	..	0.09	57	..	0	..	0	143	10.7
LFd20-A.2	Fine	3.24	200	0.201	125	0.084	0.081	0.04	25	0.212	99	..	0	324	24.3
LFd20-A.3	Fine	3.39	111	0.207	129	0.043	0.069	0.03	18	0.153	72	..	0	201	15.1
LFd20-A.4	Fine	3.70	133	0.202	126	0.040	0.085	1.07	666	0.106	50	..	0	849	63.6
LFd20-A.5	Fine	3.98	78	0.223	139	0.085	0.177	1.33	831	0.011	5	..	0	914	68.6
LFd21-A.1	Coarse	6.59	0	..	..	..	..	0.01	5	..	0	0.00	0	5	0.4
LFd21-A.2	Medium	4.81	12	..	..	..	..	0.15	96	..	0	..	0	108	8.1
LFd21-A.3	Coarse	6.83	0	..	..	..	..	0.15	93	..	0	0.00	0	93	7.0
LFd21-B.1	Coarse	6.87	0	..	..	..	..	0.01	3	..	0	0.00	0	3	0.3
LFd21-B.2	Fine	6.73	0	..	..	..	..	0.01	8	..	0	0.36	72	-40	-2.0
LFd21-B.3	Medium	6.69	0	..	..	..	..	0.20	125	..	0	0.01	2	123	9.3
LFd23-A.1	Medium	8.42	0	..	..	..	..	0.01	6	..	0	0.00	0	6	0.5
LFd23-A.2	Fine	7.59	0	..	..	..	..	<0.01	0	..	0	0.00	0	0	0.0
LFd23-A.3	Fine	5.05	12	..	..	..	..	0.07	44	..	0	..	0	55	4.2
LFd24-A.1	Fine	5.55	47	..	..	..	..	0.27	168	..	0	..	0	216	16.2
LFd24-A.2	Fine	3.69	112	0.316	197	0.134	0.270	0.25	156	0.157	73	..	0	341	25.6
LFd24-A.3	Fine	3.76	147	0.653	407	0.183	0.477	1.52	948	0.160	75	..	0	1170	87.7
LFd24-B.1	Fine	4.86	47	..	..	..	..	0.42	262	..	0	..	0	309	23.2
LFd24-B.2	Fine	4.03	153	0.446	278	0.191	0.354	1.39	867	0.122	57	..	0	1077	80.8
LFd24-B.3	Fine	4.66	51	..	..	..	..	1.64	1023	..	0	..	0	1073	80.5

January and February 2011 sampling

I.D.	Texture	Titratable actual acidity (TAA)		Extractable sulfate sulfur		Extractable Ca %Ca$_{kcl}$	Extractable Mg %Mg$_{kcl}$	Reduced inorganic sulfur % chromium reducible		Retained acidity		Acid neutralising capacity (ANC$_{BT}$)		Net acidity Chromium suite mole H+/tonne	Lime calculation Chromium suite kg CaCO$_3$/tonne DW
										Required if pH$_{KCL}$ <4.5		Required if pH$_{KCl}$ > 6.5			
		pH$_{KCl}$	(To pH 6.5) mole H+/tonne	%S$_{kcl}$	mole H+/tonne (AASS acidity)			%S$_{CR}$	mole H+/tonne	HCL extract as %S$_{HCL}$ - %S$_{kcl}$ %S$_{NAG}$	S$_{NAS}$ mole H+/tonne	% CaCO$_3$	mole H+/tonne	based on %Scrs	(includes 1.5 safety Factor when liming rate is +ve)
	Note 6													Note 5	Notes 4 & 6
LFC01-A.1	Fine	6.03	18	..	..	..	..	0.09	53	..	0	..	0	71	5.3
LFC01-A.2	Fine	4.14	87	0.169	105	0.199	0.090	0.47	291	0.059	27	..	0	405	30.4
LFc01-A.3	Fine	4.25	81	0.347	216	0.253	0.214	1.32	823	0.051	24	..	0	927	69.6
LFc01-D.1	Fine	7.22	0	..	..	..	..	0.05	31	..	0	2.57	513	-311	-15.6
LFc01-D.2	Fine	4.64	85	..	..	..	..	0.16	100	..	0	..	0	185	13.9
LFc01-D.3	Fine	3.99	154	0.374	233	0.239	0.149	1.20	748	0.006	3	..	0	905	67.9
LFc02-A.1	Coarse	5.62	3	..	..	..	..	<0.01	0	..	0	..	0	3	0.2
LFc02-A.2	Coarse	5.09	7	..	..	..	..	0.02	10	..	0	..	0	17	1.3
LFc02-A.3	Medium	4.80	15	..	..	..	..	0.13	80	..	0	..	0	95	7.1
LFc02-A.4	Medium	7.13	0	..	..	..	..	0.41	257	..	0	0.64	128	172	12.9
LFc02-B.1	Coarse	6.80	0	..	..	..	..	<0.01	0	..	0	0.14	28	-19	-0.9
LFc02-B.2	Coarse	6.71	0	..	..	..	..	<0.01	0	..	0	0.12	24	-16	-0.8
LFc02-B.3	Coarse	6.73	0	..	..	..	..	0.01	4	..	0	0.11	22	-11	-0.5
LFc02-B.4	Coarse	8.01	0	..	..	..	..	0.03	19	..	0	0.15	30	-1	-0.1
LFc03-A.1	Medium	7.16	0	..	..	..	..	0.01	8	..	0	0.16	32	-13	-0.7
LFc03-A.2	Medium	4.97	14	..	..	..	..	<0.01	0	..	0	..	0	14	1.1
LFc03-A.3	Medium	3.97	52	0.104	65	0.057	0.036	0.02	10	0.128	60	..	0	122	9.1
LFc03-A.4	Coarse	4.65	17	..	..	..	..	0.01	4	..	0	..	0	20	1.5
LFc03-A.5	Medium	4.54	27	..	..	..	..	0.10	64	..	0	..	0	90	6.8
LFc03-B.1	Coarse	6.02	2	..	..	..	..	<0.01	0	..	0	..	0	2	0.2
LFc03-B.2	Coarse	6.02	2	..	..	..	..	<0.01	0	..	0	..	0	2	0.1
LFc03-B.3	Medium	6.45	1	..	..	..	..	0.04	27	..	0	..	0	29	2.2
LFc03-B.4	Medium	5.83	3	..	..	..	..	0.12	76	..	0	..	0	79	5.9
LFc04-A.1	Coarse	6.40	1	..	..	..	..	<0.01	0	..	0	..	0	1	0.1
LFc04-A.2	Medium	4.91	10	..	..	..	..	0.03	16	..	0	..	0	26	1.9
LFc04-A.3	Medium	4.89	14	..	..	..	..	0.03	18	..	0	..	0	32	2.4
LFc04-A.4	Medium	5.00	11	..	..	..	..	0.05	28	..	0	..	0	39	2.9
LFc04-A.5	Fine	6.41	2	..	..	..	..	0.21	128	..	0	..	0	130	9.8
LFc04-C.1	Fine	6.32	4	..	..	..	..	0.02	12	..	0	..	0	16	1.2
LFc04-C.2	Fine	4.54	20	..	..	..	..	0.05	28	..	0	..	0	48	3.6
LFc04-C.3	Fine	4.22	31	0.073	45	0.040	0.053	0.11	66	0.010	5	..	0	101	7.6

I.D.	Texture	Titratable actual acidity (TAA)		Extractable sulfate sulfur		Extractable Ca %Ca$_{kcl}$	Extractable Mg %Mg$_{kcl}$	Reduced inorganic sulfur % chromium reducible		Retained acidity Required if pH$_{KCL}$ <4.5		Acid neutralising capacity (ANC$_{BT}$) Required if pH$_{KCl}$ > 6.5		Net acidity Chromium suite mole H+/tonne	Lime calculation Chromium suite kg CaCO$_3$/tonne DW
		pH$_{KCl}$	(To pH 6.5) mole H+/tonne	%S$_{kcl}$	mole H+/tonne (AASS acidity)			%S$_{CR}$	mole H+/tonne	HCL extract as %S$_{HCL}$ - %S$_{kcl}$ %S$_{NAG}$	S$_{NAS}$ mole H+/tonne	% CaCO$_3$	mole H+/tonne	based on %Scrs	(includes 1.5 safety Factor when liming rate is +ve)
	Note 6													Note 5	Notes 4 & 6
LFc06-A.1	Coarse	7.17	0	..	..	..	..	0.01	4	..	0	0.12	24	-12	-0.6
LFc06-A.2	Coarse	8.28	0	..	..	..	..	<0.01	0	..	0	0.13	26	-17	-0.9
LFc06-A.3	Medium	7.96	0	..	..	..	..	0.06	41	..	0	0.15	30	21	1.5
LFc06-A.4	Coarse	7.33	0	..	..	..	..	0.04	26	..	0	0.14	28	7	0.5
LFc06-B.1	Coarse	8.26	0	..	..	..	..	<0.01	0	..	0	0.07	14	-9	-0.5
LFc06-B.2	Medium	8.36	0	..	..	..	..	0.03	20	..	0	0.21	42	-8	-0.4
LFc06-B.3	Fine	8.83	0	..	..	..	..	0.20	122	..	0	1.64	328	-96	-4.8
LFc06-B.4	Fine	8.05	0	..	..	..	..	0.73	456	..	0	0.90	180	336	25.2
LFc07-A.1	Fine	7.51	0	..	..	..	..	0.05	34	..	0	0.09	18	22	1.6
LFc07-A.2	Fine	7.03	0	..	..	..	..	1.03	641	..	0	1.05	210	501	37.6
LFc07-A.3	Fine	7.02	0	..	..	..	..	1.05	655	..	0	1.10	220	508	38.1
LFc07-A.4	Fine	6.83	0	..	..	..	..	0.95	590	..	0	0.97	194	460	34.5
LFc07-B.1	Medium	6.69	0	0.000	0	0.000	0.000	<0.01	0	0.000	0	<0.01	0	0	0.0
LFc07-B.2	Fine	6.43	1	0.000	0	0.000	0.000	0.14	87	0.000	0	..	0	88	6.6
LFc07-B.3	Fine	6.31	2	..	..	..	..	0.14	90	..	0	..	0	92	6.9
LFc08-A.1	Coarse	7.13	0	..	..	..	..	<0.01	0	..	0	0.10	20	-13	-0.7
LFc08-A.2	Coarse	7.54	0	..	..	..	..	0.07	46	..	0	0.23	46	15	1.1
LFc08-A.3	Fine	7.53	0	..	..	..	..	1.07	667	..	0	2.41	482	345	25.9
LFc08-A.4	Fine	7.51	0	..	..	..	..	1.46	913	..	0	1.69	338	687	51.6
LFc08-B.1	Coarse	9.07	0	..	..	..	..	0.01	6	..	0	0.50	100	-60	-3.0
LFc08-B.2	Fine	7.43	0	..	..	..	..	0.26	161	..	0	1.46	292	-33	-1.7
LFc08-B.3	Fine	7.83	0	..	..	..	..	1.55	967	..	0	2.77	553	599	44.9
LFc08-B.4	Fine	7.58	0	..	..	..	..	1.89	1181	..	0	1.89	378	929	69.7
LFc10-A.1	Medium	5.70	30	..	..	..	..	0.09	56	..	0	..	0	86	6.5
LFc10-A.2	Fine	5.46	28	..	..	..	..	0.01	6	..	0	..	0	34	2.5
LFc10-A.3	Fine	3.50	133	0.319	199	0.099	0.175	0.03	19	0.262	122	..	0	274	20.5
LFc10-A.4	Fine	3.52	249	0.511	319	0.123	0.257	1.40	873	0.161	75	..	0	1197	89.8
LFc10-C.1	Coarse	4.66	17	..	..	..	..	0.02	11	..	0	..	0	28	2.1
LFc10-C.3	Coarse	4.51	18	..	..	..	..	0.11	67	..	0	..	0	85	6.3
LFc10-C.4	Coarse	4.76	16	..	..	..	..	0.10	60	..	0	..	0	75	5.7
LFc10-C2	Coarse	4.00	22	0.031	19	0.014	0.011	0.03	19	0.039	18	..	0	59	4.4
LFc10-D.1	Coarse	7.26	0	..	..	..	..	0.04	22	..	0	0.10	20	9	0.6
LFc10-D.2	Fine	8.25	0	..	..	..	..	0.39	243	..	0	23.37	4669	-2870	-143.5

I.D.	Texture	Titratable actual acidity (TAA)		Extractable sulfate sulfur		Extractable Ca %Ca$_{kcl}$	Extractable Mg %Mg$_{kcl}$	Reduced inorganic sulfur % chromium reducible		Retained acidity Required if pH$_{KCL}$ <4.5		Acid neutralising capacity (ANC$_{BT}$) Required if pH$_{Kcl}$ > 6.5		Net acidity Chromium suite mole H+/tonne	Lime calculation Chromium suite kg CaCO$_3$/tonne DW
		pH$_{KCl}$	(To pH 6.5) mole H+/tonne	%S$_{kcl}$	mole H+/tonne (AASS acidity)			%S$_{CR}$	mole H+/tonne	HCL extract as %S$_{HCL}$ - %S$_{kcl}$ %S$_{NAG}$	S$_{NAS}$ mole H+/tonne	% CaCO$_3$	mole H+/tonne	based on %Scrs	(includes 1.5 safety Factor when liming rate is +ve)
	Note 6													Note 5	Notes 4 & 6
LFc10-D.3	Fine	8.51	0	..	..	..	..	0.42	264	..	0	4.16	831	-290	-14.5
LFc10-D.4	Medium	7.87	0	..	..	..	..	0.23	143	..	0	0.10	20	129	9.7
LFc12-A.1	Coarse	4.75	9	..	..	..	..	0.01	5	..	0	..	0	14	1.0
LFc12-A.2	Medium	5.00	20	..	..	..	..	0.12	75	..	0	..	0	95	7.2
LFc12-A.3	Fine	5.26	14	..	..	..	..	0.21	129	..	0	..	0	143	10.7
LFc12-A.5	Fine	6.53	0	..	..	..	..	1.05	652	..	0	1.37	274	469	35.2
LFc12-A4	Fine	6.40	3	..	..	..	..	0.24	151	..	0	..	0	153	11.5
LFc12-B.1	Coarse	7.14	0	..	..	..	..	0.01	5	..	0	0.05	10	-2	-0.1
LFc12-B.2	Coarse	7.13	0	..	..	..	..	0.05	29	..	0	0.08	16	19	1.4
LFc12-B.3	Course	7.17	0	..	..	..	..	0.14	87	..	0	0.27	54	51	3.9
LFc12-B.4	Fine	7.02	0	..	..	..	..	0.29	183	..	0	0.39	78	131	9.9
LFc12-C.1	Coarse	6.22	2	..	..	..	..	<0.01	0	..	0	..	0	2	0.1
LFc12-C.2	Coarse	5.01	6	..	..	..	..	<0.01	0	..	0	..	0	6	0.5
LFc12-C.3	Medium	4.89	11	..	..	..	..	0.10	62	..	0	..	0	74	5.5
LFc12-C.4	Medium	5.11	11	..	..	..	..	0.22	140	..	0	..	0	151	11.3
LFc13-A.1	Course	8.76	0	..	..	..	..	0.09	56	..	0	5.40	1079	-663	-33.2
LFc13-A.2	Course	8.82	0	..	..	..	..	0.19	119	..	0	5.14	1027	-566	-28.3
LFc13-A.3	Course	9.00	0	..	..	..	..	0.05	31	..	0	3.39	677	-420	-21.0
LFc15-B.1	Medium	5.12	21	..	..	..	..	0.01	6	..	0	..	0	27	2.0
LFc15-B.2	Medium	5.23	29	..	..	..	..	0.02	12	..	0	..	0	42	3.1
LFc15-B.3	Medium	8.33	0	..	..	..	..	0.19	119	..	0	3.80	759	-388	-19.4
LFc15-B.4	Medium	8.49	0	..	..	..	..	0.23	143	..	0	6.61	1321	-737	-36.9
LFc15-B.5	Fine	4.98	70	..	..	..	..	0.25	156	..	0	..	0	226	16.9
LFc15-C.1	Medium	4.50	40	0.127	79	0.088	0.083	0.03	19	0.067	32	..	0	90	6.7
LFc15-C.2	Medium	4.61	38	..	..	..	..	0.18	112	..	0	..	0	150	11.3
LFc15-C.3	Medium	8.37	0	..	..	..	..	0.20	125	..	0	5.97	1193	-670	-33.5
LFc15-C.4	Medium	8.49	0	..	..	..	..	0.20	125	..	0	10.81	2160	-1315	-65.8
LFc15-C.5	Medium	8.11	0	..	..	..	..	0.26	162	..	0	0.47	94	100	7.5
LFc17-A.2	Coarse	5.40	21	0.000	0	0.000	0.000	0.01	6	0.000	0	..	0	27	2.1
LFc17-A.3	Medium	4.93	17	0.000	0	0.000	0.000	0.07	44	0.000	0	..	0	60	4.5
LFc17-A.4	Medium	5.61	19	0.000	0	0.000	0.000	0.15	94	0.000	0	..	0	113	8.4
LFc17-A.5	Fine	8.72	0	..	..	..	..	0.15	97	..	0	9.37	1872	-1151	-57.6
LFc17-B.1	Fine	5.50	5	..	..	..	..	<0.01	0	..	0	..	0	5	0.4

I.D.	Texture	Titratable actual acidity (TAA)		Extractable sulfate sulfur		Extractable Ca %Ca$_{kcl}$	Extractable Mg %Mg$_{kcl}$	Reduced inorganic sulfur % chromium reducible		Retained acidity Required if pH$_{KCL}$ <4.5		Acid neutralising capacity (ANC$_{BT}$) Required if pH$_{KCl}$ > 6.5		Net acidity Chromium suite mole H+/tonne	Lime calculation Chromium suite kg CaCO$_3$/tonne DW
		pH$_{KCl}$	(To pH 6.5) mole H+/tonne	%S$_{kcl}$	mole H+/tonne (AASS acidity)			%S$_{CR}$	mole H+/tonne	HCL extract as %S$_{HCL}$ - %S$_{kcl}$ %S$_{NAG}$	S$_{NAS}$ mole H+/tonne	% CaCO$_3$	mole H+/tonne	based on %Scrs	(includes 1.5 safety Factor when liming rate is +ve)
	Note 6													Note 5	Notes 4 & 6
LFc17-B.2	Fine	6.96	0	..	..	..	..	0.13	78	..	0	0.07	14	69	5.2
LFc17-B.3	Fine	6.19	3	..	..	..	..	0.06	39	..	0	..	0	42	3.2
LFc17-B.4	Fine	7.62	0	..	..	..	..	0.15	94	..	0	0.05	10	88	6.6
LFc19-A.1	Fine	4.51	60	..	..	..	..	<0.01	0	..	0	..	0	60	4.5
LFc19-A.2	Fine	4.55	60	..	..	..	..	0.01	3	..	0	..	0	63	4.7
LFc19-A.3	Fine	6.59	0	..	..	..	..	1.40	875	..	0	0.41	82	821	61.6
LFc19-A.4	Fine	8.32	0	..	..	..	..	0.76	475	..	0	9.62	1922	-806	-40.3
LFc20-A.1	Fine	3.92	71	0.048	30	0.063	0.051	0.14	87	0.074	35	..	0	193	14.5
LFc20-A.2	Fine	3.23	120	0.107	67	0.054	0.059	0.05	31	0.236	110	..	0	262	19.6
LFc20-A.3	Fine	3.36	112	0.187	116	0.049	0.077	0.04	25	0.207	97	..	0	234	17.5
LFc20-A.4	Fine	3.65	141	0.244	152	0.065	0.125	1.04	649	0.242	113	..	0	903	67.7
LFc20-A.5	Fine	4.58	39	..	..	..	..	1.40	871	..	0	..	0	911	68.3
LFc21-A.1	Coarse	1.77	0	..	..	..	..	0.01	4	..	0	..	0	4	0.3
LFc21-A.2	Coarse	5.52	4	..	..	..	..	0.02	15	..	0	..	0	19	1.4
LFc21-A.3	Medium	5.40	5	..	..	..	..	0.15	91	..	0	..	0	95	7.2
LFc21-A.4	Medium	5.91	2	0.000	0	0.000	0.000	0.16	100	0.000	0	..	0	102	7.6
LFc21-B.1	Coarse	6.64	0	..	..	..	..	0.01	4	..	0	0.09	18	-8	-0.4
LFc21-B.2	Fine	6.57	0	..	..	..	..	0.33	208	..	0	0.88	176	91	6.8
LFc21-B.3	Medium	6.56	0	..	..	..	..	0.22	136	..	0	0.03	6	132	9.9
LFc23-A.1	Coarse	7.99	0	..	..	..	..	0.01	6	..	0	0.01	2	5	0.4
LFc23-A.2	Coarse	5.51	5	..	..	..	..	<0.01	0	..	0	..	0	5	0.4
LFc23-A.3	Coarse	5.40	6	..	..	..	..	0.04	25	..	0	..	0	31	2.3
LFc24-A.1	Fine	4.57	85	..	..	..	..	0.15	94	..	0	..	0	178	13.4
LFc24-A.2	Fine	3.69	148	0.432	269	0.161	0.325	0.64	399	0.232	109	..	0	655	49.2
LFc24-A.3	Fine	3.93	200	0.691	431	0.168	0.438	1.43	892	0.249	116	..	0	1208	90.6
LFc24-A.4	Fine	4.94	47	..	..	..	..	0.34	212	..	0	..	0	259	19.4
LFc24-B.1	Fine	5.09	30	..	..	..	..	1.60	998	..	0	..	0	1028	77.1
LFc24-B.2	Fine	3.89	127	0.374	233	0.170	0.281	0.88	549	0.131	61	..	0	736	55.2
LFc24-B.3	Medium	5.58	21	0.000	0	0.000	0.000	1.63	1017	0.000	0	..	0	1038	77.8

March 2010 sampling

I.D.	Texture	Moisture Content %	Acid volatile sulfur AVS		Titratable actual acidity (TAA)		Extractable sulfate sulfur		Reduced inorganic sulfur % chromium reducible		Retained acidity		Acid neutralising capacity (ANC_BT)		Net acidity Chromium suite mole H+/tonne	Lime calculation Chromium suite kg CaCO_3/tonne DW
											Required if pH_KCL <4.5		Required if pH_KCl > 6.5			
			%Sav WW	%Sav DW	pH_KCl	(To pH 6.5) mole H+/tonne	%S_kcl	mole H+/tonne (AASS acidity)	%S_CR	mole H+/tonne	HCL extract as %S_HCL - %S_kcl %S_NAG	S_NAS mole H+/tonne	% CaCO_3	mole H+/tonne	based on %Scrs	(includes 1.5 safety Factor when liming rate is +ve)
	Note 6		Note 3	Note 3											Note 5	Notes 4 & 6
LFb01-A.1	Fine	34.6	..	..	4.90	42	..	..	0.08	48	..	0	..	0	90	6.8
LFb01-A.2	Fine	30.3	..	..	4.03	97	0.236	147	0.34	214	0.063	30	..	0	340	25.5
LFb01-A.3	Fine	47.6	..	..	5.16	47	..	..	1.39	865	..	0	..	0	912	68.4
LFb01-D.1	Fine	34.3	0.038	0.058	6.16	22	..	..	0.11	66	..	0	0.35	70	42	3.1
LFb01-D.2	Course	53.9	..	..	3.52	189	0.299	186	0.06	38	0.441	206	..	0	433	32.5
LFb02-A.1	Course	9.9	..	..	6.29	6	..	..	0.01	7	..	0	0.07	14	3	0.3
LFb02-A.2	Course	10.5	..	..	6.23	5	..	..	<0.01	0	..	0	0.03	6	1	0.1
LFb02-A.3	Course	9.3	..	..	6.27	4	..	..	<0.01	0	..	0	0.07	14	-5	-0.3
LFb02-A.4	Course	15.0	..	..	5.21	15	..	..	0.02	15	..	0	..	0	31	2.3
LFb02-A.5	Course	18.7	..	..	5.80	8	..	..	0.13	79	..	0	..	0	87	6.5
LFb02-B.1	Course	3.1	..	..	6.62	0	..	..	<0.01	0	..	0	0.05	10	-7	-0.3
LFb02-B.2	Course	10.6	..	..	6.39	1	..	..	<0.01	0	..	0	0.06	12	-7	-0.3
LFb02-B.3	Course	15.1	..	..	6.66	0	..	..	<0.01	0	..	0	0.10	20	-13	-0.7
LFb02-B.4	Course	14.7	..	..	7.64	0	..	..	0.01	4	..	0	0.12	24	-12	-0.6
LFb03-A.1	Course	9.5	..	..	6.18	5	..	..	<0.01	0	..	0	0.04	8	-1	0.0
LFb03-A.2	Course	13.6	..	..	5.21	25	..	..	<0.01	0	..	0	..	0	25	1.9
LFb03-A.3	Fine	45.0	..	..	3.15	309	0.780	486	0.07	41	0.224	105	..	0	454	34.1
LFb03-A.4	Course	17.7	..	..	4.41	36	0.090	56	<0.01	0	0.037	17	..	0	54	4.0
LFb03-A.5	Course	26.6	..	..	4.52	55	..	..	0.20	123	..	0	..	0	178	13.3
LFb03-A.6	Fine	57.1	..	..	6.33	8	..	..	1.19	742	..	0	1.31	262	575	43.1
LFb03-B.1	Course	4.0	..	..	6.72	0	..	..	<0.01	0	..	0	0.15	30	-20	-1.0
LFb03-B.2	Course	5.7	..	..	6.48	1	..	..	<0.01	0	..	0	0.06	12	-7	-0.3
LFb03-B.3	Course	12.5	..	..	5.87	8	..	..	<0.01	0	..	0	..	0	8	0.6
LFb03-B.4	Course	16.0	..	..	6.19	5	..	..	0.03	20	..	0	0.08	16	15	1.1
LFb03-B.5	Course	14.7	..	..	8.29	0	..	..	0.05	33	..	0	4.47	893	-563	-28.1
LFb04-A.1	Course	5.2	..	..	6.62	0	..	..	<0.01	0	..	0	0.05	10	-7	-0.3
LFb04-A.2	Course	16.5	..	..	6.22	5	..	..	<0.01	0	..	0	0.00	0	5	0.4
LFb04-A.3	Course	17.8	..	..	6.12	4	..	..	0.05	29	..	0	0.00	0	34	2.5
LFb04-A.4	Course	18.0	..	..	6.36	3	..	..	0.06	38	..	0	0.00	0	41	3.1
LFb04-A.5	Fine	42.9	..	..	6.53	0	..	..	0.95	593	..	0	0.44	88	535	40.1

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

APPENDIX 6 – ACID – BASE ACCOUNTING DATA

I.D.	Texture	Moisture Content %	Acid volatile sulfur AVS %Sav WW	Acid volatile sulfur AVS %Sav DW	Titratable actual acidity (TAA) pH$_{KCl}$	Titratable actual acidity (TAA) (To pH 6.5) mole H+/tonne	Extractable sulfate sulfur %S$_{kcl}$	Extractable sulfate sulfur mole H+/tonne (AASS acidity)	Reduced inorganic sulfur % chromium reducible %S$_{CR}$	Reduced inorganic sulfur % chromium reducible mole H+/tonne	Retained acidity Required if pH$_{KCL}$ <4.5 HCL extract as %S$_{HCL}$ - %S$_{kcl}$ %S$_{NAG}$	Retained acidity S$_{NAS}$ mole H+/tonne	Acid neutralising capacity (ANC$_{BT}$) Required if pH$_{KCl}$ > 6.5 % CaCO$_3$	Acid neutralising capacity (ANC$_{BT}$) mole H+/tonne	Net acidity Chromium suite mole H+/tonne based on %Scrs	Lime calculation Chromium suite kg CaCO$_3$/tonne DW (includes 1.5 safety Factor when liming rate is +ve)
	Note 6		Note 3	Note 3											Note 5	Notes 4 & 6
LFb04-C.1	Course	18.0	..	..	7.95	0	..	..	<0.01	0	..	0	0.13	26	-17	-0.9
LFb04-C.2	Course	20.2	..	..	7.48	0	..	..	0.01	4	..	0	0.00	0	4	0.3
LFb04-C.3	Course	21.3	..	..	6.87	0	..	..	0.08	50	..	0	0.15	30	30	2.3
LFb06-A.1	Course	6.6	..	..	7.03	0	..	..	<0.01	0	..	0	0.19	38	-25	-1.3
LFb06-A.2	Course	13.3	..	..	8.15	0	..	..	<0.01	0	..	0	0.17	34	-23	-1.1
LFb06-A.3	Course	14.9	..	..	8.13	0	..	..	0.04	24	..	0	0.00	0	24	1.8
LFb06-B.1	Course	10.6	..	..	8.91	0	..	..	<0.01	0	..	0	0.13	26	-17	-0.9
LFb06-B.2	Course	13.4	..	..	8.64	0	..	..	<0.01	0	..	0	0.05	10	-7	-0.3
LFb06-B.3	Course	20.8	..	..	8.24	0	..	..	0.02	10	..	0	0.06	12	2	0.1
LFb07-A.2	Course	16.7	..	..	6.32	5	..	..	<0.01	0	..	0	0.00	0	5	0.4
LFb07-A.3	Course	27.6	..	..	5.11	21	..	..	0.24	152	..	0	..	0	173	13.0
LFb07-A.4	Fine	46.8	..	..	6.16	13	..	..	0.60	377	..	0	0.28	56	353	26.5
LFb07-A.5	Fine	51.7	..	..	6.64	0	..	..	1.01	633	..	0	0.32	64	590	44.3
LFb07-B.2	Course	7.6	..	..	6.40	1	..	..	<0.01	0	..	0	0.00	0	1	0.1
LFb07-B.3	Course	29.7	..	..	6.56	0	..	..	0.04	27	..	0	0.63	126	-57	-2.9
LFb07-B.4	Medium	26.3	..	..	6.54	0	..	..	0.04	23	..	0	0.46	92	-38	-1.9
LFb08-A.1	Course	9.4	..	..	6.64	0	..	..	0.06	39	..	0	0.00	0	39	2.9
LFb08-A.2	Course	17.8	..	..	6.73	0	..	..	0.05	30	..	0	0.12	24	14	1.1
LFb08-A.3	Fine	50.6	..	..	7.64	0	..	..	1.52	947	..	0	4.91	981	293	22.0
LFb08-A.4	Fine	49.8	..	..	7.83	0	..	..	1.41	881	..	0	4.62	923	265	19.9
LFb08-B.1	Course	9.3	..	..	9.20	0	..	..	0.01	7	..	0	0.48	96	-57	-2.9
LFb08-B.2	Course	20.2	..	..	9.03	0	..	..	0.07	41	..	0	0.96	192	-87	-4.3
LFb08-B.3	Fine	53.9	..	..	7.65	0	..	..	0.31	193	..	0	1.38	276	9	0.7
LFb08-B.4	Fine	56.3	..	..	7.52	0	..	..	2.39	1490	..	0	1.25	250	1323	99.3
LFb10-A.1	Medium	5.0	..	..	3.77	106	0.156	97	0.02	14	0.046	22	..	0	142	10.6
LFb10-A.2	Medium	11.0	..	..	4.24	42	0.055	34	0.01	8	0.030	14	..	0	65	4.8
LFb10-A.3	Medium	7.9	..	..	6.54	0	..	..	0.01	6	..	0	1.09	218	-139	-7.0
LFb10-A.4	Fine	26.7	..	..	6.42	4	..	..	<0.01	0	..	0	0.78	156	-100	-5.0
LFb10-C.1	Medium	9.5	..	..	2.92	1694	9.350	5832	0.02	10	0.090	42	..	0	1745	130.9
LFb10-C.2	Fine	48.7	..	..	2.77	410	1.320	823	0.06	35	0.072	34	..	0	479	35.9
LFb10-C.3	Medium	39.0	..	..	3.19	160	0.233	145	0.04	23	0.192	90	..	0	273	20.5
LFb10-C.4	Course	12.6	..	..	4.76	27	..	..	0.01	5	..	0	..	0	33	2.5

I.D.	Texture	Moisture Content %	Acid volatile sulfur AVS		Titratable actual acidity (TAA)		Extractable sulfate sulfur		Reduced inorganic sulfur % chromium reducible		Retained acidity		Acid neutralising capacity (ANC$_{BT}$)		Net acidity Chromium suite mole H+/tonne	Lime calculation Chromium suite kg CaCO$_3$/tonne DW
											Required if pH$_{KCL}$ <4.5		Required if pH$_{KC}$l > 6.5			
			%Sav WW	%Sav DW	pH$_{KCl}$	(To pH 6.5) mole H+/tonne	%S$_{kcl}$	mole H+/tonne (AASS acidity)	%S$_{CR}$	mole H+/tonne	HCL extract as %S$_{HCL}$ - %S$_{kcl}$ %S$_{NAG}$	S$_{NAS}$ mole H+/tonne	% CaCO$_3$	mole H+/tonne	based on %Scrs	(includes 1.5 safety Factor when liming rate is +ve)
	Note 6		Note 3	Note 3											Note 5	Notes 4 & 6
LFb10-C.5	Course	18.7	..	..	3.79	52	0.105	65	0.09	59	0.016	8	..	0	119	8.9
LFb10-C.6	Course	17.9	..	..	4.63	23	..	..	0.12	76	..	0	..	0	99	7.4
LFb10-D.1	Fine	4.9	..	..	7.62	0	..	..	0.38	239	..	0	6.01	1201	-561	-28.1
LFb10-D.2	Course	2.3	..	..	7.63	0	..	..	<0.01	0	..	0	0.16	32	-21	-1.1
LFb10-D.3	Medium	17.7	..	..	4.77	22	..	..	0.13	83	..	0	..	0	104	7.8
LFb10-D.4	Course	16.3	..	..	5.88	3	..	..	0.18	112	..	0	0.02	4	113	8.4
LFb12-A.1	Course	4.6	..	..	5.04	58	..	..	0.01	6	..	0	..	0	64	4.8
LFb12-A.2	Course	0.8	..	..	5.83	14	..	..	<0.01	0	..	0	..	0	14	1.1
LFb12-A.3	Course	11.1	..	..	6.55	0	..	..	0.01	4	..	0	0.10	20	-10	-0.5
LFb12-A.4	Course	23.2	..	..	4.39	24	0.034	21	0.01	5	0.040	19	..	0	48	3.6
LFb12-A.5	Course	27.6	..	..	5.90	7	..	..	0.25	158	..	0	..	0	164	12.3
LFb12-A.6	Fine	39.8	..	..	6.49	1	..	..	0.56	349	..	0	0.41	82	295	22.1
LFb12-B.1	Course	1.5	..	..	6.20	2	..	..	0.01	3	..	0	0.00	0	6	0.4
LFb12-B.2	Course	10.6	..	..	6.50	0	..	..	<0.01	0	..	0	0.00	0	0	0.0
LFb12-B.3	Course	17.5	..	..	6.87	0	..	..	0.05	34	..	0	0.06	12	26	2.0
LFb12-B.4	Course	20.7	..	..	6.74	0	..	..	0.14	90	..	0	0.06	12	82	6.2
LFb12-C.1	Course	1.6	..	..	6.00	3	..	..	<0.01	0	..	0	0.01	2	2	0.1
LFb12-C.2	Course	5.8	..	..	5.65	5	..	..	0.01	4	..	0	..	0	10	0.7
LFb12-C.3	Course	10.2	..	..	5.12	8	..	..	<0.01	0	..	0	..	0	8	0.6
LFb12-C.4	Course	17.0	..	..	4.61	13	..	..	0.01	6	..	0	..	0	19	1.4
LFb12-C.5	Course	16.1	..	..	6.20	3	..	..	0.65	402	..	0	0.11	22	391	29.3
LFb13-A.1	Fine	50.1	..	..	3.51	127	0.265	165	0.02	15	0.044	20	..	0	162	12.2
LFb13-A.2	Course	19.2	..	..	6.15	4	..	..	0.01	5	..	0	0.11	22	-6	-0.3
LFb13-A.3	Course	19.9	..	..	8.85	0	..	..	0.08	48	..	0	5.81	1161	-726	-36.3
LFb15-B.1	Medium	11.2	..	..	3.54	168	1.200	748	0.20	124	0.368	172	..	0	464	34.8
LFb15-B.2	Medium	18.4	..	..	4.53	24	..	..	0.01	3	..	0	..	0	27	2.0
LFb15-B.3	Fine	26.0	..	..	4.03	40	0.075	46	0.01	5	0.096	45	..	0	90	6.7
LFb15-B.4	Fine	26.0	..	..	4.07	41	0.065	40	0.05	31	0.083	39	..	0	111	8.3
LFb15-B.5	Fine	28.4	..	..	4.15	46	0.099	61	0.17	107	0.050	23	..	0	176	13.2
LFb15-B.6	Fine	27.1	..	..	8.65	0	..	..	0.27	166	..	0	4.35	869	-413	-20.7
LFb15-C.1	Fine	10.9	..	..	3.19	219	0.895	558	0.25	154	0.405	189	..	0	562	42.1
LFb15-C.2	Fine	38.5	..	..	3.62	128	0.456	284	0.24	148	0.180	84	..	0	360	27.0
LFb15-C.3	Fine	27.3	..	..	4.36	40	0.173	108	0.08	52	0.047	22	..	0	115	8.6

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

I.D.	Texture	Moisture Content %	Acid volatile sulfur AVS		Titratable actual acidity (TAA)		Extractable sulfate sulfur		Reduced inorganic sulfur % chromium reducible		Retained acidity Required if pH$_{KCL}$ <4.5		Acid neutralising capacity (ANC$_{BT}$) Required if pH$_{KCl}$ > 6.5		Net acidity Chromium suite mole H+/tonne	Lime calculation Chromium suite kg CaCO$_3$/tonne DW
			%Sav WW	%Sav DW	pH$_{KCl}$	(To pH 6.5) mole H+/tonne	%S$_{kcl}$	mole H+/tonne (AASS acidity)	%S$_{CR}$	mole H+/tonne	HCL extract as %S$_{HCL}$ - %S$_{kcl}$ %S$_{NAG}$	S$_{NAS}$ mole H+/tonne	% CaCO$_3$	mole H+/tonne	based on %Scrs	(includes 1.5 safety Factor when liming rate is +ve)
	Note 6		Note 3	Note 3											Note 5	Notes 4 & 6
LFb15-C.4	Fine	28.9	..	..	4.76	41	..	..	0.26	159	..	0	..	0	201	15.1
LFb15-C5	Medium	31.4	..	..	7.95	0	..	..	0.29	178	..	0	15.38	3073	-1871	-93.5
LFb17-A.1	Course	3.8	..	..	5.33	16	..	..	<0.01	0	..	0	..	0	16	1.2
LFb17-A.2	Course	18.3	..	..	4.30	39	0.046	28	<0.01	0	0.053	25	..	0	64	4.8
LFb17-A.3	Course	16.3	..	..	4.43	25	0.036	22	<0.01	0	0.037	17	..	0	42	3.2
LFb17-A.4	Course	22.3	..	..	5.39	29	..	..	0.11	70	..	0	..	0	99	7.4
LFb17-A.5	Course	18.5	..	..	6.45	2	..	..	0.11	70	..	0	0.06	12	64	4.8
LFb17-B.1	Course	12.5	..	..	5.36	12	..	..	<0.01	0	..	0	..	0	12	0.9
LFb17-B.2	Course	16.8	..	..	5.18	11	..	..	0.01	5	..	0	..	0	15	1.1
LFb17-B.3	Course	18.2	..	..	6.20	3	..	..	0.06	37	..	0	0.00	0	40	3.0
LFb17-B.4	Course	23.1	..	..	8.00	0	..	..	0.16	102	..	0	0.14	28	84	6.3

October and November 2009 sampling

I.D.	Texture	Moisture Content %	Acid volatile sulfur AVS		Titratable actual acidity (TAA)		Extractable sulfate sulfur		Extractable Ca %Cakcl	Extractable Mg %Mgkcl	Reduced inorganic sulfur % chromium reducible		Retained acidity		Acid neutralising capacity (ANC_BT)		Net acidity Chromium suite mole H+/tonne	Lime calculation Chromium suite kg CaCO3/tonne DW
													Required if pH_KCl <4.5		Required if pH_KCl > 6.5			
			%Sav WW	%Sav DW	pH_KCl	(To pH 6.5) mole H+/tonne	%Skcl	mole H+/tonne (AASS acidity)			%S_CR	mole H+/tonne	HCL extract as %S_HCL - %Skcl %S_NAG	S_NAS mole H+/tonne	% CaCO3	mole H+/tonne	based on %Scrs	(includes 1.5 safety Factor when liming rate is +ve)
	Note 6		Note 3	Note 3													Note 5	Notes 4 & 6
LFa01-A.1	Fine	34.9	..	..	4.69	56	..	..	..	..	0.04	22	..	0	..	0	78	5.9
LFa01-A.2	Fine	30.6	..	..	3.53	131	0.310	193	..	..	0.21	129	0.04	20	..	0	279	20.9
LFa01-A.3	Fine	48.3	..	..	5.74	17	..	..	..	..	1.61	1003	..	0	..	0	1020	76.5
LFa01-D.2	Fine	41.3	..	..	3.25	217	0.438	273	..	..	0.06	40	0.39	180	..	0	437	32.8
LFa02-A.1	Coarse	12.1	..	..	6.92	0	..	..	..	..	0.01	6	..	..	0.00	0	6	0.5
LFa02-A.2	Coarse	9.8	..	..	6.28	4	..	..	..	..	0.01	6	..	..	..	0	11	0.8
LFa02-A.3	Coarse	16.1	..	..	6.02	11	..	..	..	..	0.01	6	..	..	..	0	18	1.3
LFa02-A.4	Coarse	19.6	..	..	5.12	25	..	..	..	..	0.16	100	..	..	..	0	125	9.4
LFa02-A.5	Coarse	19.3	..	..	6.34	12	..	..	..	..	0.08	50	..	..	..	0	62	4.7
LFa02-B.1	Coarse	4.7	..	..	6.70	0	..	..	..	..	<0.01	0	..	..	0.00	0	0	0.0
LFa02-B.2	Coarse	12.9	..	..	6.56	0	..	..	..	..	<0.01	0	..	..	0.08	16	-11	-0.5
LFa02-B.3	Coarse	14.2	..	..	6.56	0	..	..	..	..	<0.01	0	..	..	0.04	8	-5	-0.3
LFa02-B.4	Coarse	16.3	..	..	6.70	0	..	..	..	..	0.01	6	..	..	0.11	22	-8	-0.4
LFa02-B.5	Coarse	16.2	..	..	9.04	0	..	..	..	..	0.01	6	..	..	0.13	26	-11	-0.6
LFa03-A.1	Coarse	10.8	..	..	5.25	15	..	..	..	..	<0.01	0	..	0	..	0	15	1.1
LFa03-A.2	Medium	36.5	..	..	4.51	109	..	..	..	..	0.43	268	..	0	..	0	377	28.3
LFa03-A.3	Coarse	16.1	..	..	4.75	20	..	..	..	..	0.05	31	..	0	..	0	51	3.8
LFa03-A.4	Medium	21.1	..	..	5.76	14	..	..	..	..	0.24	150	..	0	..	0	164	12.3
LFa03-B.1	Coarse	5.1	..	..	6.65	0	..	..	..	..	<0.01	0	..	0	0.00	0	0	0.0
LFa03-B.2	Coarse	14.7	..	..	5.83	8	..	..	..	..	<0.01	0	..	0	..	0	8	0.6
LFa03-B.3	Coarse	20.6	..	..	7.45	0	..	..	..	..	0.14	87	..	0	0.00	0	87	6.5
LFa04-A.1	Coarse	8.4	..	..	7.10	0	..	..	..	..	<0.01	0	..	0	0.00	0	0	0.0
LFa04-A.2	Coarse	17.2	..	..	6.82	0	..	..	..	..	0.03	19	..	0	0.00	0	19	1.4
LFa04-A.3	Fine	37.9	..	..	5.89	21	..	..	..	..	0.69	430	..	0	..	0	451	33.9
LFa04-A.4	Coarse	18.7	..	..	6.67	0	..	..	..	..	0.06	37	..	0	0.00	0	37	2.8
LFa04-C.1	Coarse	16.0	..	..	9.48	0	..	..	..	..	0.01	6	..	0	0.62	124	-76	-3.8
LFa04-C.2	Coarse	18.3	..	..	8.71	0	..	..	..	..	<0.01	0	..	0	0.06	12	-8	-0.4
LFa04-C.3	Coarse	18.7	..	..	8.16	0	..	..	..	..	0.01	6	..	0	0.00	0	6	0.5

I.D.	Texture	Moisture Content %	Acid volatile sulfur AVS %Sav WW	Acid volatile sulfur AVS %Sav DW	Titratable actual acidity (TAA) pH$_{KCl}$	Titratable actual acidity (TAA) (To pH 6.5) mole H+/tonne	Extractable sulfate sulfur %S$_{kcl}$	Extractable sulfate sulfur mole H+/tonne (AASS acidity)	Extractable Ca %Ca$_{kcl}$	Extractable Mg %Mg$_{kcl}$	Reduced inorganic sulfur % chromium reducible %S$_{CR}$	Reduced inorganic sulfur mole H+/tonne	Retained acidity HCL extract as %S$_{HCL}$ - %S$_{kcl}$ %S$_{NAG}$	Retained acidity S$_{NAS}$ mole H+/tonne	Acid neutralising capacity (ANC$_{BT}$) % CaCO$_3$	Acid neutralising capacity (ANC$_{BT}$) mole H+/tonne	Net acidity Chromium suite mole H+/tonne based on %Scrs	Lime calculation Chromium suite kg CaCO$_3$/tonne DW (includes 1.5 safety Factor when liming rate is +ve)
	Note 6		Note 3	Note 3													Note 5	Notes 4 & 6
LFa06-A.1	Coarse	4.6	..	..	6.31	1	..	..	..	..	0.01	6	..	..	..	0	8	0.6
LFa06-A.2	Coarse	13.7	..	..	7.24	0	..	..	..	..	<0.01	0	..	..	0.00	0	0	0.0
LFa06-A.3	Coarse	15.6	..	..	7.67	0	..	..	..	..	0.02	12	..	..	0.01	2	11	0.8
LFa06-B.1	Coarse	16.2	..	..	8.83	0	..	..	..	..	<0.01	0	..	..	0.08	16	-11	-0.5
LFa06-B.2	Coarse	15.5	..	..	7.84	0	..	..	..	..	<0.01	0	..	..	0.10	20	-13	-0.7
LFa06-B.3	Coarse	21.2	..	..	8.71	0	..	..	..	..	0.04	25	..	..	0.17	34	2	0.2
LFa06-B.4	Coarse	15.2	..	..	9.00	0	..	..	..	..	0.03	19	..	..	0.14	28	0	0.0
				.				.		.				.				
LFa07-A.2	Coarse	11.6	..	..	6.41	4	..	..	..	..	<0.01	0	..	..	..	0	4	0.3
LFa07-A.3	Fine	53.1	..	..	6.74	0	..	..	..	..	0.86	536	..	..	0.38	76	486	36.4
LFa07-A.4	Fine	58.2	..	..	6.70	0	..	..	..	..	1.15	717	..	..	0.83	166	607	45.5
LFa07-A.5	Fine	53.6			6.90	0					0.96	599			0.00	0	599	44.9
LFa07-B.2	Coarse	16.6	..	..	6.89	0	..	..	..	..	<0.01	0	..	..	0.00	0	0	0.0
LFa07-B.3	Medium	25.5	..	..	6.69	0	..	..	..	..	0.03	19	..	..	0.27	54	-17	-0.9
LFa07-B.4	Medium	34.6	..	..	6.60	0	..	..	..	..	0.08	50	..	..	0.77	154	-53	-2.6
LFa08-A.1	Coarse	12.7	..	..	6.52	0	..	..	..	..	<0.01	0	..	..	0.00	0	0	0.0
LFa08-A.2	Medium	19.7	..	..	4.58	22	..	..	..	..	0.03	19	..	..	..	0	41	3.1
LFa08-A.3	Medium	22.7	..	..	8.29	0	..	..	..	..	0.17	106	..	..	0.68	136	15	1.2
LFa08-A.4	Fine	44.5	..	..	7.99	0	..	..	..	..	1.48	923	..	..	6.25	1249	91	6.8
LFa08-A.5	Fine	47.6	..	..	8.02	0	..	..	..	..	1.12	699	..	..	1.23	246	535	40.1
LFa08-B.1	Coarse	15.7	..	..	9.22	0	..	..	..	..	0.01	6	..	..	0.46	92	-55	-2.8
LFa08-B.2	Coarse	16.5	..	..	9.26	0	..	..	..	..	0.01	6	..	..	0.60	120	-74	-3.7
LFa08-B.3	Coarse	16.7	..	..	9.18	0	..	..	..	..	0.04	25	..	..	0.52	104	-44	-2.2
LFa08-B.4	Fine	58.8	..	..	7.77	0	..	..	..	..	1.75	1091	..	..	0.48	96	1028	77.1
LFa10-A.1	Fine	21.9	..	..	3.62	150	0.594	371	..	..	0.04	22	0.00	0	..	0	173	13.0
LFa10-A.2	Medium	29.0	..	..	4.11	59	0.030	19	..	..	0.01	6	0.04	17	..	0	82	6.2
LFa10-A.3	Medium	24.7	..	..	6.06	12	..	..	..	..	<0.01	0	..	0	..	0	12	0.9
LFa10-A.4	Fine	43.8	..	..	6.51	0	..	..	..	..	<0.01	0	..	0	..	0	0	0.0
LFa10-C.1	Medium	20.6	..	..	3.74	80	0.880	549	..	..	0.02	12	0.69	324	..	0	416	31.2
LFa10-C.2	Fine	42.0	..	..	3.14	191	0.210	131	..	..	0.03	19	0.24	114	..	0	324	24.3
LFa10-C.3	Coarse	20.0	..	..	4.86	22	..	..	..	..	0.01	6	..	0	..	0	28	2.1
LFa10-C.4	Coarse	19.3	..	..	4.30	40	0.117	73	..	..	0.12	75	0.00	0	..	0	115	8.6

I.D.	Texture	Moisture Content %	Acid volatile sulfur AVS		Titratable actual acidity (TAA)		Extractable sulfate sulfur		Extractable Ca %Ca$_{kcl}$	Extractable Mg %Mg$_{kcl}$	Reduced inorganic sulfur % chromium reducible		Retained acidity		Acid neutralising capacity (ANC$_{BT}$)		Net acidity Chromium suite mole H+/tonne	Lime calculation Chromium suite kg CaCO$_3$/tonne DW
													Required if pH$_{KCL}$ <4.5		Required if pH$_{KCl}$ > 6.5			
			%Sav WW	%Sav DW	pH$_{KCl}$	(To pH 6.5) mole H+/tonne	%S$_{kcl}$	mole H+/tonne (AASS acidity)			%S$_{CR}$	mole H+/tonne	HCL extract as %S$_{HCL}$ - %S$_{kcl}$ %S$_{NAG}$	S$_{NAS}$ mole H+/tonne	% CaCO$_3$	mole H+/tonne	based on %Scrs	(includes 1.5 safety Factor when liming rate is +ve)
	Note 6		Note 3	Note 3													Note 5	Notes 4 & 6
LFa10-C.5	Coarse	18.1	..	..	5.29	13	..	..	..	..	0.13	81	..	0	..	0	94	7.1
LFa10-D.1	Fine	39.5	0.03	0.050	8.56	0	..	..	..	..	0.08	50	..	0	1.42	284	-139	-7.0
LFa10-D.2	Coarse	15.5	..	..	6.62	0	..	..	..	..	<0.01	0	..	0	0.10	20	-13	-0.7
LFa10-D.3	Medium	19.1	..	..	6.39	1	..	..	..	..	0.16	100	..	0	..	0	101	7.6
LFa12-A.1	Coarse	19.2	..	..	6.71	0	..	..	..	..	0.01	6	..	0	0.00	0	6	0.5
LFa12-A.2	Coarse	18.7	..	..	5.75	10	..	..	..	..	<0.01	0	..	0	..	0	10	0.8
LFa12-A.3	Fine	28.7	..	..	5.31	13	..	..	..	..	0.23	143	..	0	..	0	156	11.7
LFa12-A.4	Fine	38.6	..	..	6.48	1	..	..	..	..	0.46	287	..	0	..	0	288	21.6
LFa12-B.1	Fine	61.2	..	..	4.62	152	..	..	..	..	0.08	50	..	0	..	0	202	15.2
LFa12-B.2	Fine	58.6	..	..	5.64	45	..	..	..	..	0.47	293	..	0	..	0	338	25.4
LFa12-B.3	Coarse	16.1	..	..	6.60	0	..	..	..	..	0.02	12	..	0	0.01	2	11	0.8
LFa12-B.4	Coarse	17.6	..	..	6.57	0	..	..	..	..	0.01	6	..	0	0.15	30	-14	-0.7
LFa12-C.1	Coarse	7.9	..	..	3.60	549	1.998	1246	..	..	0.01	6	1.16	543	..	0	1099	82.4
LFa12-C.2	Coarse	9.5	..	..	5.31	15	..	..	..	..	<0.01	0	..	0	..	0	15	1.1
LFa12-C.3	Coarse	16.5	..	..	5.29	16	..	..	..	..	<0.01	0	..	0	..	0	16	1.2
LFa12-C.4	Coarse	17.4	..	..	6.01	7	..	..	..	..	0.02	12	..	0	..	0	19	1.4
LFa12-C.5	Medium	20.1	..	..	6.51	0	..	..	..	..	0.09	56	..	0	..	0	56	4.2
LFa13-A.1	Fine	55.5	..	..	4.08	115	0.140	87	..	..	0.17	106	0.10	48	..	0	268	20.1
LFa13-A.2	Coarse	20.3	..	..	5.86	11	..	..	..	..	0.02	12	..	0	..	0	23	1.7
LFa13-A.3	Coarse	19.3	..	..	8.26	0	..	..	..	..	0.07	44	..	0	2.96	591	-351	-17.5
LFa15-B.1	Coarse	15.0	..	..	3.23	243	1.070	667	..	..	0.18	112	0.77	362	..	0	717	53.8
LFa15-B.2	Medium	21.0	..	..	4.17	40	0.062	39	..	..	0.01	6	0.12	57	..	0	103	7.7
LFa15-B.3	Fine	28.0	..	..	4.06	48	0.053	33	..	..	0.01	6	0.15	72	..	0	126	9.5
LFa15-B.4	Fine	29.0	..	..	4.06	59	0.064	40	..	..	0.15	94	0.07	34	..	0	186	14.0
LFa15-B.5	Fine	24.3	..	..	8.17	0	..	..	..	..	0.25	156	..	0	2.61	521	-192	-9.6
LFa15-C.1	Coarse	23.8	..	..	3.21	234	0.850	530	..	..	0.18	112	0.60	279	..	0	625	46.9
LFa15-C.2	Medium	25.5	..	..	3.24	142	0.286	179	..	..	0.21	131	0.24	112	..	0	385	28.9
LFa15-C.3	Fine	30.9	..	..	4.05	57	0.169	105	..	..	0.05	31	0.10	46	..	0	134	10.0
LFa15-C.4	Fine	30.9	..	..	7.83	0	..	..	..	..	0.33	206	..	0	..	0	206	15.4
LFa17-A.1	Coarse	19.0	..	..	4.39	30	0.011	7	..	..	0.01	6	0.06	29	..	0	65	4.9
LFa17-A.2	Fine	26.0	..	..	3.99	51	0.035	22	..	..	0.02	12	0.07	34	..	0	97	7.3

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

I.D.	Texture	Moisture Content %	Acid volatile sulfur AVS		Titratable actual acidity (TAA)		Extractable sulfate sulfur		Extractable Ca %Ca_kcl	Extractable Mg %Mg_kcl	Reduced inorganic sulfur % chromium reducible		Retained acidity		Acid neutralising capacity (ANC_BT)		Net acidity Chromium suite mole H+/tonne	Lime calculation Chromium suite kg CaCO₃/tonne DW
													Required if pH_KCL <4.5		Required if pH_KCl > 6.5			
			%Sav WW	%Sav DW	pH_KCl	(To pH 6.5) mole H+/tonne	%S_kcl	mole H+/tonne (AASS acidity)			%S_CR	mole H+/tonne	HCL extract as %S_HCL - %S_kcl %S_NAG	S_NAS mole H+/tonne	% CaCO₃	mole H+/tonne	based on %Scrs	(includes 1.5 safety Factor when liming rate is +ve)
	Note 6		Note 3	Note 3													Note 5	Notes 4 & 6
LFa17-A.3	Coarse	19.3	..	..	4.49	30	0.029	18	..	..	0.03	19	0.06	30	..	0	79	5.9
LFa17-A.4	Medium	19.4	..	..	6.32	5	..	..	..	..	0.10	62	..	0	..	0	67	5.0
LFa17-B.1	Coarse	6.0	..	..	6.13	7	..	..	..	..	<0.01	0	..	0	..	0	7	0.5
LFa17-B.2	Coarse	16.9	..	..	6.17	7	..	..	..	..	<0.01	0	..	0	..	0	7	0.5
LFa17-B.3	Medium	18.9	..	..	5.78	10	..	..	..	..	0.02	12	..	0	..	0	22	1.7
LFa17-B.4	Coarse	18.1	..	..	6.62	0	..	..	..	..	0.04	25	..	0	0.08	16	14	1.1

Appendix 7 – Historic data

Site and sample descriptions

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
FIN 26M3 5.1	**LF01 - Wallys Landing and Wetland -** Middle of drainage ditch located to the north east of the Finniss River. **Subaqueous.**	Spade/ Gouge Auger	0	5	Firm dark grey clay with orange surface coatings on ped faces.
FIN 26M3 5.2			5	20	Firm dark grey clay with orange surface coatings on ped faces.
FIN 26M3 5.3			20	25	Friable dark grey sandy clay.
FIN 26M3 5.4			25	50	Firm very dark grey clay with yellow jarosite mottles.
AA 29.5	**LF02 - Point Sturt North -** Soil profile located approximately 55 m north east of the pre-drought shoreline.	Spade	0	3	Pale yellowish grey fine sand: slightly moist.
AA 29.6			3	10	Pale yellowish brown to white medium to fine sand: few root remnants.
AA 29.7			10	15	Pale grey to pale yellowish grey medium sand: diffuse yellowish and darker grey mottles.
AA 29.8			15	35	As above.
AA 29.9			35	60	Grey to greenish grey clay with some sand and firm black organic remnants (like nodules) with brown centres (2 -3 cm).
AA 29.10			60	70	Grey clayey sand.
AAa 29.1		Spade	0	1	No data
AAa 29.2			1	5	No data
AAa 29.3			5	20	No data
AAa 29.4			20	35	No data
AAa 29.5			35	70	No data
AAa 29.6			70	85	No data
AA 30.1	**Point Sturt North -** Soil profile located approximately 200 m north east of the pre-drought shoreline.	Spade	0	5	Yellowish grey medium to fine sand.
AA 30.2			5	20	As above: saturated.
AA 30.3			20	55	Pale yellowish grey medium sand.

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
AAa 30.1			0	2	No data
AAa 30.2			2	10	No data
AAa 30.3		Spade	10	25	No data
AAa 30.4			25	40	No data
AAa 30.5			40	55	No data
AA 16.1			0	3	Yellowish gel with black mottles and some sand
AA 16.2			3	12	Dark grey to black silt with sand and clay lenses: black mottles (45%): few fine roots
AA 16.3			12	20	Grey silty fine sand with black mottles (10%)
AA 16.4	**LF03 - Milang -** South of the main Milang beach. Soil profile located 150 m east of the shoreline. **Subaqueous.**	Spade/ Gouge Auger	20	30	Dark olive brown to black clay: sulfidic: many fine roots: structured with sand in cracks: sulfidic smell
AA 16.5			30	50	Clayey material similar to above
AA 16.6			30	50	Grey sand with olive grey clay lenses
AA 16.7			50	80	Grey sand: sulfidic: no shell or roots
AA 15.1			0	5	Yellowish medium sand: abrupt boundary
AA 15.2	Soil profile located 500 m east of the shoreline. **Subaqueous.**	Spade/ Gouge Auger	5	15	Very dark grey medium sand (50%) with black (40%) and yellow (10%) mottles: clear wavy boundary
AA 15.3			15	30	Pale grey medium sand with minor black mottles which are more clayey: few shells: few very fine roots
AA 11.1	Soil profile located 300 m south of the pre-drought shoreline. **Subaqueous.**	Spade/ Gouge Auger	0	3	Yellowish grey medium sand: mica flakes throughout
AA 11.2			3	10	Dark grey medium sand: sulfidic: black mottles

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
AA 11.3			10	20	As above: grey with black bands about 3mm wide: mica flakes
AA 11.4			20	30	As above
LL. 1501	Soil profile collected from boat approximately 730 m south of the pre-drought shoreline. **Subaqueous.**	Spade/ Gouge Auger	0	10	Grey coarse sand.
LL. 1502			10	30	Grey coarse sand.
LL. 1503			30	50	Grey coarse sand.
PO 4.1	**LF06 - Poltalloch -** Approximately 4 km north east of The Narrows, on the Poltalloch Station. Soil profile located approximately 200 m from pre-drought shoreline.	Spade	0	8	Yellowish brown medium sand: greenish algal crust with orange oxides a few mm below: few vertical orange-brown old root channels continuing below: very irregular sharp boundary to
PO 4.2			8	15	Dark grey sand with inclusions of the above and orange root channel mottles (5%)
PO 4.3			15	20	Grey sand with diffuse black mottles (30%): shelly at base
PO 4.4			20	32	As above with fewer black mottles: shells continue to 50 cm.
AT 12.1	**LF07 - Waltowa -** The north eastern extent of Lake Albert, on Waltowa Beach. Soil profile located approximately 90 m south west of the pre-drought shoreline.	Spade/ Gouge Auger	0	5	Yellowish grey medium sand (loose): pH 4–4.5.
AT 12.2			5	25	Pale grey medium sand: pH 4–3.9
AT 12.3			20	40	Grey medium sand to loamy sand: sulfidic.
AT 12.4			40	70	Strongly sulfidic: very soft with n = 2
W1S 1.1	Soil profile located approximately 160 m south west of the pre-drought shoreline.	Spade	0	3	Yellow-greyish medium sand matrix with black mottles (10%) and orange mottles (10%).
W1S 1.2			3	40	Light greyish sandy clay with few black mottles.
W1S 1.3			40	50	Very dark grey medium clay with very fine sand.
AT 4.1	**LF08 - Meningie -** West of the Meningie jetty. Soil profile located approximately 90 m north of the pre-drought shoreline. **Subaqueous.**	Spade/ Gouge Auger	0	5	Yellowish grey medium sand
AT 4.2			5	10	Greyish yellow medium sand: very diffuse orange mottles
AT 4.3			10	30	Pale brownish grey medium sand
AT 4.4			30	60	Grey clayey sand with common small shells
AT 4.5			60	70	Very dark grey to black heavy clay: few small shells (to 2 mm)

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
AT 17.1	Soil profile located approximately 90 m north of the pre-drought shoreline. **Subaqueous.**	Spade/ Gouge Auger	0	1	Yellowish grey medium sand, loose
AT 17.2			1	10	Brownish grey medium sand
AT 17.3			10	20	Dark grey sandy clay
AT 17.4			20	30	Bluish grey heavy clay (soft)
AT 9.1	**LF10 - Campbell Park -** Northern side of Campbell Park Peninsula. Soil profile located in a reed bed, on the pre-drought shoreline.	Spade	0	5	Dense root mat with brownish grey clay
AT 9.2			5	30	Grey heavy clay: common fine roots
AT 9.3			30	50	Dark grey heavy clay
AT 9.4			50	100	Grey and pale grey heavy clay
AT 7.1	Soil profile located 120 m north of the pre-drought shore. **Subaqueous.**	Spade/ Gouge Auger	0	5	Yellowish grey medium sand
AT 7.2			5	20	Grey heavy clay: common decomposing roots
AT 7.3			20	40	Grey heavy clay: decomposing reeds
AT 7.4			40	50	Grey to pale grey medium sand
AT 7.5			50	75	Brownish grey medium sand
AT 19.1	Soil profile located 120 m north of the pre-drought shore.	Spade	0	8	Greenish yellow sand. pH 4.7
AT 19.2			8	18	Sand (30%) in organic clay matrix. Jarosite in bright yellow mottles/streaks. Sulfuric pH 2.5.
AT 19.3			18	28	Sandy clay with many fossil roots and yellow mottles, especially along root pores (large) and orange mottles. Sulfuric, pH 3.3.
AT 19.4			18	50	Pale grey sand with some grey clay lenses: sulfidic: field pH 4.
AA 33.1	**LF13 - Tauwitchere -** Northern side of Tauwitchere Island.	Spade	0	1	Pale grey surface crust underlain by drying MBO
AA 33.2			0	10	Very peaty with inclusions of grey clay: base of Phragmites plant, root mat: field pH 2.2
AA 33.3			10	25	Peaty with grey clay: field pH 2.5: even, abrupt to
AA 33.4			25	40	Yellowish grey sand: saturated: strong sulfidic smell: many live roots: field pH 7

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
AA 33.5			40	60	Dark grey sand: 25-40 cm is slightly coarser.
BCM 1.1	**LF15 - Boggy Creek -** A tributary of Holmes Creek that forms the eastern boundary of Hindmarsh Island. The area comprised a dried creek bed. Soil profile located in the middle of the dried creek bed.	Spade	0	3	Black fine sandy clay loam with algae on surface and MBO in cracks.
BCM 1.2			3	15	Greyish brown fine sandy clay loam.
BCM 1.3			15	20	Dark greyish brown fine sandy clay with hard relict woody root fragments.
BCM 1.4			20	30	Light olive grey light clay with bright yellow jarosite mottles.
BCM 1.5			30	38	Greyish brown light clay with jarosite mottles.
BCM 1.6			38	50	Grey fine clayey sand with clay lenses.
BCM 1.7			50	60	Grey fine clayey sand with clay lenses.
BCM 1.8			60	80	Dark grey fine clayey sand with clay lenses.
BCM 1.9			80	100	Olive grey fine clayey sand with few large shell and calcrete fragments and with clay lenses.
BCM 1.10			100	160	Grey fine clayey sand with few large shell and calcrete fragments and with clay lenses.
BCM 1.11			160	180	Dark grey fine clayey sand with few large shell fragments and with clay lenses.
PSM 1.1	**LF17 - Point Sturt South -** Southern side of Point Sturt on the south western side of Lake Alexandrina. Soil profile located 160 m south of the pre-drought shoreline.	Spade	0	0.5	White surface crystals.
PSM 1.2			0	1	Green surface crystals.
PSM 1.3			1	10	Loose light brownish grey medium sand.
PSM 1.4			10	20	Loose light brownish grey medium sand.
PSM 1.5			20	30	Loose light brownish grey medium sand.
PSM 1.6			30	40	Very soft light brownish grey medium sand.
PSM 1.7			40	50	Very soft light grey medium sand.
PSM 1.8			50	60	Very soft light grey medium sand.
PSM 1.9			60	160	Very soft greyish brown sandy clay.
CUR27-M2	**Currency Creek: Jetty + vineyard + homestead view site** 10m from reeds under 80 cm water. **Subaqueous.**	Spade/ Gouge Auger	0	2	Black with some monosulfidic material, medium sand, soft
CUR27-M2			2	15	Grey, loamy sand, relic roots with distinct yellowish jarosite

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Sample ID	Locality description	Sampling tool	Upper depth (cm)	Lower depth (cm)	Morphology
					mottles (20 %), distinct brownish red and brown mottles (5 %), soft
CUR27-M2			15	30	Grey, loamy sand, relic roots with distinct yellowish jarosite mottles (20 %), distinct brownish red and brown mottles (5 %), soft
CUR27-M2			30	60	Grey loamy sand with reddish brown mottles (5 %). Common relic roots with common jarosite mottles along root channels, soft
CUR27-M2			60	90	Dark grey to olive , loamy sand with common relic roots with few jarosite mottles along root channels, soft
FIN20-M2			0	6	Black clay with organic black clayey gel with monosulfidic material. Many dead roots from 0 to 1 cm, soft.
FIN20-M2	**Finniss River: Airstrip site –**closest site to main bank adjacent to airstrip with very wide cracks still clearly evident under 60 cm water. **Subaqueous.**	D-Auger	6	12	Dark greyish brown, heavy clay. Common roots with distinct yellow jarosite mottles and coatings (30 – 35 %) along root channels and on surfaces of subangular blocky structures
FIN20-M2			12	25	Grey, heavy clay. Common roots with distinct yellow jarosite mottles and coatings (30 – 35 %) along root channels and on surfaces of subangular blocky structures.
FIN20-M2			25	50	Dark grey, heavy clay with subangular blocky structures.
FIN23-M2			0	10	Black with surface layer of gel with monosulfidic material , light clay with organic/ peat with many dead roots from 0 to 1 cm, soft.
FIN23-M2	**Finniss River: Airstrip site** –middle site near Phragmites with cracks still clearly evident under 80 cm water. **Subaqueous.**	Spade/ D-Auger	10	25	Dark grey brown with distinct yellow jarosite mottles and coatings (15 %) along root channels and on surfaces of subangular blocky structures, heavy clay, common roots.
FIN23-M2			25	50	Dark grey brown heavy clay, very soft

Acid – base accounting and pH

* NOTE:

1 - All analysis is Dry Weight (DW) - samples dried and ground immediately upon arrival (unless supplied dried and ground)

2 - Samples analysed by SPOCAS method 23 (ie Suspension Peroxide Oxidation Combined Acidity & sulfate) and 'Chromium Reducible Sulfur' technique (S_{CR} - Method 22B)

3 - Methods from Ahern, CR, McElnea AE , Sullivan LA (2004). *Acid Sulfate Soils Laboratory Methods Guidelines.* QLD DNRME.

4 - Bulk Density is required for liming rate calculations per soil volume. Lab. Bulk Density is no longer applicable - field bulk density rings can be used and dried/ weighed in the laboratory.

5 - **ABA Equation**: **Net Acidity = Potential Sulfidic Acidity (ie. Scrs or Sox) + Actual Acidity + Retained Acidity - measured ANC/FF   (with FF currently defaulted to 1.5)**

6 - The neutralising requirement, lime calculation, includes a 1.5 safety margin for acid neutralisation (an increased safety factor may be required in some cases)

7 - For Texture: coarse = sands to loamy sands: medium = sandy loams to light clays: fine = medium to heavy clays and silty clays

8 - ..   denotes not requested or required

9 - SCREENING, CRS, TAA and ANC are NATA accredited but other SPOCAS segments are currently not NATA accredited

10- Results at or below detection limits are replaced with '0' for calculation purposes.

11 - Projects that disturb >1000 tonnes of soil, the ≥0.03% S classification guideline would apply (refer to acid sulfate management guidelines).

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

I.D.	Texture	pH water	pH peroxide	pH incubation (> 10 weeks)	Titratable actual acidity (TAA)		Reduced inorganic sulfur % chromium reducible		Acid neutralising capacity (ANC$_{BT}$) Required if pH$_{KCl}$ > 6.5		Net acidity Chromium suite mole H+/tonne	Lime calculation Chromium suite kg CaCO$_3$/tonne DW
					pH$_{KCl}$	(To pH 6.5) mole H+/tonne	%S$_{CR}$	mole H+/tonne	% CaCO$_3$	based on %Scrs	based on %Scrs	(includes 1.5 safety Factor when liming rate is +ve)
	Note 6										Note 5	Notes 4 & 6
FIN 26M3 4.1	Fine	5.06	2.15	5.00	5.87	21	0.026	16.2	..	0.0	37.2	2.8
FIN 26M3 4.2	Fine	5.06	2.23	5.00	5.14	42	0.017	10.6	..	0.0	57.5	4.3
FIN 26M3 4.3	Coarse	4.03	2.07	4.50	4.60	39	0.008	5.0	..	0.0	52.3	3.9
FIN 26M3 4.4	Coarse	3.27	1.83	2.50	5.03	31	0.015	9.4	..	0.0	40.4	3.0
FIN 26M3 4.5	Coarse	3.09	1.38	2.50	3.61	162	0.857	534.5	..	0.0	742.3	55.7
AA 29.5	Medium	3.00	2.20	2.50	3.11	72	0.006	3.7	0	0.0	76.0	6.0
AA 29.6	Medium	2.80	1.50	2.50	5.24	3	<0.005	0.0	0	0.0	3.0	0.0
AA 29.7	Medium	2.60	1.30	2.50	3.49	23	0.005	3.1	0	0.0	26.0	2.0
AA 29.8	Medium	2.70	1.80	2.50	3.24	45	0.014	8.7	0	0.0	54.0	4.0
AA 29.9	Fine	8.60	1.70	2.50	4.12	12	0.143	89.2	0	0.0	101.0	8.0
AA 29.10	Fine	8.70	1.70	2.50	4.46	6	0.099	61.7	0	0.0	68.0	5.0
AAa 29.1	Medium	2.80	2.30	3.12	3.24		0.012		0		115.0	9.0
AAa 29.2	Medium	2.30	1.60	2.88	3.79	27	0.007	4.4	0	0.0	32.0	2.0
AAa 29.3	Medium	2.60	1.60	2.64	4.12	16	0.011	6.9	0	0.0	23.0	2.0
AAa 29.4	Medium	2.40	1.80	2.51	4.39	10	0.046	28.7	0	0.0	38.0	3.0
AAa 29.5	Medium	3.00	1.80	2.35	4.88	2	0.038	23.7	0	0.0	26.0	2.0
AAa 29.6	Medium	6.00	1.80	2.79	4.49	6	0.079	49.3	0	0.0	55.0	4.0
AA 30.1	Medium	8.80	7.20	7.00	9.01	0	0.020	12.5	1.01	201.8	−122	−9
AA 30.2	Medium	8.20	6.90	7.00	8.92	0	0.014	8.7	0.2	40.0	−18	−1
AA 30.3	Medium	7.70	5.30	5.50	6.57	0	<0.005	0.0	0.13	26.0	−17	−1
AAa 30.1	Medium	8.10	7.70	7.83	9.06	0	0.010	6.2	0.78	155.8	−98	−7
AAa 30.2	Medium	8.30	7.80	8.01	8.92	0	0.005	3.1	0.25	50.0	−30	−2
AAa 30.3	Medium	..	..	7.01	8.37	0	0.006	3.7	0.07	14.0	−6	0.0
AAa 30.4	Medium	6.60	3.30	6.97	7.00	0	0.008	5.0	0.02	4.0	2.0	0.0
AAa 30.5	Medium	7.50	6.40	6.96	8.46	0	<0.005	0.0	0.11	22.0	−15	−1
AA 16.1	Medium	7.50	4.40	6.55	8.38	0	0.055	34.3	0.35	70.7	−13	−1
AA 16.2	Medium	7.80	3.10	5.16	7.82	0	0.044	27.4	0.19	37.8	2.0	0.0
AA 16.3	Coarse	7.10	2.10	4.01	6.39	2	0.025	15.6	0	0.0	17.0	1.0
AA 16.4	Medium	6.30	1.30	2.36	6.18	4	0.623	388.6	0	0.0	392.0	29.0
AA 16.5	Coarse	5.20	1.40	2.48	6.29	2	0.180	112.3	0	0.0	114.0	9.0
AA 16.6	Coarse	5.80	1.80	2.85	6.54	0	0.126	78.6	0.09	17.4	67.0	5.0

I.D.	Texture	pH water	pH peroxide	pH incubation (> 10 weeks)	Titratable actual acidity (TAA)		Reduced inorganic sulfur % chromium reducible		Acid neutralising capacity (ANC_BT) Required if pH_KCl > 6.5		Net acidity Chromium suite mole H+/tonne	Lime calculation Chromium suite kg CaCO_3/tonne DW
					pH_{KCl}	(To pH 6.5) mole H+/tonne	$\%S_{CR}$	mole H+/tonne	% CaCO_3	based on %Scrs	based on %Scrs	(includes 1.5 safety Factor when liming rate is +ve)
	Note 6										Note 5	Notes 4 & 6
AA 15.1	Coarse	7.30	4.90	6.07	6.87	0	0.006	3.7	0.12	24.2	−12	−1
AA 15.2	Coarse	7.30	3.60	5.22	6.87	0	0.009	5.6	0.08	16.5	−5	0.0
AA 15.3	Coarse	7.40	2.00	2.88	6.46	1	0.073	45.5	0.04	7.8	41.0	3.0
AA 11.1	Coarse	7.50	5.70	5.12	6.98	0	<0.005	0.0	0.1	19.4	−13	−1
AA 11.2	Coarse	6.90	3.10	4.05	6.54	0	0.010	6.2	0.03	6.8	2.0	0.0
AA 11.3	Coarse	7.50	4.60	5.11	6.61	0	0.009	5.6	0.05	10.7	−1	0.0
AA 11.4	Coarse	6.20	4.40	4.98	6.72	0	0.009	5.6	0.06	12.6	−3	0.0
LL.1501	Coarse	8.17	6.23	8.28	9.17	0	<0.005	0.0	0.19	37.9	-25.3	-1.9
LL.1502	Coarse	8.08	1.77	2.38	7.26	0	0.043	26.8	0.01	2.0	25.5	1.9
LL.1503	Coarse	6.93	1.79	2.29	6.89	0	0.054	33.7	0.00	0.0	33.7	2.5
PO 4.1	Medium	7.70	7.60	7.00	7.63	0	<0.005	0.0	0.07	14.0	−9	−1
PO 4.2	Medium	7.30	4.90	5.50	6.94	0	0.006	3.7	0.06	12.0	−4	0.0
PO 4.3	Medium	7.50	7.00	5.50	8.64	0	0.005	3.1	0.11	22.0	−12	−1
PO 4.4	Medium	7.60	4.10	7.00	8.86	0	<0.005	0.0	0.16	32.0	−21	−2
AT 12.1	..	4.90	3.30	7.00	6.54	5	0.006	3.7	0.17	34.0	−14	−1
AT 12.2	..	2.90	1.90	3.90	4.82	1	0.004	2.5	<0.05	0.0	4.0	0.0
AT 12.3	..	4.40	1.90	2.50	5.76	0	0.067	41.8	<0.05	0.0	42.0	3.0
AT 12.4	..	7.20	1.90	3.00	6.34	0	0.883	550.7	<0.05	0.0	551.0	41.0
W1S 1.1	Coarse	7.81	5.58	7.00	8.30	0	0.009	5.6	0.33	65.9	-38.0	-3.0
W1S 1.2	Coarse	7.00	3.72	5.00	5.80	2	0.007	4.4	0.01	2.0	5.0	0.0
W1S 1.3	Medium	7.54	4.66	5.30	6.39	2	0.066	41.2	0.56	111.9	-31.0	-2.0
AT 4.1	Coarse	7.90	6.80	7.07	9.22	0	0.009	5.6	0.38	75.6	−45	−3
AT 4.2	Coarse	8.10	2.60	5.12	8.85	0	0.050	31.2	0.16	32.0	10.0	1.0
AT 4.3	Coarse	7.60	2.10	3.78	8.27	0	0.023	14.3	0.13	26.2	−3	0.0
AT 4.4	Coarse	8.20	2.10	7.35	8.90	0	0.112	69.9	0.34	68.8	24.0	2.0
AT 4.5	Medium	7.90	1.60	4.07	8.37	0	0.720	449.1	1.44	286.8	258.0	19.0
AT 17.1	..	7.70	7.40	7.00	9.52	5	0.006	3.7	1.19	237.8	−150	−11
AT 17.2	..	7.90	7.10	7.00	9.34	10	0.019	11.9	0.8	159.8	−85	−6
AT 17.3	..	7.20	4.00	7.00	8.12	0	0.141	87.9	1.29	257.7	−84	−6
AT 17.4	..				8.26	0	0.971	605.6	1.63	325.7	388.0	29.0

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

I.D.	Texture	pH water	pH peroxide	pH incubation (> 10 weeks)	Titratable actual acidity (TAA)		Reduced inorganic sulfur % chromium reducible		Acid neutralising capacity (ANC$_{BT}$) Required if pH$_{KCl}$ > 6.5		Net acidity Chromium suite mole H+/tonne	Lime calculation Chromium suite kg CaCO$_3$/tonne DW
					pH$_{KCl}$	(To pH 6.5) mole H+/tonne	%S$_{CR}$	mole H+/tonne	% CaCO$_3$	based on %Scrs	based on %Scrs	(includes 1.5 safety Factor when liming rate is +ve)
	Note 6										Note 5	Notes 4 & 6
AT 9.1	..	3.20	1.70	..	..		..		..		..	..
AT 9.2	Medium	3.00	1.80	3.28	3.12	282	0.044	27.4	0	0.0	309.0	23.0
AT 9.3	Fine	6.20	4.30	5.58	6.12	2	0.014	8.7	0	0.0	10.0	1.0
AT 9.4	Fine	7.90	7.20	7.04	6.75	0	0.023	14.3	0.81	161.8	−94	−7
AT 7.1	Coarse	8.00	6.70	7.27	9.18	0	0.003	1.9	0.2	40.7	−25	−2
AT 7.2	Medium	8.20	1.20	2.48	7.23	0	1.079	673.0	1.5	299.4	473.0	36.0
AT 7.3	Medium	8.20	1.30	2.12	6.96	0	2.367	1476.3	1.22	244.2	1314.0	99.0
AT 7.4	Coarse	8.10	1.90	2.34	6.68	0	0.168	104.8	0.13	26.2	87.0	7.0
AT 7.5	Coarse	7.40	1.90	2.78	7.36	0	0.183	114.1	0.13	25.2	97.0	7.0
AT 19.1	..	8.00	6.70	7.00	8.87	0	0.004	2.5	0.32	63.9	−40	−3
AT 19.2	..	2.50	1.40	2.50	7.97	0	0.370	230.8	0.85	169.8	118.0	9.0
AT 19.3	..	3.40	1.50	2.50	5.70	5	0.101	63.0	<0.05	0.0	68.0	5.0
AT 19.4	..	3.80	1.50	2.50	7.38	0	0.169	105.4	<0.05	0.0	105.0	8.0
AA 33.1	..	7.10	3.40	6.50	..		..		..		..	..
AA 33.2	..	2.80	1.70	3.60	3.19	152	0.076	47.4	<0.05	0.0	199.0	15.0
AA33.3	..	2.60	1.70	3.60	3.15	258	0.105	65.5	<0.05	0.0	323.0	24.0
AA 33.4	..	3.70	2.00	3.60	6.02	8	0.065	40.5	<0.05	0.0	49.0	4.0
AA 33.5	..	7.60	6.60	7.00	8.63	0	0.076	47.4	7.19	1436.6	−910	−68
BCM 1.1	3.19	4.40	1.50	3.19	4.30	82	0.504	314.0	0	0.0	465.0	35.0
BCM 1.2	3.26	3.30	2.00	3.26	4.30	29	<0.005	0.0	0	0.0	57.0	4.3
BCM 1.3	3.19	3.00	1.90	3.19	4.00	44	<0.005	0.0	0	0.0	58.0	4.3
BCM 1.4	2.89	3.10	1.80	2.89	4.10	46	0.045	28.0	0	0.0	112.0	8.4
BCM 1.5	2.07	3.20	1.60	2.07	3.90	79	0.239	149.0	0	0.0	248.0	19.0
BCM 1.6	7.42	7.20	6.20	7.42	7.80	0	0.186	116.0	1.5	304.0	-188.0	-6.5
BCM 1.7	7.65	8.50	6.60	7.65	8.30	0	0.255	159.0	5.6	1127.0	-968.0	-44.0
BCM 1.8	7.64	8.60	6.60	7.64	5.70	0	0.182	114.0	3.4	673.0	-560.0	-25.0
BCM 1.9	7.74	8.50	6.60	7.74	8.60	0	0.474	296.0	5.6	1117.0	-821.0	-34.0
BCM 1.10	7.83	8.80	6.60	7.83	9.10	0	0.196	122.0	20	4004.0	-3882.0	-191.0
PSM 1.1	3.01	3.80	3.00	3.01	5.60	6	<0.005	0.0	0	0.0	6.0	0.5
PSM 1.2	3.59	3.10	2.40	3.59	5.00	13	<0.005	0.0	0	0.0	13.0	1.0
PSM 1.3	3.11	3.10	2.60	3.11	5.10	6	<0.005	0.0	0	0.0	6.0	0.5

I.D.	Texture	pH water	pH peroxide	pH incubation (> 10 weeks)	Titratable actual acidity (TAA)		Reduced inorganic sulfur % chromium reducible		Acid neutralising capacity (ANC$_{BT}$) Required if pH$_{KCl}$ > 6.5		Net acidity Chromium suite mole H+/tonne	Lime calculation Chromium suite kg CaCO$_3$/tonne DW
					pH$_{KCl}$	(To pH 6.5) mole H+/tonne	%S$_{CR}$	mole H+/tonne	% CaCO$_3$	based on %Scrs	based on %Scrs	(includes 1.5 safety Factor when liming rate is +ve)
	Note 6										Note 5	Notes 4 & 6
PSM 1.4	2.86	2.90	2.00	2.86	4.70	12	0.019	12.0	0	0.0	24.0	1.8
PSM 1.5	2.83	3.00	1.80	2.83	5.00	7	<0.005	0.0	0	0.0	7.0	0.5
PSM 1.6	2.38	3.20	2.00	2.38	5.10	8	0.022	14.0	0	0.0	22.0	1.6
PSM 1.7	2.54	3.70	1.70	2.54	5.50	4	0.010	6.0	0	0.0	10.0	0.8
PSM 1.8	2.45	6.50	1.80	2.45	7.60	0	0.045	28.0	0.08	16.0	12.0	1.3
PSM 1.9	2.27	8.10	1.70	..	..	..	..	..	..		..	..

Recovery of re-flooded acid sulfate soil environments around Lakes Alexandrina and Albert, South Australia

Appendix 8 – Subaqueous soil sampling methods

During drought conditions (2007 to 2009), soil sampling around the margins of the Lower Lakes was achieved using spades and standard augers (e.g. sand auger, gouge auger and Russian-D auger). Following reflooding and inundation in September/October 2010, it was not possible to retrieve adequate quantity/quality of soil material using standard sampling equipment. Soil samples had to be collected from beneath up to 1.6 m of water, often in windy and rough conditions. Hence, new sampling methods and equipment had to be employed.

Following extensive testing, an Undisturbed Wet Sampler (UWS) (made by Dormer Engineering: http://www.doreng.com.au) was chosen to collect subaqueous soil cores. The UWS is used for obtaining undisturbed samples in water saturated materials and retains the sample inside a removable soft clear plastic liner using a plastic sample retainer (split finger) one way valve. The sampler is made from stainless steel tube with a threaded removable nose piece and is easily pushed in by hand. The plastic sample retaining valve is reusable and the soft clear plastic liner is easily sealed for sample transportation, gives a clear view of the sample and is easy to cut open for access. The internal diameter of the sample retaining valve and the clear plastic tube are 34 mm.

To enable effective sampling of sandy soil material, a concrete vibrator was connected to the UWS to create a makeshift vibracore sampler. The vibrations cause a thin layer of material to mobilise along the inner and outer wall of the UWS, reducing friction and easing penetration into the substrate. The liquid spaces in the matrix allow sediment grains to be displaced by the vibrating UWS. As a UWS penetrates the sediment the material captured inside the descending UWS moves upward at the same rate.

The UWS/vibracore sampling system was operated from an inflatable boat. The concrete vibrator was fastened to the deck of the boat and the field operatives stood in the water to operate the UWS (Figure A9.1). Soil cores were left in the plastic liner for transportation to the laboratory.
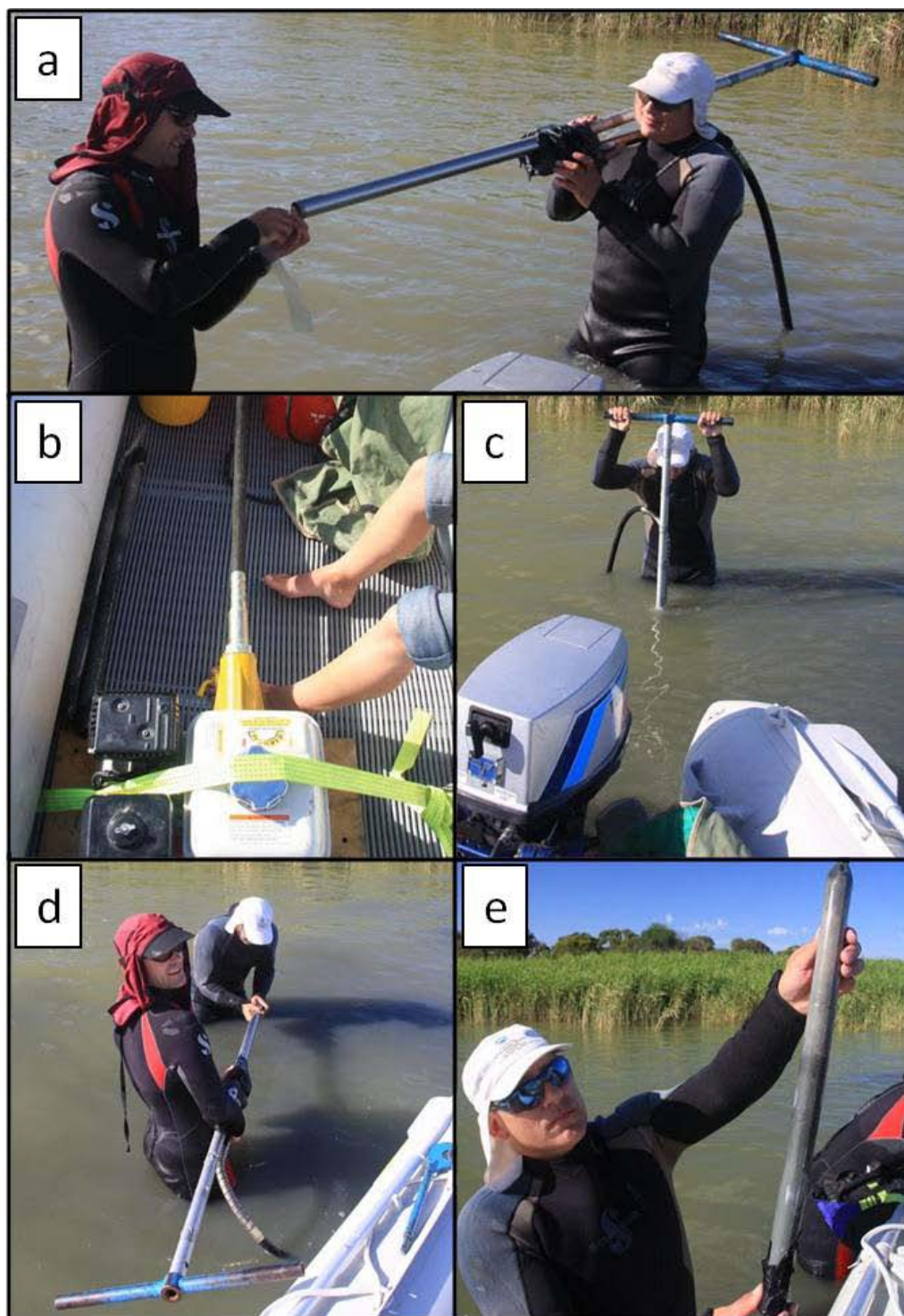
Figure A9.1 Photos showing the vibracoring methods employed for sampling subaqueous soil cores in the Lower Lakes; a: loading clear plastic liner into the UWS in preparation for sampling, b:concrete vibrator secured to deck of boat, c: UWS/vibracore equipment being used to collect subaqueous soil core, d: removing soil core from UWS and d: the subaqueous soil core, contained in a soft plastic liner, that is ready to be transported to the laboratory

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