Engineering the Future

STAGE 1 PRELIMINARY SITE INVESTIGATION

Proposed Residential Development

12 Corks Lane, Ballina NSW
Part of Lot 2, DP1155600

For:
Palm Lake Works

March 2018

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Executive Summary

ENV Solutions Pty Ltd (ENV) has conducted a combined contamination and Acid Sulfate Soil (ASS) investigation (a Stage 1 Preliminary Site Investigation (PSI)) for proposed residential development of land situated at 12 Cork Land, Ballina, NSW (Part of Lot 2, DP1155600) – the 'site'.

It is understood that Palm Lake Works intends to develop the approximate 9 ha parcel of land site with low density residential dwellings and a wellness centre. This investigation provides environmentally relevant information to support the Development Application (DA) for the development proposal.

ENV's investigation comprised the following activities:

- An inspection of the site to identify its general layout and note field indicators of potential contamination, such as vegetation stress, discolouration of surface soils and/or non-natural odours.
- A desk-top review of available information relating to historical ownership and development on the land (if any).
- The collection of shallow soil samples from the site surface for potential laboratory analysis.
- The drilling of boreholes across the site, to collect information regarding the potential contamination status of deeper soils and characterise the ASS potential of the site soils generally.
- The laboratory analysis of 100 soil samples for a suite of chemical parameters, based on the available site history information.
- The laboratory analysis of selected soil samples for ASS potential.
- The preparation of a report on the investigation (this report).

Based on the preliminary desk-top review of the site's history, the following potentially contaminating activities and associated chemicals of potential concern relevant to this investigation were identified and considered plausible:

- Possible historical agricultural use – potentially involving the application of persistent pesticides such as organochlorine pesticides (OCPs) and/or fertilisers to ground surfaces. Potential contaminants associated with these activities which were considered further for the assessment included OCPs and a suite of metals.

An ASS investigation was undertaken because of the ASS risk (Class 2 soils) attributed to the soils on mapping included in the Ballina Local Environmental Plan (LEP, 2012).

The contamination investigation included the collection and laboratory analysis of 100 soil samples from across the site. Most samples collected were from shallow soils (0 – 150 mm), however some additional samples were collected from deeper profiles during the ASS borehole investigation. The individual soil samples were composited by the laboratory, with the subsequent analysis of 25 composite samples from the investigation. This was considered appropriate in the absence of point sources of

contamination and the nature of the chemicals of interest (i.e. not volatile). Groundwater investigations were not conducted as part of the assessment.

The composite soil samples were laboratory analysed for OCPs and a suite of up to 17 metals. Two individual samples were also analysed for a broader suite of chemicals, including total recoverable hydrocarbons (TRH); benzene, toluene, ethylbenzene, xylenes and naphthalene (BTEXN); polycyclic aromatic hydrocarbons (PAH) and polychlorinated bi-phenyls (PCBs). The results indicated that concentrations of each of the analytes tested were less than the composite level and individual investigation and screening levels adopted for the investigation. **From a chemical perspective, the soils are considered suitable for the proposed low density residential development.**

The ASS investigation included the drilling of an additional 19 boreholes across the site, with associated soil sampling for field peroxide screening and chromium suite testing of selected samples, to quantify actual and potential acidity levels in the soils. The results of the chromium suite testing indicate that both actual and potential acid sulfate soils are present at the site, and that these will require liming to neutralise their acidity, should they be disturbed during construction activities associated with the proposed residential development. Information provided by Palm Lake Works indicates that although up to 2 m thickness of fill material will be placed on the site during its development, some excavation into the natural soils may be required to construct bio-retention basins and swales near the site's eastern boundary.

On the basis of the ASS investigation results, ENV recommends that an Acid Sulfate Soil Management Plan (ASSMP) is prepared to assist with the appropriate management of site soils during the future construction activities, to mitigate the potential for environmental harm associated with the actual and potential acidity of the soils. ENV has prepared an ASSMP on the basis of the Stage 1 PSI, which has been provided to Palm Lake Works separately.

1 Introduction

ENV Solutions Pty Ltd (ENV) has been engaged by Palm Lake Works to undertake a Stage 1 Preliminary Site Investigation (PSI) of the property described as part of Lot 2, DP1155600 (12 Cork Lane), Ballina, NSW (Attachment 1, Figure 1) – the 'site'. The investigation will provide information to support a Development Application (DA) for the site. Palm Lake Works intends to develop the property with low density residential dwellings and a wellness centre.

2 Scope of Works

Clause 7(1) of State Environment Planning Policy No 55 – Remediation of Land (SEPP 55) states that:

"(1) A consent authority must not consent to the carrying out of any development on land unless:

(a) it has considered whether the land is contaminated, and

(b) if the land is contaminated, it is satisfied that the land is suitable in its contaminated state (or will be suitable, after remediation) for the purpose for which the development is proposed to be carried out, and

(c) if the land requires remediation to be made suitable for the purpose for which the development is proposed to be carried out, it is satisfied that the land will be remediated before the land is used for that purpose.

(2) Before determining an application for consent to carry out development that would involve a change of use on any of the land specified in subclause (4), the consent authority must consider a report specifying the findings of a preliminary investigation of the land concerned carried out in accordance with the contaminated land planning guidelines.

(3) The applicant for development consent must carry out the investigation required by subclause (2) and must provide a report on it to the consent authority…"

This Stage 1 PSI has been prepared to address these SEPP 55 requirements.

The Stage 1 PSI has been prepared in accordance with the *Managing Land Contamination Planning Guidelines* (Department of Urban Affairs and Planning [DUAP] and the NSW Environment Protection Authority [EPA], 2011) and *Guidelines for Consultants Reporting on Contaminated Sites* (Office of Environment and Heritage (OEH, 2011)). As the investigation includes an acid sulfate soil (ASS) assessment, the *Acid Sulfate Soils – Assessment Guidelines* (Acid Sulfate Soil Management Advisory Committee (ASSMAC), 1998) has also been referenced.

This Stage 1 PSI:

- Describes the site conditions and surrounding environment;
- Reviews site history details;
- Identifies past and present potentially contaminating activities and potential contaminant types;
- Assesses soil sample analysis results against relevant criteria;
- Provides a preliminary assessment of the site contamination and characterisation of ASS;
- Assesses the need for further investigations and management of ASS; and
- Assesses the overall suitability of the site (from an environmental perspective) for the proposed low density residential development.

3 Methodology

This Stage 1 PSI has been undertaken to identify the potential for contamination at the site, and to characterise the ASS potential of soils at the property. A desktop review of site history information; and a site inspection including borehole investigations and soil sampling have been conducted as part of the investigation.

The desktop site history review included collating information from the following sources:

- Historical aerial photographs for the Ballina area;
- Historical Town and Parish Maps from the NSW Department of Land and Property Information (LPI);
- NSW Office of Environment and Heritage's (OEH) Protection of Environment Operations Act 1997 (POEO Act) Public Register;
- OEH's Contaminated Land – Record of Notices.

The site inspection and investigation included:

- An inspection of the site to identify point sources and areas of potential contamination; and
- Preliminary soil sampling in order to detect contamination hotspots and characterise the ASS potential of the site soils.

4 Site Identification

Table 1 provides identification details of the subject land relevant to the Stage 1 PSI.

Table 1: Site Identification Details

Site Address	12 Corks Lane, Ballina, NSW
Site Area	Total area proposed for residential development – approximately 9.1 ha (91,000 m^2) (information from Palm Lake Works).
Real Property Description	Part of Lot 2, DP1155600
Local Government Area	Ballina Shire Council
Zoning	RU2 – Rural Landscape – Ballina Local Environmental Plan (LEP) 2012. The objectives of this zone are (Figure 2, Attachment 1): - To encourage sustainable primary industry production by maintaining and enhancing the natural resource base. - To maintain the rural landscape character of the land. - To provide for a range of compatible land uses, including extensive agriculture. - To minimise the fragmentation and alienation of resource lands. - To minimise conflict between land uses within the zone and land uses within adjoining zones. - To enable small-scale tourist-orientated development that is compatible with the rural nature of the land. - To encourage development that involves restoration or enhancement (or both) of the natural environment if consistent with the production and landscape character of the land. - To enable development that does not adversely impact on the natural environment, including habitat and waterways. - To ensure that there is not unreasonable or uneconomic demands (or both) for the provision of public infrastructure.
Site Features	- Irregularly shaped block approximately 650 long x 300 m wide through its central portion. - Open, cleared grassland containing islands of remnant vegetation. - Generally flat and low lying. - Water channels running around the western site border and close to the eastern site border. These channels are likely to be tidally influenced by North Creek, which is approximately 130 m south-east of the site at its closest point.
Surrounding Environment	- Corks Lane borders the site to the west, while North Creek Road borders the site to the south-east. - The first stages of residential development which form part of Palm Lake Works' overall development on Corks Lane are situated immediately south-west of the subject property. - The Ballina Byron Gateway Airport is situated across Corks Lane to the north and north-west, with the terminal building approximately 1 km to the west-north-west at its closest point. - North Creek is situated 130 m to the south-east of the property at its closest point, and runs in an approximate north-south

	direction. The Creek is tidally influenced, and joins the Richmond River approximately 3 km south of the property.
Existing Land Use	None known (currently vacant)
Proposed Land Use	Low density residential dwellings
Topography	Between approximately 0 and 1 m Australian Height Datum (AHD) (Google Earth imagery). The site is relatively flat, with grades of less than 3%.
Soils	Typically a thin sandy topsoil, underlain by silty or clayey sand/sandy clay to below groundwater level (groundwater between approximately 0.2 and 0.8 m below the ground surface).
Groundwater Resources	A search of the NSW Office of Water Groundwater Bores online mapping shows 2 existing bores within 500 m of the subject site (refer to Figure 3, Attachment 1).
Surface Water	North Creek is situated 130 m to the south-east of the property at its closest point, and runs in an approximate north-south direction. The Creek is tidally influenced, and joins the Richmond River approximately 3 km south of the property. A number of small surface water channels run directly adjacent to the subject property (refer to Figures 8A and 8B, Attachment 1). These drains are expected to ultimately discharge into North Creek and be tidally influenced.
Flooding	Flood planning maps provided in the Ballina LEP (2012) indicate that the site is situated within a flood planning area associated with North Creek (Figure 4, Attachment 1). As such, development consent for the proposed development will be subject to flooding controls being implemented at the property. It is understood that Palm Lake Works intends to raise the surface level of the site by approximately 2 m through the addition of fill materials as part of the development.
Acid Sulfate Soils	Acid Sulfate Soil (ASS) risk maps provided in the Ballina LEP (2012) indicate that the site is Class 2 with respect to ASS (refer to Figure 5, Attachment 1). For this Class, any works which occur below the natural ground surface or which act to lower the water table require development consent. An ASS assessment forms part of this investigation, and characterises the ASS potential of soils at the subject property for management purposes during construction activities which will be required as part of the development.

5 Site Condition and Surrounding Environment

A desktop study was undertaken to establish the physical characteristics of the site and surrounding environment. This study was supplemented by site observations made during fieldwork conducted on 24 and 25 January 2018. Photographs taken during the site inspection and field program are presented in Attachment 2.

5.1 Site Description

The site is irregularly shaped, with an approximate area of 9.1 ha. The site is approximately 650 m from north to south, and approximately 300 m wide through its central portion.

The majority of the site has been cleared of native vegetation (low shrubs with some smaller trees), with open grass land remaining that is understood to be regularly slashed. Small islands of remnant vegetation exist in the central site portions and around the site perimeter. The site is low lying and relatively flat. Several shallow, artificial drains were present in a north-east to south-west direction throughout the majority of the site, spaced approximately 20 m apart. The drains have presumably been dug to assist with the drainage of surface water from the site.

A surface water channel runs along the entire length of the site's western boundary, and is likely to discharge into North Creek (south). A second channel runs close to the site's eastern boundary. Both channels are likely to be tidally influenced by the adjacent North Creek.

5.2 Surrounding Environment

Corks Lane borders the site to the west, while North Creek Road borders the site to the south-east.

The first stages of residential development which form part of Palm Lake Works' overall development on Corks Lane are situated immediately south-west of the subject property.

The Ballina Byron Gateway Airport is situated across Corks Lane to the north and north-west, with the terminal building approximately 1 km to the west-north-west at its closest point.

North Creek is situated 130 m to the south-east of the property at its closest point, and runs in an approximate north-south direction. The Creek is tidally influenced, and joins the Richmond River approximately 3 km south of the property.

The northern edge of the Ballina Central Business District (CBD) is situated approximately 1.8 km to the south-west of the property, while the major commercial and industrial precinct of Ballina is situated approximately 850 m to the south-west at its closest point.

5.3 Topography

The site is very low lying, with an elevation of between 0 and 1 m AHD. The site is relatively flat, with grades of less than 3%.

5.4 Groundwater Resources

A search for existing licensed groundwater bores was undertaken on 19 January 2018, using the NSW Department of Primary Industries (DPI) Office of Water – Groundwater Resources Map. The search indicated that there are two (2) groundwater bores located within 500 m of the subject site, approximately 400 m to the north-north-west (GW029610) and approximately 500 m to the south-west (GW305632) (Figure 3, Attachment 1). The bore licence for GW029610 is listed as being 'active', although it is not known whether the bore is still in use. The bore is listed as having been constructed for stock purposes (unknown date), to a depth of just 1.5 m, and screens a water bearing zone from 0.9 to 1.5 m. The salinity is listed as being between 0 and

500 ppm. The bore licence for GW305632 is also listed as being active, with the bore having been installed in 2006. No other details are provided for this bore on the licence.

5.5 Flooding

Flood planning maps provided in the Ballina LEP (2012) indicate that the site is situated in a flood planning area (Figure 4, Attachment 1). As such, development consent for the proposed development will be subject to flooding controls being implemented at the property. It is understood that Palm Lake Works intends to raise the surface level of the site by approximately 2 m through the addition of fill materials as part of the development.

5.6 Acid Sulfate Soils

ASS risk maps provided in the Ballina LEP (2012) indicate that the site is Class 2 with respect to ASS (refer to Figure 5, Attachment 1). For this Class, any works which occur below the natural ground surface or which act to lower the water table require development consent. An ASS assessment forms part of this investigation, and characterises the ASS potential of soils at the subject property for management purposes during construction activities which will be required as part of the development.

6 Site History

A desktop review of site history was undertaken to develop a picture of the history of site uses and development and potential sources and locations of any contamination. The findings of the desk-top site history assessment are summarised below.

6.1 Previous Environmental Investigations

No previous environmental investigations are known to have been conducted at the subject site.

6.2 Aerial Photographs

Historical aerial photographs from 1947, 1958 and 1979 were reviewed to evaluate potential historic occupation and use of the land. The resolution of each of the photographs made interpretation of the photos difficult, although there are no developments visible at the site in the photographs reviewed. Figures 6A, 6B and 6C (Attachment 1) present the aerial photographs from 1947, 1958 and 1979.

6.3 LPI Town and Parish Maps

The LPI Historical Land Records Viewer (HLRV) was used to locate available Town and Parish Maps for the Ballina area. The 1929 and the 1936 Parish Maps available for the

Ballina area suggest the land and surrounding areas have been part of broad-acre (larger) allotments, which may have been used for pastoral and possibly agricultural activities (Figure 7, Attachment 1).

6.4 POEO Act Public Register Search

The NSW EPA POEO Act Public Register contains information about environment protection licences, licence applications, notices issued under the POEO Act and pollution studies and reduction programs.

The EPA's POEO Act Public Register was searched for the area surrounding the subject property. Several licences are currently issued under the POEO Act for this area, with the two closest being an aquaculture and mariculture plant to the south-east of the site (adjacent to North Creek) and a non-thermal waste disposal facility approximately 1,500 m from the site (Ballina Shire Council landfill). The remaining licences are for sewerage treatment, land-based extraction, composting and hazardous waste disposal; all of which are greater than 2 km from the site. Given the nature and/or distance of these licensed activities from the site, they are expected to pose a negligible risk to the environmental quality of soils at the subject site.

The Register for unlicensed premises which are still regulated by the NSW EPA was also reviewed, with three premises which either formerly or currently manufacture cement products listed as being regulated by the EPA. The premises are all located more than 500 m from the subject property, and are therefore also expected to pose a negligible risk to the environmental quality of soils at the subject site.

6.5 Contaminated Land – Record of Notices Search

The OEH's Contaminated Land – Record of Notices was searched (accessed 19 January 2018) for the Ballina area. No records were found.

6.6 Cattle Dip Site Locator

The NSW DPI's cattle dip site locator was accessed on 23 January 2018. A search of the Ballina area indicated that there were five (5) cattle dips in the vicinity of the subject site. The two closest dip sites are 'Ballina' and 'North Creek', located approximately 3 km and 850 m, respectively, from the site. 'North Creek' has been remediated and is considered to pose a negligible risk to the environmental quality of the subject site. Given the distance of the other dip sites from the subject site, they are also expected to pose a negligible risk to the environmental quality of the subject site.

6.7 Areas of Environmental Concern and Potential Contaminants

Based on the desk-top site history assessment, the only plausible source of potential contaminants at the site is likely to be from previous agricultural use. Such use may have involved the application of persistent pesticides such as organochlorine pesticides (OCPs) and/or fertilisers to ground surfaces. Potential contaminants associated with these activities were adopted as chemicals of interest for the intrusive soil sampling program.

7 Preliminary Conceptual Site Model (CSM)

From the desktop study, a preliminary Conceptual Site Model (CSM) was developed to identify potential sources, exposure pathways and receptors of contamination at the subject site. This information is summarised in the following sub-sections.

7.1 Contamination Sources

Based on the desktop appraisal of site history and current site uses, potential contamination sources are considered to include the following:

- Previous agricultural use – application of persistent pesticides and/or fertilisers to ground surfaces.

7.2 Chemicals of Potential Concern

Based on the likely contamination source(s), the chemicals of potential concern (COPC) have been summarised in Table 2.

Table 2: Summary of COPC

Chemical	Comments
Organochlorine pesticides (OCPs)	Associated with insecticides used historically for pest control
Metals	Associated with pesticides and fertilisers

7.3 Potentially Affected Environmental Media

The chemicals of potential concern may affect the quality of soils at the site. Groundwater investigations were beyond the scope of this investigation.

7.4 Potential Exposure Pathways and Receptors of Contamination

Potential exposure pathways and receptors of contamination at the site are summarised in Table 3.

Table 3: Summary of Potential Exposure Pathways and Receptors of Contamination

Potential Exposure Pathway	Potential Receptor(s)
On Site	**On SIte**
Direct contact with contaminated soil	- Sub-surface workers - Future residents at the development
Inhalation of vapours from soil (volatile chemicals only)	- Sub-surface workers - Future residents at the development - Future visitors to the site (transient only)

8 Data Quality Objectives

8.1 Issues Identification

This investigation was conducted to assess the contamination status of soil beneath the site. The investigation provides information to support the DA for future residential development of the site. An ASS investigation was also conducted as part of the assessment – refer to Section 0 for further details.

8.2 Project Resources

The investigation was completed using the resources summarised in Table 4.

Table 4: Summary of Project Resources

Project Resource	Details
Site Developer	Palm Lake Works
Environmental Consultant	Craig Helbig (Senior Environmental Scientist/Toxicologist – ENV Solutions Pty Ltd (ENV))

8.3 Data Gaps and Sampling Objectives

The sampling objectives were to assess the soil quality and ASS potential beneath the site. It is understood that no previous soil investigations have been conducted at the site.

8.4 Required Information

To achieve the sampling objectives, soil data were collected by drilling boreholes and collecting shallow samples at strategic locations across the site.

No further information was required to achieve the project objectives for the contamination investigation.

8.5 Study Boundaries

The study boundaries for the recent investigation were the boundaries for the subject site, as shown on Figures 8A and 8B (Attachment 1). No works were undertaken beyond this area.

The subject site forms a part of Lot 2, DP1155600, representing approximately a third of the total lot area. The remaining portions of this lot have either been developed by Palm Lake Works for the same type of residential purpose as the subject site, or are proposed for the same type of development in the near future.

8.6 Analytical Approach (including QA samples)

Data from the soil investigation have been compared with the assessment criteria presented in Section 8.7. The precision (reproducibility), accuracy, representativeness and overall reliability of the data has been assessed using the performance criteria presented in Table 5. This included internal quality assurance (QA) testing conducted by the analytical laboratories and field QA testing (duplicate samples).

The QA sampling regime was adopted from the NEPM and from AS4482.1 Guide to the Investigation and Sampling of Sites with Potentially Contaminated Soil – Part 1: Non-volatile and semi-volatile compounds (2005); and Part 2: Volatile compounds (1999).

Table 5: Summary of Performance Criteria

QA Sample Type	Media	Frequency	Acceptable Range of Results
Precision (Reproducibility)			
Field Sampling			
Intra-and inter-laboratory duplicates	Soil	Approximately 1 duplicate sample per 13 composite samples analysed (soil) – 25 composite samples analysed in total	Soil: Relative percent difference (RPD) ≤50%
Laboratory Analysis			
Internal duplicate	Soil	1 per 10 primary samples	Laboratory specified, concentration dependent; Envirolab example: (RPD of any % for concentrations < 5 x LOR; RPD of 0-50% for concentrations > 5 x LOR)
Accuracy			
Laboratory Analysis			
Matrix Spikes	Soil	1 per sampling batch (20 samples per batch)	Laboratory specified; Envirolab example: 70-130% (inorganics); 60-140% (organics)
Surrogate Spikes	Soil	1 per sampling batch (20 samples per batch)	Laboratory specified; Envirolab example: 70-130% (inorganics); 60-140% (organics)
Laboratory Control Samples	Soil	1 per sampling batch (20 samples per batch)	Laboratory specified;

QA Sample Type	Media	Frequency	Acceptable Range of Results
			Envirolab example: 70-130% (inorganics); 60-140% (organics)
Representativeness			
Laboratory Analysis			
Laboratory Blank	Soil	1 per sampling batch (20 samples per batch)	Results <LOR

Where the reported QA data did not meet the specified performance criteria, the potential influence of the QA results has been discussed with respect to the precision, accuracy and representativeness of the primary data set.

8.7 Assessment Criteria

For the purpose of assessing site contamination, investigation levels from OEH's approved guidelines have been selected for the protection of human health and ecological impacts via exposure to contaminants.

OEH recommends using the NEPM for assessing soil and groundwater contamination, which includes a range of investigation and screening levels for various land uses that are designed to be used for guidance purposes to determine if further investigation is required (NEPC, 2013). For the purpose of this investigation, the following investigation and screening levels from *Schedule B(1) Guideline on Investigation Levels for Soil and Groundwater* (NEPC, 2013) have been adopted:

- Soil:
    - NEPM Health Investigation Levels (HILs) and Health Screening Levels (HSLs) exposure setting A (HIL A) for Residential (low density) land use, consistent with the proposed development; and
    - NEPM Ecological Investigation Levels (EILs) and Ecological Screening Levels (ESLs) for Residential land use.

Each of the investigation and screening levels were divided by four to account for the composite sampling. With respect to the EILs, the soils were reasonable assumed to have a mid-range Cation Exchange Capacity (CEC) of 30 cmol/kg, and a pH of 6.0 (refer to field pH measured as part of the peroxide screen testing - Table 6). For chromium, the clay content of the samples was assumed to be 5%.

The function of the NEPM investigation and screening levels is to be an indicator for contamination, and they are not to be used as maximum permissible levels that would preclude intended land uses. The NEPM recommends that further investigation and health risk assessments are undertaken where chemical concentrations in soil and/or groundwater exceed the screening levels presented in Schedule B(1).

For the purposes of the ASS investigation, the criteria presented in the Acid Sulfate Soils Assessment Guidelines (Acid Sulfate Soils Management Advisory Committee (ASSMAC), 1998 were used. The ASSMAC guidelines provide action criteria based on the volume and texture of soil to be disturbed.

8.8 Assumptions and Limitations of Assessment Criteria

The threshold and background levels contained in these documents have been established through toxicity tests and field and laboratory experiments. In some cases, insufficient data currently exist to provide thresholds. In these cases, the data are simply used as an indicator of the presence and extent of contamination.

For the contamination assessment, the HILs establish the concentration of a contaminant above which further appropriate health investigation and evaluation will be required. The HILs are derived from generic assumptions that are not necessarily applicable to a particular site. Concentrations slightly in excess of the HILs do not imply that a significant health risk is likely to be present; rather that further investigation is required to establish the degree of risk posed to potential receptors at the subject site.

The HSLs for soil has been derived from predictive vapour modelling of subsurface volatile compounds. The derivation process makes many assumptions regarding the behaviour of these compounds, which may not be consistent with the sub-surface conditions and consequent behaviour of these compounds at a particular site. Although the HSL methodology enables some parameter inputs to be adjusted to more accurately reflect local soil, site or building conditions, others cannot be adjusted and may affect the accuracy of the HSL adopted for the Tier 1 (screening level) assessment.

For the ASS investigation, the action criteria presented in the 1998 ASSMAC Guidelines have been derived based on both the texture of soil to be disturbed, and its volume.

8.9 Investigation Design Optimisation

The proposed sampling regime was designed principally to investigate the chemical quality and ASS potential of soil beneath the site. The regime was designed in consideration of guidance provided by the NSW EPA, as well as applicable Australian Standards.

9 Site Investigation – Contamination Assessment

9.1 Sampling and Analysis

Section 2.1 of the *Sampling Design Guidelines* (NSW EPA, 1995) states that a soil and groundwater sampling and analysis program may be required where preliminary investigations indicate possible sources of contamination. The National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended 2013 (the 'NEPM'; NEPC, 2013) provides similar guidance relating to site assessment. Given the potential for the site to have been used historically for agricultural purposes, contamination sampling and analysis were undertaken at the site.

A total of nineteen (19) boreholes were completed to a maximum depth of 2.0 m and surface samples collected from a further 81 locations, as shown on the Site Plan (Attachment 1, Figures 8A and 8B), in general accordance with the *Sampling Design Guidelines* (NSW EPA, 1995). The geological profile was logged in general accordance with the Unified Soil Classification System (USCS) and photographs taken of the site and sampling locations. Photographs are presented in Attachment 2.

The sampling locations were placed to provide even coverage across the site area, and were established using a grid of approximately 35 m. Some sample locations were moved in consideration of existing vegetation (with restricted access). The sampling density achieved met the minimum requirements of the *Sampling Design Guidelines* (EPA, 1995), which is 55 sampling points per 5 ha (extrapolated to 100 sampling points for 9.1 ha).

Soil samples were collected from the 19 boreholes at regular intervals of approximately 0.5 m to the maximum investigation depth (2.0 m) at each location, with some exceptions based on sample recovery and changes in lithology. The 81 shallow samples were collected by hand, using a shovel, from the top 150 mm of soil at each location.

A total of one hundred (100) primary soil samples were collected and sent to the analytical laboratory. Here, they were composited into 25 samples for analysis. This was considered to be an appropriate strategy because of the diffuse nature of contamination associated with broad-acre agricultural activities. Two intra-laboratory and two inter-laboratory duplicate samples were also collected with primary samples from borehole S82 (0.2-0.2 m) (QC1, QC2) and S4 (QC3, QC4).

9.2 Sampling Methodology and Field Quality Assurance/Quality Control (QA/QC)

Soil samples were collected in the field by appropriately qualified Environmental Scientists from ENV. Using fresh disposable gloves, soil samples were collected by hand either directly from the auger length (19 boreholes) or from spoil brought to the surface by hand or using a shovel (81 shallow sampling locations). Samples were sealed in glass sample jars (supplied by the laboratory) and chilled prior to dispatch to the laboratory.

The reusable sampling equipment (solid flight augers and shovel) was cleaned by scraping to remove gross cuttings, and then washing with potable water.

All samples were stored in an iced cool box and transported to Environmental Analysis Laboratory (EAL) in Lismore, NSW or Eurofins MGT in Sydney, NSW using Chain of Custody (COC) documentation for the specified testing (refer Attachment 3).

The relative percent differences (RPDs) calculated between the two primary samples and their corresponding duplicate samples are discussed in Section 9.4.1.

9.3 Subsurface Conditions

The soils encountered comprised predominantly of a thin profile of sandy topsoil (up to approximately 0.2 m bgl, with some exceptions), underlain by silty or clayey sand/sandy clay to below groundwater level (groundwater between approximately 0.2 and 0.8 m below the ground surface). The plasticity of the fines in these soils ranged from low to medium, with a fine to medium grain size noted for the sand in the matrix. The colour of the soils ranged from dark brown (topsoil) to grey brown (sandy clay and clayey/silty sand profiles).

No surface staining, non-natural odours or others indicators of potential contamination such as stressed vegetation were noted during the investigation.

Sulfidic odours were noted in soils encountered in most of the 19 boreholes drilled as part of the investigation. The odours were generally present in soils close to and below groundwater level, and ranged from 'slight' to 'strong'. Sulfidic odours were not noted in the shallows soils within the boreholes, or during the surface soil sampling program.

Groundwater was encountered in each of the 19 boreholes drilled as part of the investigation. Groundwater was present at depths ranging between 0.2 m below ground level (m bgl) (several boreholes, including S3, S6 and S36) and 0.8 m bgl (S31, S53 and S56).

9.4 Laboratory Analysis Results

Soil sample laboratory analysis results are tabulated and presented in Attachment 3, together with the RPD calculations for the duplicate samples. Laboratory certificates are also provided in Attachment 3.

9.4.1 Quality Assurance/Quality Control

Duplicate Samples

The RPD between primary soil samples S82_0.2-0.5 m and S4; and their corresponding intra-laboratory and inter-laboratory duplicate samples QC1/QC2 and QC3/QC4, respectively; was calculated to assess the level of reproducibility in the laboratory results. The RPD results are tabulated in Attachment 3.

The calculated RPDs for these duplicate pairs indicated that the RPDs were less than the acceptable threshold of 50% for all analytes tested. RPDs could not be calculated for some metals and OCPs, which were reported at concentrations less than the laboratory LOR in one or both duplicate pair samples. The RPDs are considered to indicate an acceptable level of reproducibility in the sample concentrations.

Internal Laboratory QA Testing

The results of the internal laboratory QA testing were reviewed and were considered acceptable for the purposes of the investigation.

9.4.2 Primary Samples

The primary sample results are tabulated in Attachment 3.

The results indicate that concentrations of each of the analytes tested were less than the composite level investigation and screening levels adopted for the investigation.

10 Site Investigation – Acid Sulfate Soils (ASS) Assessment

10.1 Sampling and Analysis

The ASS investigation was undertaken because of the ASS risk (Class 2 soils) attributed to the soils on the mapping including in the Ballina LEP (2012). The ASS investigation was conducted concurrently with the contamination assessment, and involved the collection of samples from each of the 19 boreholes drilled across the site. The borehole locations are presented on Figures 8A and 8B, Attachment 1. This number of boreholes meets the minimum density required by the ASSMAC 1998 Guidelines, which is two boreholes per ha (total site area investigation was 9.1 ha).

The samples were collected from spoil recovered during the drilling process approximately every 0.5 m to the maximum investigation depth (2.0 m), with some exceptions based on changes in lithology and sample recovery. The geological profile was logged in general accordance with the USCS and photographs taken of selected sampling locations. Photographs are presented in Attachment 2.

All samples were frozen overnight before being transported to the analytical laboratory (EAL, Lismore) with accompanying COC documentation. Each of the 95 samples collected were subjected to field peroxide screening, and then 25 of these samples were analysed for ASS using the chromium suite testing method, based on the peroxide testing results. This number of samples meets the requirements of the ASSMAC Guidelines (1998), which is that a minimum of 25% of the samples that are subjected to field peroxide screening be tested using the chromium suite or Suspension Peroxide Oxidation Combined Activity and Sulfur (SPOCAS) method. The samples selected were those reported by the lab with one or more of the folowing characteristics: a vigorous reaction with peroxide (indicating the presence of organics or sulfur which were oxidised by the peroxide), a large pH change when peroxide was added to the soil (indicating the same as above) or a low measured pH prior to the addition of peroxide (indicating the potential presence of actual acid sulfate soils (AASS), or sulfides which have already been oxidised in the soil).

10.2 Sampling Methodology and Field Quality Assurance/Quality Control (QA/QC)

Soil samples for ASS analysis were collected in the field by appropriately qualified Environmental Scientists from ENV. Using fresh disposable gloves, soil samples were collected by hand directly from the auger length after it was removed from the ground. The samples were sealed in new zip-lock plastic bags, with as much air excluded from the bag as possible (to minimise the potential oxidation of any sulfides in the samples) and chilled in an esky using ice, prior to being frozen overnight and then dispatched to the laboratory the next day.

The reusable sampling equipment (solid flight augers) was cleaned by scraping to remove gross cuttings, and then washing with high pressure potable water.

All samples were stored in an iced cool box and transported frozen to Environmental Analysis Laboratory (EAL) in Lismore, NSW using COC documentation for the specified testing (refer Attachment 3).

10.3 Subsurface Conditions

The subsurface conditions encountered during the borehole investigation are summarised in Section 9.3.

10.4 Laboratory Analysis Results

10.4.1 Peroxide Screening Results

The laboratory peroxide screening results (refer to Table 6) indicate that the lowest pH_{FOX} and greatest drop in pH measurements following oxidation of the samples with peroxide were generally reported for samples collected in the top 0.5 m of the profile, and from the deeper profiles (1.5 to 2.0 m). The topsoil samples from the surface at each location were generally collected from immediately below grass roots and other surface vegetation. Many of these samples were noted to contain a high proportion of organic matter such as leaf litter and grass and shrub roots, which may have lead to pH results which were biased low, as the organic matter is oxidised by the peroxide in preference to inorganic sulfides present in the soil. The samples collected from the deeper soil profiles did not contain observable organic matter, therefore the low pH_{FOX} measurements and large changes in pH following peroxide oxidation were more likely to be associated with the presence of inorganic sulfides.

Notwithstanding the above, a total of 24 samples from the surface profiles, middle and deeper profiles, were subjected to testing for ASS via the chromium suite method (refer to Section 10.4.2).

Table 6: Summary of Acid Sulfate Soil (ASS) Field Screening Results

Sample Identification	EAL Lab Code	Texture	Moisture Content		pH_F and pH_{FOX}			
			(% moisture of total wet weight)	(g moisture / g of oven dry soil)	pH_F	pH_{FOX}	pH change	Reaction
Method Info.		**	**		*(In-house method S21)*			
S12 0-0.1	G6862/1	Medium	19.6	0.24	5.72	2.08	-3.64	Low
S12 0.5-0.6	G6862/2	Medium	22.2	0.29	4.46	1.87	-2.59	Very High
S12 1.0-1.1	G6862/3	Medium	22.6	0.29	4.54	2.02	-2.52	Very High
S12 1.5-1.6	G6862/4	Medium	23.8	0.31	5.19	2.06	-3.13	Very High
S12 1.9-2.0	G6862/5	Medium	21.9	0.28	5.16	2.14	-3.02	Very High
S6 0-0.1	G6862/6	Medium	22.2	0.29	6.76	1.94	-4.82	Low
S6 0.5-0.6	G6862/7	Medium	23.1	0.30	5.63	2.01	-3.62	Very High
S6 1.0-1.1	G6862/8	Medium	22.0	0.28	5.34	1.87	-3.47	Very High
S6 1.5-1.6	G6862/9	Medium	21.5	0.27	5.24	1.97	-3.27	Very High
S6 1.9-2.0	G6862/10	Medium	22.2	0.29	6.15	2.01	-4.14	Very High
S3 0-0.1	G6862/11	Medium	22.0	0.28	7.14	3.76	-3.38	Medium
S3 0.5-0.6	G6862/12	Medium	22.9	0.30	7.12	1.70	-5.42	Low
S3 1.0-1.1	G6862/13	Medium	22.6	0.29	6.09	1.96	-4.13	Very High
S3 1.5-1.6	G6862/14	Medium	20.6	0.26	6.92	2.08	-4.84	Very High
S3 1.9-2.0	G6862/15	Medium	22.8	0.30	7.02	2.14	-4.88	Low
S21 0-0.1	G6862/16	Medium	21.2	0.27	7.20	3.86	-3.34	Medium
S21 0.5-0.6	G6862/17	Coarse	18.5	0.23	7.95	3.28	-4.67	Low
S21 1.0-1.1	G6862/18	Coarse	22.5	0.29	5.76	2.14	-3.62	Very High
S21 1.5-1.6	G6862/19	Coarse	20.4	0.26	6.98	2.15	-4.83	Very High
S21 1.9-2.0	G6862/20	Coarse	20.3	0.25	7.21	2.26	-4.95	Very High
S26 0-0.1	G6862/21	Fine	29.3	0.41	7.18	4.08	-3.10	Medium
S26 0.5-0.6	G6862/22	Fine	22.8	0.30	7.07	4.01	-3.06	Medium
S26 1.0-1.1	G6862/23	Medium	22.2	0.29	5.95	2.06	-3.89	Very High
S26 1.5-1.6	G6862/24	Medium	22.8	0.29	5.32	2.04	-3.28	Very High
S26 1.9-2.0	G6862/25	Medium	20.2	0.25	6.22	2.11	-4.11	Low
SA2 0-0.1	G6862/26	Medium	19.7	0.25	6.54	3.70	-2.84	Medium
SA2 0.5-0.6	G6862/27	Medium	21.0	0.27	6.33	3.74	-2.59	Medium
SA2 1.0-1.1	G6862/28	Medium	21.5	0.27	5.29	2.03	-3.26	Very High
SA2 1.5-1.6	G6862/29	Coarse	20.6	0.26	5.16	2.34	-2.82	Very High
SA2 1.9-2.0	G6862/30	Medium	22.4	0.29	5.64	2.36	-3.28	Very High

S36 0-0.1	*G6862/31*	Medium	20.2	0.25	5.73	2.68	-3.05	Medium
S36 0.5-0.6	*G6862/32*	Medium	21.3	0.27	5.58	2.04	-3.54	Low
S36 1.0-1.1	*G6862/33*	Medium	25.7	0.35	5.68	1.91	-3.77	Very High
S36 1.5-1.6	*G6862/34*	Medium	24.0	0.32	5.78	2.04	-3.74	Very High
S36 1.9-2.0	*G6862/35*	Medium	23.4	0.31	5.87	2.03	-3.84	Very High
S53 0-0.1	*G6862/36*	Fine	20.9	0.26	5.18	2.48	-2.70	Medium
S53 0.5-0.6	*G6862/37*	Medium	20.4	0.26	6.47	2.84	-3.63	Medium
S53 1.0-1.1	*G6862/38*	Medium	23.6	0.31	5.56	2.00	-3.56	Very High
S53 1.5-1.6	*G6862/39*	Medium	23.1	0.30	6.05	2.07	-3.98	Very High
S53 1.9-2.0	*G6862/40*	Medium	21.9	0.28	6.12	2.10	-4.02	Low
S31 0-0.1	*G6862/41*	Fine	20.7	0.26	5.08	2.80	-2.28	Very High
S31 0.5-0.6	*G6862/42*	Medium	18.4	0.22	5.23	2.93	-2.30	Low
S31 1.0-1.1	*G6862/43*	Medium	21.2	0.27	4.34	2.08	-2.26	Medium
S31 1.5-1.6	*G6862/44*	Medium	23.7	0.31	4.71	2.10	-2.61	Low
S31 1.9-2.0	*G6862/45*	Medium	21.6	0.28	4.76	2.11	-2.65	High
S50 0-0.1	*G6862/46*	Medium	27.9	0.39	4.67	3.08	-1.59	Medium
S50 0.5-0.6	*G6862/47*	Medium	19.6	0.24	4.94	2.83	-2.11	Medium
S50 1.0-1.1	*G6862/48*	Medium	20.1	0.25	4.96	2.85	-2.11	Medium
S50 1.5-1.6	*G6862/49*	Medium	22.8	0.30	4.49	1.98	-2.51	Very High
S50 1.9-2.0	*G6862/50*	Medium	21.7	0.28	4.64	1.99	-2.65	Very High
S56 0-0.1	*G6862/51*	Medium	27.7	0.38	4.81	2.81	-2.00	Very High
S56 0.5-0.6	*G6862/52*	Fine	23.7	0.31	4.79	3.04	-1.75	Medium
S56 1.0-1.1	*G6862/53*	Fine	21.9	0.28	4.76	2.69	-2.07	Medium
S56 1.5-1.6	*G6862/54*	Medium	23.2	0.30	4.95	2.87	-2.08	Low
S56 1.9-2.0	*G6862/55*	Fine	21.6	0.27	4.71	2.22	-2.49	Very High
S70 0-0.1	*G6862/56*	Fine	23.6	0.31	5.35	3.95	-1.40	Medium
S70 0.5-0.6	*G6862/57*	Medium	21.9	0.28	7.37	5.29	-2.08	Medium
S70 1.0-1.1	*G6862/58*	Medium	22.3	0.29	6.90	2.26	-4.64	Very High
S70 1.5-1.6	*G6862/59*	Medium	22.2	0.29	6.05	2.17	-3.88	Very High
S70 1.9-2.0	*G6862/60*	Medium	22.3	0.29	6.22	2.24	-3.98	Very High
S73 0-0.1	*G6862/61*	Medium	29.4	0.42	6.26	2.00	-4.26	Very High
S73 0.5-0.6	*G6862/62*	Medium	18.1	0.22	4.80	2.70	-2.10	Medium
S73 1.0-1.1	*G6862/63*	Medium	21.4	0.27	4.87	3.27	-1.60	Low
S73 1.5-1.6	*G6862/64*	Medium	22.5	0.29	5.16	2.80	-2.36	Low
S73 1.9-2.0	*G6862/65*	Medium	20.4	0.26	4.62	2.28	-2.34	Very high

S67 0-0.1	*G6862/66*	Medium	17.0	0.20	5.08	3.04	-2.04	Low
S67 0.5-0.6	*G6862/67*	Coarse	15.2	0.18	5.76	3.69	-2.07	Medium
S67 1.0-1.1	*G6862/68*	Coarse	15.6	0.18	6.03	3.52	-2.51	Medium
S67 1.5-1.9	*G6862/69*	Medium	20.3	0.25	4.68	1.95	-2.73	Very high
S67 1.9-2.0	*G6862/70*	Medium	20.1	0.25	5.16	2.12	-3.04	Very high
S83 0-0.1	*G6862/71*	Medium	17.4	0.21	4.85	2.61	-2.24	Medium
S83 0.5-0.6	*G6862/72*	Medium	16.8	0.20	5.38	3.18	-2.20	Low
S83 1.0-1.1	*G6862/73*	Coarse	16.6	0.20	5.57	3.28	-2.29	Low
S83 1.5-1.6	*G6862/74*	Medium	20.9	0.26	4.38	2.43	-1.95	Very high
S83 1.9-2.0	*G6862/75*	Medium	20.7	0.26	4.99	2.21	-2.78	Very high
S82 0-0.1	*G6862/76*	Fine	18.9	0.23	4.81	2.64	-2.17	Low
S82 0.5-0.6	*G6862/77*	Coarse	13.4	0.16	4.95	2.78	-2.17	Low
S82 1.0-1.1	*G6862/78*	Medium	22.0	0.28	4.46	2.37	-2.09	Very high
S82 1.5-1.6	*G6862/79*	Medium	19.7	0.25	4.21	2.31	-1.90	Very high
S82 1.9-2.0	*G6862/80*	Medium	21.6	0.27	4.55	2.39	-2.16	Very high
S97 0-0.1	*G6862/81*	Medium	21.3	0.27	4.72	2.44	-2.28	High
S97 0.5-0.6	*G6862/82*	Medium	17.9	0.22	5.41	3.40	-2.01	Medium
S97 1.0-1.1	*G6862/83*	Medium	20.1	0.25	4.87	2.83	-2.04	Very high
S97 1.5-1.6	*G6862/84*	Coarse	21.7	0.28	4.85	2.33	-2.52	Very high
S97 1.9-2.0	*G6862/85*	Coarse	20.5	0.26	5.05	2.43	-2.62	Very high
S86 0-0.1	*G6862/86*	Coarse	14.3	0.17	5.05	2.99	-2.06	Low
S86 0.5-0.6	*G6862/87*	Medium	19.3	0.24	5.20	3.21	-1.99	Medium
S86 1.0-1.1	*G6862/88*	Medium	21.5	0.27	5.02	2.64	-2.38	Very high
S86 1.5-1.6	*G6862/89*	Medium	20.8	0.26	4.97	2.31	-2.66	Very high
S86 1.9-2.0	*G6862/90*	Medium	20.5	0.26	5.01	2.66	-2.35	Very high
S91 0-0.1	*G6862/91*	Medium	25.4	0.34	4.65	3.32	-1.33	Very high
S91 0.5-0.6	*G6862/92*	Coarse	14.8	0.17	5.50	3.47	-2.03	Medium
S91 1.0-1.1	*G6862/93*	Medium	19.5	0.24	5.11	2.74	-2.37	Very high
S91 1.5-1.6	*G6862/94*	Coarse	20.9	0.26	4.77	2.72	-2.05	Very high
S91 1.9-2.0	*G6862/95*	Coarse	21.5	0.27	4.80	2.33	-2.47	Very high

Abbreviations:

pH_F = Field pH

pH_{FOX} = pH after addition of hydrogen peroxide

10.4.2 Chromium Suite Method Results

The laboratory certificate and associated documentation are presented in Attachment 3. Tabulated results are also presented below in Table 7.

Table 7: Summary of Chromium Suite Testing Results

Sample Identification	EAL Lab Code	Texture	Moisture Content		pH$_F$ and pH$_{FOX}$				KCl-extractable sulfur (S_{KCl})		Potential Sulfidic Acidity (Chromium Reducible Sulfur - CRS)		Actual Acidity (Titratable Actual Acidity - TAA)		Retained Acidity (% S_{KCl} – % S_{KCl})		Acid Neutralising Capacity (ANC_{BT})		Net Acidity (based on S_{CR})	Lime Calculation
			(% moisture of total wet weight)	(g moisture / g of oven dry soil)	pH$_F$	pH$_{FOX}$	pH change	Reaction	(% S_{KCl})	(equiv. mol H$^+$/t)	(% S_{Cr})	(mol H$^+$/t)	pH$_{KCl}$	(mol H$^+$/t)	(%S_{NAS})	(mol H$^+$/t)	(% $CaCO_3$)	(mol H$^+$/t)	(mol H$^+$/t)	(kg CaCO3/t DW)
Method Info.		**	**		*(In-house method S21)*				**		*(In-house method S20)*		*(In-house method 16b)*		**		*(In-house method S14)*		**	**
S12 0-0.1	G6862/1	Medium	19.6	0.24	5.72	2.08	-3.64	Low	..	..	..	..	..	..	..	..	..	..	..	..
S12 0.5-0.6	G6862/2	Medium	22.2	0.29	4.46	1.87	-2.59	Very High	..	..	..	..	..	..	..	..	..	..	..	..
S12 1.0-1.1	G6862/3	Medium	22.6	0.29	4.54	2.02	-2.52	Very High	..	..	..	..	..	..	..	..	..	..	..	..
S12 1.5-1.6	G6862/4	Medium	23.8	0.31	5.19	2.06	-3.13	Very High	..	..	0.296	185	4.79	8	..	..	..	..	193	14.5
S12 1.9-2.0	G6862/5	Medium	21.9	0.28	5.16	2.14	-3.02	Very High	..	..	..	..	..	..	..	..	..	..	..	..
S6 0-0.1	G6862/6	Medium	22.2	0.29	6.76	1.94	-4.82	Low	..	..	..	..	..	..	..	..	..	..	..	..
S6 0.5-0.6	G6862/7	Medium	23.1	0.30	5.63	2.01	-3.62	Very High	..	..	..	..	..	..	..	..	..	..	..	..
S6 1.0-1.1	G6862/8	Medium	22.0	0.28	5.34	1.87	-3.47	Very High	..	..	..	..	..	..	..	..	..	..	..	..
S6 1.5-1.6	G6862/9	Medium	21.5	0.27	5.24	1.97	-3.27	Very High	..	..	..	..	..	..	..	..	..	..	..	..
S6 1.9-2.0	G6862/10	Medium	22.2	0.29	6.15	2.01	-4.14	Very High	..	..	0.373	233	5.52	3	..	..	..	..	235	17.6
S3 0-0.1	G6862/11	Medium	22.0	0.28	7.14	3.76	-3.38	Medium	..	..	0.012	7	6.23	2	..	..	..	..	9	0.7
S3 0.5-0.6	G6862/12	Medium	22.9	0.30	7.12	1.70	-5.42	Low	..	..	..	..	..	..	..	..	..	..	..	..
S3 1.0-1.1	G6862/13	Medium	22.6	0.29	6.09	1.96	-4.13	Very High	..	..	..	..	..	..	..	..	..	..	..	..
S3 1.5-1.6	G6862/14	Medium	20.6	0.26	6.92	2.08	-4.84	Very High	..	..	0.279	174	5.77	2	..	..	..	..	176	13.2
S3 1.9-2.0	G6862/15	Medium	22.8	0.30	7.02	2.14	-4.88	Low	..	..	..	..	..	..	..	..	..	..	..	..
S21 0-0.1	G6862/16	Medium	21.2	0.27	7.20	3.86	-3.34	Medium	..	..	..	..	..	..	..	..	..	..	..	..
S21 0.5-0.6	G6862/17	Coarse	18.5	0.23	7.95	3.28	-4.67	Low	..	..	..	..	..	..	..	..	..	..	..	..
S21 1.0-1.1	G6862/18	Coarse	22.5	0.29	5.76	2.14	-3.62	Very High	..	..	..	..	..	..	..	..	..	..	..	..
S21 1.5-1.6	G6862/19	Coarse	20.4	0.26	6.98	2.15	-4.83	Very High	..	..	..	..	..	..	..	..	..	..	..	..
S21 1.9-2.0	G6862/20	Coarse	20.3	0.25	7.21	2.26	-4.95	Very High	..	..	0.217	135	6.07	2	..	..	..	..	137	10.3
S26 0-0.1	G6862/21	Fine	29.3	0.41	7.18	4.08	-3.10	Medium	..	..	0.009	6	6.48	1	..	..	..	..	7	0.5
S26 0.5-0.6	G6862/22	Fine	22.8	0.30	7.07	4.01	-3.06	Medium	..	..	..	..	..	..	..	..	..	..	..	..
S26 1.0-1.1	G6862/23	Medium	22.2	0.29	5.95	2.06	-3.89	Very High	..	..	0.230	143	5.15	6	..	..	..	..	150	11.2
S26 1.5-1.6	G6862/24	Medium	22.8	0.29	5.32	2.04	-3.28	Very High	..	..	..	..	..	..	..	..	..	..	..	..
S26 1.9-2.0	G6862/25	Medium	20.2	0.25	6.22	2.11	-4.11	Low	..	..	..	..	..	..	..	..	..	..	..	..
SA2 0-0.1	G6862/26	Medium	19.7	0.25	6.54	3.70	-2.84	Medium	..	..	..	..	..	..	..	..	..	..	..	..
SA2 0.5-0.6	G6862/27	Medium	21.0	0.27	6.33	3.74	-2.59	Medium	..	..	..	..	..	..	..	..	..	..	..	..
SA2 1.0-1.1	G6862/28	Medium	21.5	0.27	5.29	2.03	-3.26	Very High	..	..	0.251	157	4.81	8	..	..	..	..	164	12.3
SA2 1.5-1.6	G6862/29	Coarse	20.6	0.26	5.16	2.34	-2.82	Very High	..	..	..	..	..	..	..	..	..	..	..	..
SA2 1.9-2.0	G6862/30	Medium	22.4	0.29	5.64	2.36	-3.28	Very High	..	..	..	..	..	..	..	..	..	..	..	..
S36 0-0.1	G6862/31	Medium	20.2	0.25	5.73	2.68	-3.05	Medium	..	..	..	..	..	..	..	..	..	..	..	..
S36 0.5-0.6	G6862/32	Medium	21.3	0.27	5.58	2.04	-3.54	Low	..	..	..	..	..	..	..	..	..	..	..	..
S36 1.0-1.1	G6862/33	Medium	25.7	0.35	5.68	1.91	-3.77	Very High	..	..	..	..	..	..	..	..	..	..	..	..
S36 1.5-1.6	G6862/34	Medium	24.0	0.32	5.78	2.04	-3.74	Very High	..	..	..	..	..	..	..	..	..	..	..	..
S36 1.9-2.0	G6862/35	Medium	23.4	0.31	5.87	2.03	-3.84	Very High	..	..	0.448	279	4.60	15	..	..	..	..	295	22.1
S53 0-0.1	G6862/36	Fine	20.9	0.26	5.18	2.48	-2.70	Medium	0.005	3	<0.005	0	4.33	62	0.011	5	..	..	67	5.0
S53 0.5-0.6	G6862/37	Medium	20.4	0.26	6.47	2.84	-3.63	Medium	..	..	..	..	..	..	..	..	..	..	..	..
S53 1.0-1.1	G6862/38	Medium	23.6	0.31	5.56	2.00	-3.56	Very High	..	..	..	..	..	..	..	..	..	..	..	..
S53 1.5-1.6	G6862/39	Medium	23.1	0.30	6.05	2.07	-3.98	Very High	..	..	..	..	..	..	..	..	..	..	..	..
S53 1.9-2.0	G6862/40	Medium	21.9	0.28	6.12	2.10	-4.02	Low	..	..	..	..	..	..	..	..	..	..	..	..

Sample Identification	EAL Lab Code	Texture	Moisture Content		pH$_F$ and pH$_{FOX}$				KCl-extractable sulfur (S_{KCl})		Potential Sulfidic Acidity (Chromium Reducible Sulfur - CRS)		Actual Acidity (Titratable Actual Acidity - TAA)		Retained Acidity (S_{KCl} – S_{TAA})		Acid Neutralising Capacity (ANC_{BT})		Net Acidity (based on S_{CR})	Lime Calculation
			(% moisture of total wet weight)	(g moisture / g of oven dry soil)	pH$_F$	pH$_{FOX}$	pH change	Reaction	(% S_{KCl})	(equiv. mol H$^+$/t)	(% S_{CR})	(mol H$^+$/t)	pH$_{KCl}$	(mol H$^+$/t)	(%S_{NAS})	(mol H$^+$/t)	(% $CaCO_3$)	(mol H$^+$/t)	(mol H$^+$/t)	(kg CaCO3/t DW)
S31 0-0.1	*G6862/41*	Fine	20.7	0.26	5.08	2.80	-2.28	Very High	..	..	..	..	..	..	..	..	..	..	..	..
S31 0.5-0.6	*G6862/42*	Medium	18.4	0.22	5.23	2.93	-2.30	Low	..	..	..	..	..	..	..	..	..	..	..	..
S31 1.0-1.1	*G6862/43*	Medium	21.2	0.27	4.34	2.08	-2.26	Medium	..	..	..	..	..	..	..	..	..	..	..	..
S31 1.5-1.6	*G6862/44*	Medium	23.7	0.31	4.71	2.10	-2.61	Low	..	..	..	..	..	..	..	..	..	..	..	..
S31 1.9-2.0	*G6862/45*	Medium	21.6	0.28	4.76	2.11	-2.65	High	0.008	5	0.311	194	4.40	25	0.005	2	..	..	222	16.6
S50 0-0.1	*G6862/46*	Medium	27.9	0.39	4.67	3.08	-1.59	Medium	..	..	..	..	..	..	..	..	..	..	..	..
S50 0.5-0.6	*G6862/47*	Medium	19.6	0.24	4.94	2.83	-2.11	Medium	0.001	0	0.008	5	4.38	62	0.006	3	..	..	70	5.2
S50 1.0-1.1	*G6862/48*	Medium	20.1	0.25	4.96	2.85	-2.11	Medium	..	..	..	..	..	..	..	..	..	..	..	..
S50 1.5-1.6	*G6862/49*	Medium	22.8	0.30	4.49	1.98	-2.51	Very High	..	..	..	..	..	..	..	..	..	..	..	..
S50 1.9-2.0	*G6862/50*	Medium	21.7	0.28	4.64	1.99	-2.65	Very High	0.000	0	0.301	188	4.56	13	..	..	..	..	201	15.1
S56 0-0.1	*G6862/51*	Medium	27.7	0.38	4.81	2.81	-2.00	Very High	..	..	..	..	..	..	..	..	..	..	..	..
S56 0.5-0.6	*G6862/52*	Fine	23.7	0.31	4.79	3.04	-1.75	Medium	0.001	0	0.006	4	4.20	111	0.008	4	..	..	118	8.9
S56 1.0-1.1	*G6862/53*	Fine	21.9	0.28	4.76	2.69	-2.07	Medium	..	..	..	..	..	..	..	..	..	..	..	..
S56 1.5-1.6	*G6862/54*	Medium	23.2	0.30	4.95	2.87	-2.08	Low	..	..	..	..	..	..	..	..	..	..	..	..
S56 1.9-2.0	*G6862/55*	Fine	21.6	0.27	4.71	2.22	-2.49	Very High	..	..	..	..	..	..	..	..	..	..	..	..
S70 0-0.1	*G6862/56*	Fine	23.6	0.31	5.35	3.95	-1.40	Medium	..	..	..	..	..	..	..	..	..	..	..	..
S70 0.5-0.6	*G6862/57*	Medium	21.9	0.28	7.37	5.29	-2.08	Medium	..	..	..	..	..	..	..	..	..	..	..	..
S70 1.0-1.1	*G6862/58*	Medium	22.3	0.29	6.90	2.26	-4.64	Very High	0.000	0	0.566	353	5.25	8	..	..	..	..	361	27.1
S70 1.5-1.6	*G6862/59*	Medium	22.2	0.29	6.05	2.17	-3.88	Very High	..	..	..	..	..	..	..	..	..	..	..	..
S70 1.9-2.0	*G6862/60*	Medium	22.3	0.29	6.22	2.24	-3.98	Very High	..	..	..	..	..	..	..	..	..	..	..	..
S73 0-0.1	*G6862/61*	Medium	29.4	0.42	6.26	2.00	-4.26	Very High	0.002	1	0.019	12	4.21	170	0.012	6	..	..	188	14.1
S73 0.5-0.6	*G6862/62*	Medium	18.1	0.22	4.80	2.70	-2.10	Medium	..	..	..	..	..	..	..	..	..	..	..	..
S73 1.0-1.1	*G6862/63*	Medium	21.4	0.27	4.87	3.27	-1.60	Low	..	..	..	..	..	..	..	..	..	..	..	..
S73 1.5-1.6	*G6862/64*	Medium	22.5	0.29	5.16	2.80	-2.36	Low	..	..	..	..	..	..	..	..	..	..	..	..
S73 1.9-2.0	*G6862/65*	Medium	20.4	0.26	4.62	2.28	-2.34	Very high	..	..	..	..	..	..	..	..	..	..	..	..
S67 0-0.1	*G6862/66*	Medium	17.0	0.20	5.08	3.04	-2.04	Low	..	..	..	..	..	..	..	..	..	..	..	..
S67 0.5-0.6	*G6862/67*	Coarse	15.2	0.18	5.76	3.69	-2.07	Medium	..	..	..	..	..	..	..	..	..	..	..	..
S67 1.0-1.1	*G6862/68*	Coarse	15.6	0.18	6.03	3.52	-2.51	Medium	..	..	..	..	..	..	..	..	..	..	..	..
S67 1.5-1.9	*G6862/69*	Medium	20.3	0.25	4.68	1.95	-2.73	Very high	..	..	..	..	..	..	..	..	..	..	..	..
S67 1.9-2.0	*G6862/70*	Medium	20.1	0.25	5.16	2.12	-3.04	Very high	..	..	0.545	340	4.63	15	..	..	..	..	355	26.6
S83 0-0.1	*G6862/71*	Medium	17.4	0.21	4.85	2.61	-2.24	Medium	..	..	..	..	..	..	..	..	..	..	..	..
S83 0.5-0.6	*G6862/72*	Medium	16.8	0.20	5.38	3.18	-2.20	Low	..	..	..	..	..	..	..	..	..	..	..	..
S83 1.0-1.1	*G6862/73*	Coarse	16.6	0.20	5.57	3.28	-2.29	Low	..	..	..	..	..	..	..	..	..	..	..	..
S83 1.5-1.6	*G6862/74*	Medium	20.9	0.26	4.38	2.43	-1.95	Very high	..	..	..	..	..	..	..	..	..	..	..	..
S83 1.9-2.0	*G6862/75*	Medium	20.7	0.26	4.99	2.21	-2.78	Very high	..	..	0.357	223	4.62	20	..	..	..	..	242	18.2
S82 0-0.1	*G6862/76*	Fine	18.9	0.23	4.81	2.64	-2.17	Low	..	..	..	..	..	..	..	..	..	..	..	..
S82 0.5-0.6	*G6862/77*	Coarse	13.4	0.16	4.95	2.78	-2.17	Low	..	..	..	..	..	..	..	..	..	..	..	..
S82 1.0-1.1	*G6862/78*	Medium	22.0	0.28	4.46	2.37	-2.09	Very high	0.013	8	0.478	298	4.48	28	0.004	2	..	..	328	24.6
S82 1.5-1.6	*G6862/79*	Medium	19.7	0.25	4.21	2.31	-1.90	Very high	..	..	..	..	..	..	..	..	..	..	..	..
S82 1.9-2.0	*G6862/80*	Medium	21.6	0.27	4.55	2.39	-2.16	Very high	..	..	..	..	..	..	..	..	..	..	..	..

Sample Identification	EAL Lab Code	Texture	Moisture Content		pH$_F$ and pH$_{FOX}$				KCl-extractable sulfur (S_{KCl})		Potential Sulfidic Acidity (Chromium Reducible Sulfur - CRS)		Actual Acidity (Titratable Actual Acidity - TAA)		Retained Acidity (S_{KCl} – S_{KCl})		Acid Neutralising Capacity (ANC_{BT})		Net Acidity (based on S_{CR})	Lime Calculation
			(% moisture of total wet weight)	(g moisture / g of oven dry soil)	pH$_F$	pH$_{FOX}$	pH change	Reaction	(% S_{KCl})	(equiv. mol H^+/t)	(% S_{Cr})	(mol H^+/t)	pH$_{KCl}$	(mol H^+/t)	(%S_{NAS})	(mol H^+/t)	(% $CaCO_3$)	(mol H^+/t)	(mol H^+/t)	(kg CaCO3/t DW)
S97 0-0.1	*G6862/81*	Medium	21.3	0.27	4.72	2.44	-2.28	High	0.000	0	0.014	9	4.11	140	0.010	5	..	..	153	11.5
S97 0.5-0.6	*G6862/82*	Medium	17.9	0.22	5.41	3.40	-2.01	Medium	..	..	..	..	..	..	..	..	..	..	..	..
S97 1.0-1.1	*G6862/83*	Medium	20.1	0.25	4.87	2.83	-2.04	Very high	..	..	..	..	..	..	..	..	..	..	..	..
S97 1.5-1.6	*G6862/84*	Coarse	21.7	0.28	4.85	2.33	-2.52	Very high	..	..	..	..	..	..	..	..	..	..	..	..
S97 1.9-2.0	*G6862/85*	Coarse	20.5	0.26	5.05	2.43	-2.62	Very high	..	..	0.148	92	4.80	14	..	..	..	..	106	8.0
S86 0-0.1	*G6862/86*	Coarse	14.3	0.17	5.05	2.99	-2.06	Low	..	..	..	..	..	..	..	..	..	..	..	..
S86 0.5-0.6	*G6862/87*	Medium	19.3	0.24	5.20	3.21	-1.99	Medium	..	..	..	..	..	..	..	..	..	..	..	..
S86 1.0-1.1	*G6862/88*	Medium	21.5	0.27	5.02	2.64	-2.38	Very high	..	..	..	..	..	..	..	..	..	..	..	..
S86 1.5-1.6	*G6862/89*	Medium	20.8	0.26	4.97	2.31	-2.66	Very high	..	..	0.288	180	4.87	15	..	..	..	..	194	14.6
S86 1.9-2.0	*G6862/90*	Medium	20.5	0.26	5.01	2.66	-2.35	Very high	..	..	..	..	..	..	..	..	..	..	..	..
S91 0-0.1	*G6862/91*	Medium	25.4	0.34	4.65	3.32	-1.33	Very high	..	..	..	..	..	..	..	..	..	..	..	..
S91 0.5-0.6	*G6862/92*	Coarse	14.8	0.17	5.50	3.47	-2.03	Medium	..	..	<0.005	0	4.61	20	..	..	..	..	20	1.5
S91 1.0-1.1	*G6862/93*	Medium	19.5	0.24	5.11	2.74	-2.37	Very high	..	..	..	..	..	..	..	..	..	..	..	..
S91 1.5-1.6	*G6862/94*	Coarse	20.9	0.26	4.77	2.72	-2.05	Very high	..	..	..	..	..	..	..	..	..	..	..	..
S91 1.9-2.0	*G6862/95*	Coarse	21.5	0.27	4.80	2.33	-2.47	Very high	..	..	0.332	207	4.59	18	..	..	..	..	225	16.9

NOTES:

1. All analysis is reported on a dry weight (DW) basis, unless wet weight (WW) is specified.
2. Samples are dried and ground immediately upon arrival (unless supplied dried and ground).
3. Analytical procedures are sourced from Ahern CR, McElnea AE and Sullivan LA (2004). *Acid sulfate soil laboratory method guidelines*. Queensland Department of Natural Resources, Mines and Energy: Indooroopilly, Qld, Australia.
4. The Acid Base Accounting Equation is **Net Acidity = Actual Acidity + Retained Acidity + Potential Sulfidic Acidity (S_{Cr} or S_{HX}) – Acid Neutralising Capacity/Fineness Factor** (Ahern et al. 2004 - full reference above).
5. Retained Acidity is required when the pH$_{KCl}$ < 4.5 or where jarosite has been visually observed. Acid Neutralising Capacity is required when the Potential Sulfidic Acidity is greater than the texture dependent trigger and the pH$_{KCl}$ is ≥ 6.5.
6. **An acid sulfate soil management plan is triggered by Net Acidity results greater than the texture dependent criterion: coarse texture ≥ 0.03% S or 19 mol H^+/t; medium texture ≥ 0.06% S or 37 mol H^+/t; fine texture ≥ 0.1% S or 62 mol H^+/t)** (Ahern *et al.* 2004 - full reference above)
7. For projects that disturb > 1000 tonnes of soil, the coarse trigger of ≥ 0.03% S must be applied in accordance with Ahern CR, Stone Y and Blunden B (1998). *Acid sulfate soils assessment guidelines*. Acid Sulfate Soil Management Advisory Committee: Wollongbar, NSW, Australia.
8. Acid sulfate soil texture triggers can be related to standard soil textures: coarse = sands to loamy sands; medium = sandy loams to light clays; fine = medium to heavy clays and silty clays (Ahern et al. 1998 - full reference above).
9. Bulk density is required to convert liming rates to soil volume based results. Field bulk density rings can be submitted to EAL for bulk density determination.
10. **The lime calculation includes a Safety Factor of 1.5 as a safety margin for acid neutralisation (Ahern et al. 2004). This is only applied to positive values. An increased Safety Factor may be required in some cases.**
11. A negative Net Acidity result indicates an excess acid neutralising capacity.
12. '..' is reported where a test is either not requested or not required. Where pH$_{KCl}$ is < 4.5 or > 6.5, zero is reported for S_{NAS} and ANC in Net Acidity calculations, respectively.
13. Results refer to samples as received at the laboratory. This report is not to be reproduced except in full.

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Actual Soil Acidity

The chromium suite analysis results for the 24 selected samples (refer to Table 7) show that titratable actual acidity (TAA) concentrations in six samples tested were greater than the ASSMAC action criteria, which are based on soil texture. The actual acidity trigger values and associated samples are:

- coarse texture (e.g. sand): ≥ 19 mol H+/t;
    - sample S91 (0.5 – 0.6 m).
- medium texture: ≥ 37 mol H+/t;
    - samples S50 (0.5 – 0.6 m), S73 (0 – 0.1 m) and S97 (0 – 0.1 m).
- fine texture (e.g. clay): ≥ 62 mol H+/t;
    - samples S53 (0 – 0.1 m) and S56 (0.5 – 0.6 m).

Potential Soil Acidity

The laboratory results also show that the reduced inorganic sulfur concentrations in most of the samples tested were greater than the ASSMAC action criteria. The potential acidity trigger values and associated samples are:

- coarse texture (e.g. sand), ≥ 0.03% S;
    - sample S21 (1.9 – 2.0 m), S97 (1.9 – 2.0 m) and S91 (1.9 – 2.0 m).
- medium texture ≥ 0.06% S;
    - samples S12 (1.5 – 1.6 m), S6 (1.9 – 2.0 m), S3 (1.5 – 1.6 m), S26 (1.0 – 1.1 m), S32 (1.0 – 1.1 m), S36 (1.9 – 2.0 m), S31 (1.9 – 2.0 m), S50 (1.9 – 2.0 m), S70 (1.0 – 1.1 m), S67 (1.9 – 2.0 m), S83 (1.9 – 2.0 m), S82 (1.0 – 1.1 m) and S86 (1.5 – 1.6 m).
- fine texture (e.g. clay), ≥ 0.1% S;
    - all samples tested less than the action criterion.

The laboratory results indicate that some of the soil profiles contain actual acidity, and that all profiles in selected locations have a potential acidity which results in a net acidity requiring liming for neutralisation purposes, should the soils be exposed or disturbed during construction activities associated with the proposed residential development. The calculated liming rates range from 0.5 to 27.1 kg of $CaCO_3$ equivalent per tonne of soil to effectively neutralise the net acidity in the soils, depending on soil depth. Further elaboration on the calculated liming rates is provided in the ASSMP.

ENV understands from information provided by Palm Lake Works that although up to approximately 2 m thickness of fill materials will be placed on top of the natural soils as part of the site redevelopment, some excavation into the natural soils may be required to construct bio-retention basins and a perimeter swale near the site's boundaries to manage stormwater from the development. These excavations are required near the site's eastern boundary, immediately to the east of the proposed residential dwelling locations, and in the southern site portion (refer to Attachment 1). It is understood that excavations for construction of these features will extend to a

depth of approximately 0.2 m into the natural ground surface (RL1.0). Although no surface samples from the eastern side of the site were analysed for ASS using the chromium suite method, the results for surface soils analysed from other parts of the site indicate that none of these soils are PASS (chromium reducible sulfur concentrations were less than the action criteria of 0.03, 0.06 or 0.1% S (depending on soil texture) presented in ASSMAC (1998)). However, some of the soils analysed were actual acid sulfate soil (AASS), having a TAA greater than the respective ASSMAC (1998) criteria based on soil texture (18 to 62 mol H^+/tonne for <1,000 tonnes of soil disturbed, or 18 mol H^+/tonne for >1,000 tonnes of soil disturbed). In accordance with the requirements of ASSMAC (1998), ground disturbance works in soils with TAA concentrations exceeding these criteria require the preparation of an Acid Sulfate Soil Management Plan (ASSMP).

11 Conclusions and Recommendations

ENV has conducted a combined contamination and ASS investigation for proposed residential development at the subject site.

Based on the preliminary desk-top review of the site history, the following potentially contaminating activities and associated chemicals of potential concern were identified:

- Previous agricultural use – potentially involving the application of persistent pesticides such as organochlorine pesticides (OCPs) and/or fertilisers to ground surfaces. Potential contaminants associated with these activities which were considered further for the assessment included OCPs and metals.

An ASS investigation was undertaken because of the ASS risk (Class 2 soils) attributed to the soils on mapping included in the Ballina LEP (2012).

The contamination investigation included the collection and laboratory analysis of 100 soil samples from across the site. Most samples collected were from shallow soils (0 – 150 mm), however some additional samples were collected from deeper profiles during the ASS borehole investigation (refer below). Groundwater investigations were not conducted as part of the assessment.

The soil samples were laboratory analysed for organochlorine pesticides (OCPs) and a suite of up to 17 metals. Two samples were also analysed for a broader suite of chemicals, including TRH, BTEXN, PAH and PCBs. The results indicate that concentrations of each of the analytes tested were less than the composite level and individual investigation and screening levels adopted for the investigation. **From a chemical perspective, the soils are considered suitable for the proposed low density residential development.**

The ASS investigation included the drilling of an additional 19 boreholes across the site, with associated soil sampling for field peroxide screening and chromium suite testing of selected samples to quantify actual and potential acidity levels in the soils. The results of the chromium suite testing indicate that both actual and potential acid sulfate soils are present at the site, and that these will require liming to neutralise

their acidity and potential acidity during construction activities associated with the proposed residential development.

On the basis of the ASS investigation, ENV recommends that an Acid Sulfate Soil Management Plan (ASSMP) is prepared to assist with the appropriate management of site soils during the future construction activities, to mitigate the potential for environmental harm associated with the actual and potential acidity of the soils. ENV has prepared an ASSMP, which has been provided to Palm Lake Works separately.

12 References

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13 Glossary

Below is a list of commonly used abbreviations in the report:

AEC – Areas of Environmental Concern

ASSMAC – Acid Sulfate Soils Management Advisory Committee

COC – Chain of Custody

DPI – Department of Primary Industries

EILs – Ecological Investigation Levels

ENV – ENV Solutions PTY LTD

ESLs – Ecological Screening Levels

HILs – Health Investigation Levels (for soil)

HSLs – Health Screening Levels (for soil and groundwater)

NEPC – National Environment Protection Council

NEPM – National Environment Protection (Assessment of Site Contamination) Amendment Measure 2013 (No. 1)

NSW EPA – New South Wales Environment Protection Authority

OEH – Office of Environment & Heritage

QA/QC – Quality Assurance and Quality Control

14 Document Control:

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Scope of Engagement:

This report has been prepared by ENV Solutions PTY LTD (ENV) ABN 46856079490 at the request of Palm Lake Works for the purpose of supporting a Development Application for the site and is not to be used for any other purpose or by any other person or corporation.

This report has been prepared based on the information provided to us and from other information obtained as a result of enquiries made by us. ENV accepts no responsibility for any loss or damage suffered howsoever arising to any person or corporation who may use or rely on this document for a purpose other than that described above.

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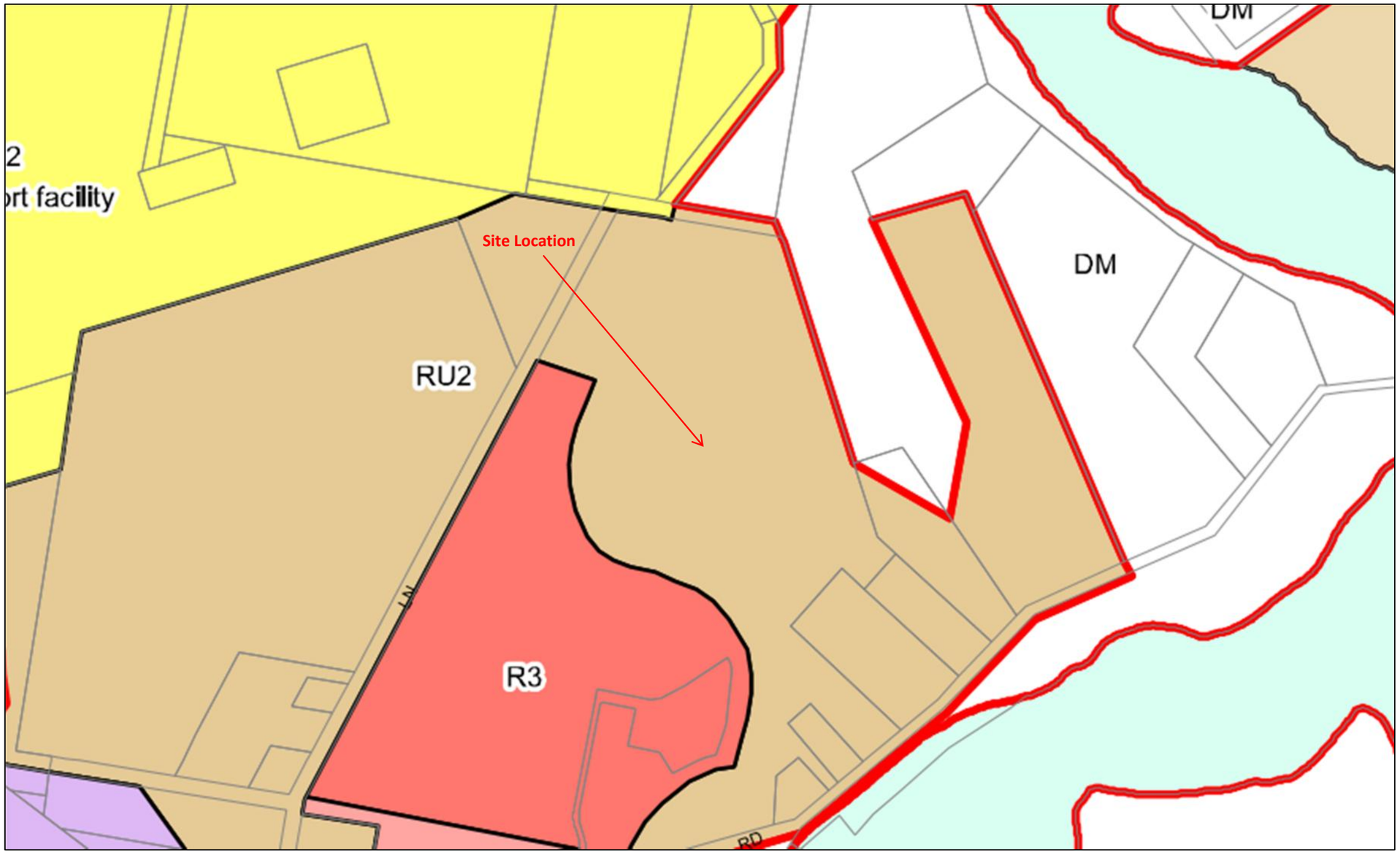
15 Attachments

Attachment 1	Figures 1, 2, 3, 4, 5, 6A, 6B, 6C, 7, 8A and 8B
Attachment 2	Site Photographs
Attachment 3	Laboratory Certificates, Chain of Custody Documentation and Tabulated Results

ATTACHMENT 1

Figures 1, 2, 3, 4, 5, 6A, 6B, 6C, 7, 8A and 8B

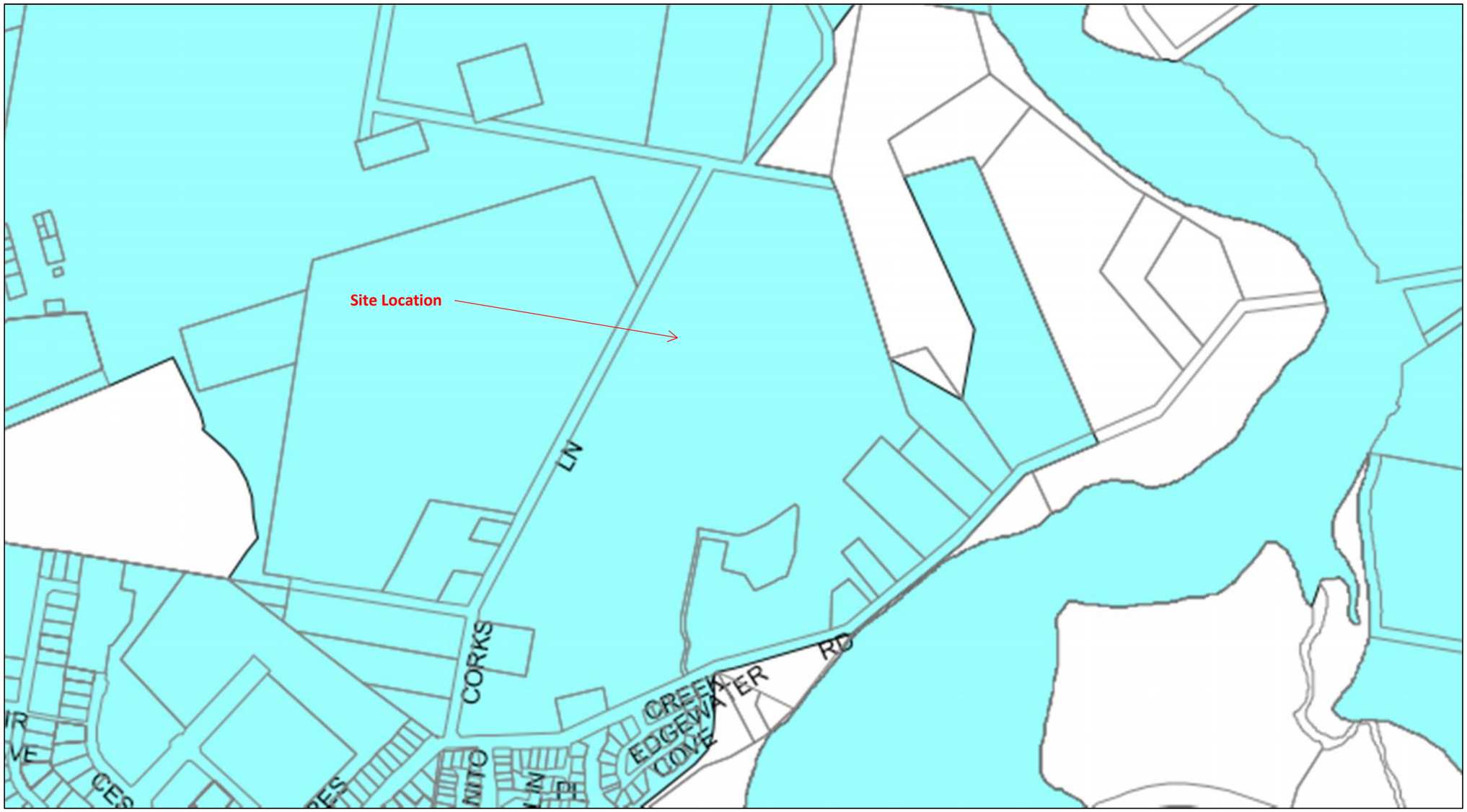
ENV Solutions Environmental Engineering Solutions	Ph: 0405 364 636 Email: craig@envsolutions.com.au Mail: PO Box 248 Ballina, NSW 2478 Job No.: 18012 Project: Corks Lane – Stage 1 PSI	**Figure 1 – Site Location Plan**	Client: Palm Lake Works Date: 23/01/2018 By: Craig Helbig	Not to scale. Illustration only. Background aerial imagery from Sixmaps (imagery dated 2012).



RU2 Rural Landscape

ENV Solutions Environmental Engineering Solutions	Ph: 0405 364 636 Email: craig@envsolutions.com.au Mail: PO Box 248 Ballina, NSW 2478	**Figure 2 – Zoning Plan**	Client: Palm Lake Works	Not to scale. Illustration only.
	Job No.: 18012 Project: Corks Lane – Stage 1 PSI		Date: 23/01/2018 By: Craig Helbig	Reproduced from Ballina Shire Council LEP (2012)

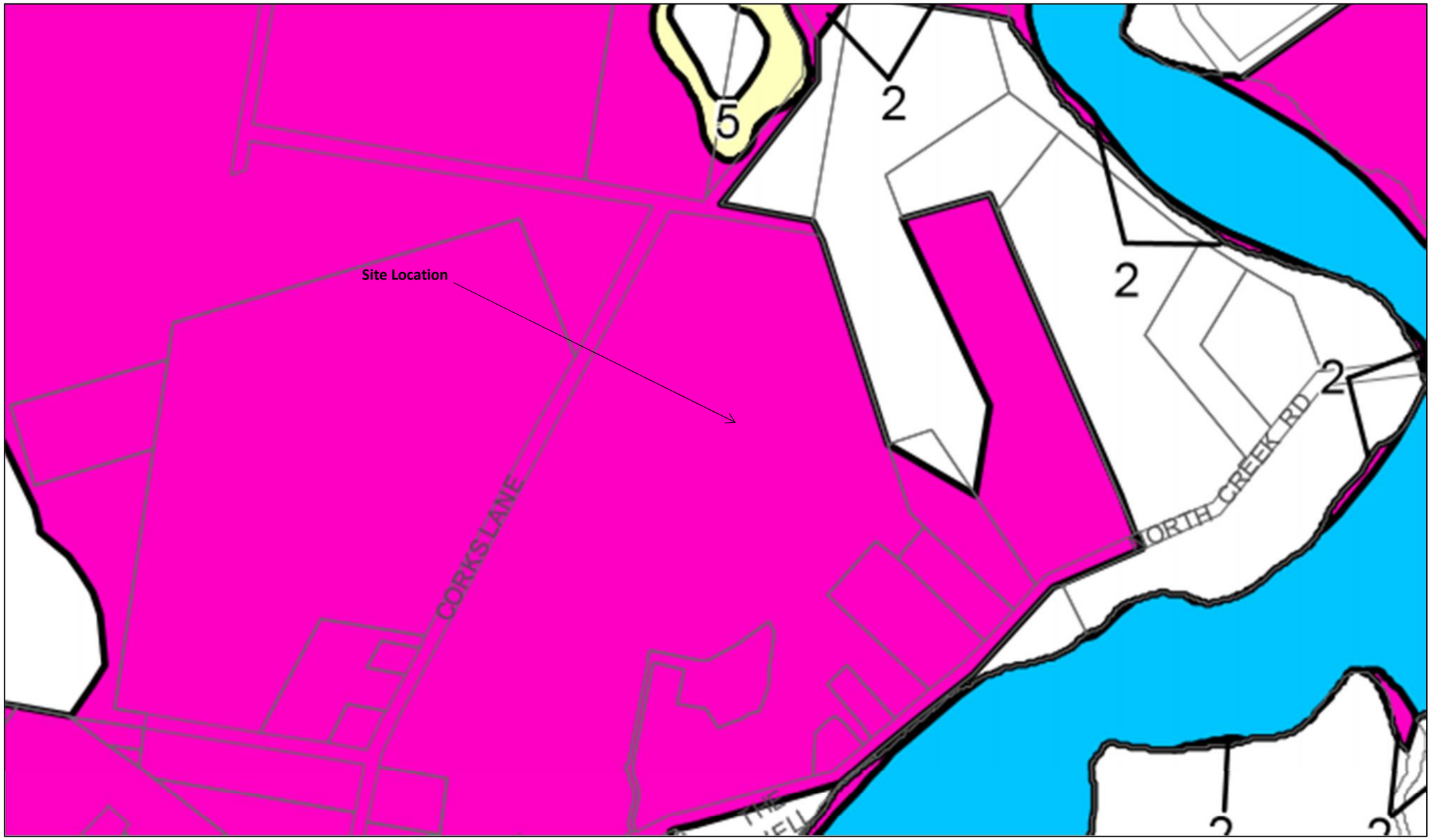
ENV Solutions Environmental Engineering Solutions	Ph: 0405 364 636 Email: craig@envsolutions.com.au Mail: PO Box 248 Ballina, NSW 2478 Job No.: 18012 Project: Corks Lane – Stage 1 PSI	**Figure 3 – Regional Bore Location Plan**	Client: Palm Lake Works Date: 23/01/2018 By: Craig Helbig	Not to scale. Illustration only. Reproduced from Department of Primary Industries (DPI) Office of Water (OOW) Groundwater Database



Flood Planning Land

Flood Planning Area

ENV Solutions Environmental Engineering Solutions	Ph: 0405 364 636 Email: craig@envsolutions.com.au Mail: PO Box 248 Ballina, NSW 2478 Job No.: 18012 Project: Corks Lane – Stage 1 PSI	**Figure 4 – Flooding Risk**	Client: Palm Lake Works Date: 23/01/2018 By: Craig Helbig	Not to scale. Illustration only. Reproduced from Ballina Shire Council LEP (2012)



ENV Solutions Environmental Engineering Solutions	Ph: 0405 364 636 Email: craig@envsolutions.com.au Mail: PO Box 248 Ballina, NSW 2478 Job No.: 18012 Project: Corks Lane – Stage 1 PSI	**Figure 5 – Acid Sulfate Soil (ASS) Risk**	Client: Palm Lake Works Date: 23/01/2018 By: Craig Helbig	Not to scale. Illustration only. Reproduced from Ballina Shire Council LEP (2012)

ENV Solutions
Environmental Engineering Solutions

Ph: 0405 364 636
Email: craig@envsolutions.com.au
Mail: PO Box 248 Ballina, NSW 2478

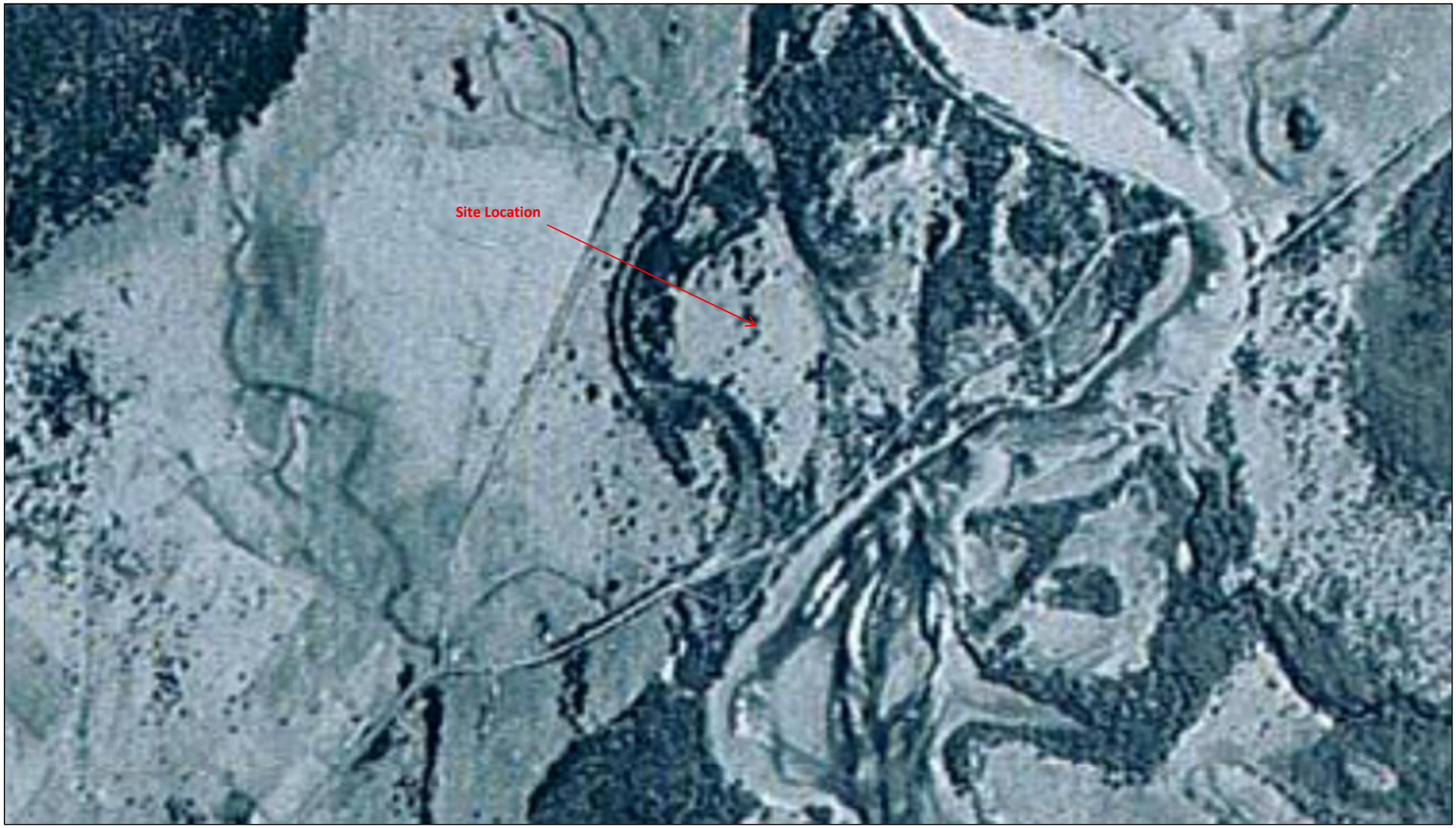
Job No.: 18012
Project: Corks Lane – Stage 1 PSI

Figure 6A – Historical Aerial Photograph (1947)

Client: Palm Lake Works

Date: 23/01/2018
By: Craig Helbig

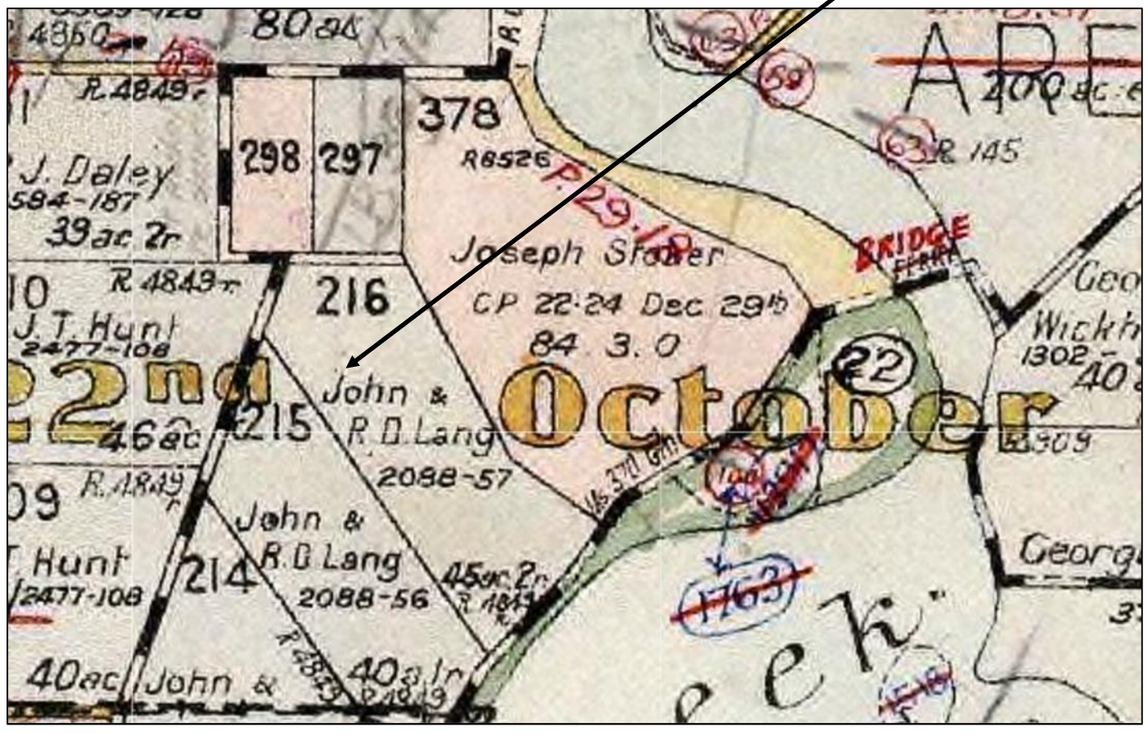
Not to scale. Illustration only.



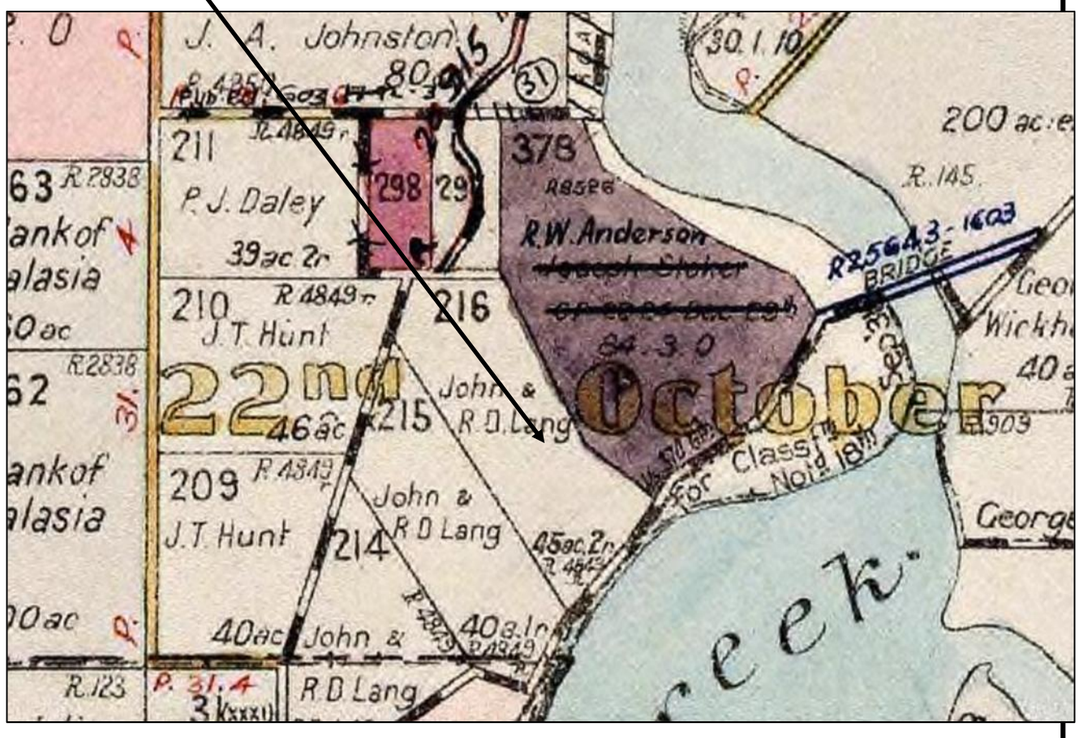
ENV Solutions Environmental Engineering Solutions	Ph: 0405 364 636 Email: craig@envsolutions.com.au Mail: PO Box 248 Ballina, NSW 2478 Job No.: 18012 Project: Corks Lane – Stage 1 PSI	**Figure 6B – Historical Aerial Photograph (1958)**	Client: Palm Lake Works Date: 23/01/2018 By: Craig Helbig	Not to scale. Illustration only.

ENV Solutions Environmental Engineering Solutions	Ph: 0405 364 636 Email: craig@envsolutions.com.au Mail: PO Box 248 Ballina, NSW 2478 Job No.: 18012 Project: Corks Lane – Stage 1 PSI	**Figure 6C – Historical Aerial Photograph (1979)**	Client: Palm Lake Works Date: 23/01/2018 By: Craig Helbig	Not to scale. Illustration only.

Site Location

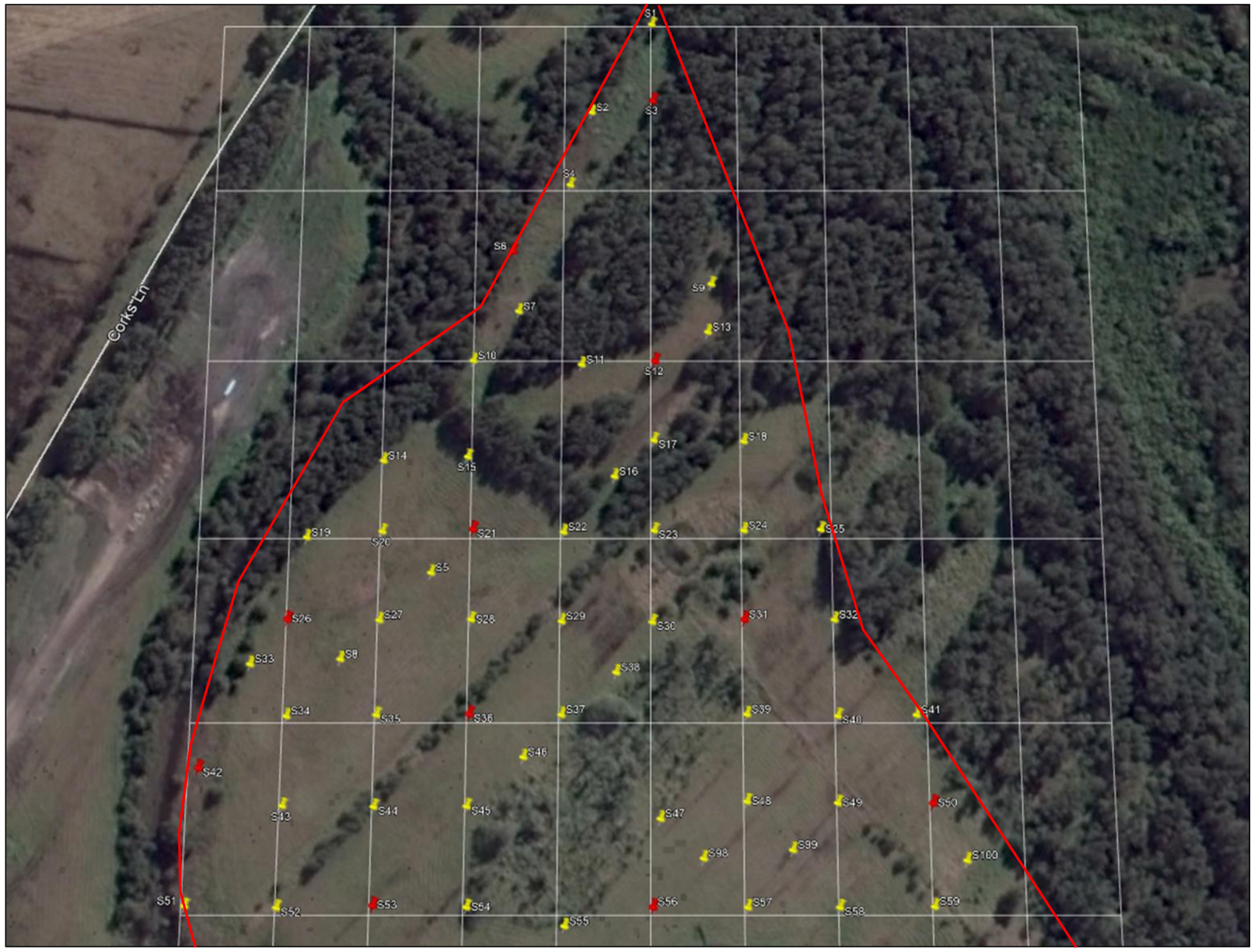


1929



1936

ENV Solutions – Environmental Engineering Solutions	Ph: 0405 364 636 Email: craig@envsolutions.com.au Mail: PO Box 248 Ballina, NSW 2478 Job No.: 17111 Project: 16 Corks Lane – Preliminary Contamination Assessment	**Figure 7 – Parish Maps (1929, 1936)**	Client: Palm Lake Works Date: 23/01/2018 By: Craig Helbig	Not to scale. Illustration only. Reproduced from the Land and Property Information (LPI) Historical Land Records Viewer (HLRV; 2018)



Surface Location (0 – 0.15 m)

Acid Sulfate Soil (ASS) Location (0 – 2 m)

Approximate Site Boundary

ENV Solutions
Environmental Engineering Solutions

Ph: 0405 364 636
Email: craig@envsolutions.com.au
Mail: PO Box 248 Ballina, NSW 2478

Job No.: 18012
Project: Corks Lane – Stage 1 PSI

Figure 8A – Sampling Plan (Northern Portion)

Client: Palm Lake Works

Date: 29/01/2018
By: Craig Helbig

Not to scale. Illustration only.

Background aerial imagery from Sixmaps (imagery dated 2012).

Surface Location (0 – 0.15 m)

Acid Sulfate Soil (ASS) Location (0 – 2 m)

Approximate Site Boundary

ENV Solutions
Environmental Engineering Solutions

Ph: 0405 364 636
Email: craig@envsolutions.com.au
Mail: PO Box 248 Ballina, NSW 2478

Job No.: 18012
Project: Corks Lane – Stage 1 PSI

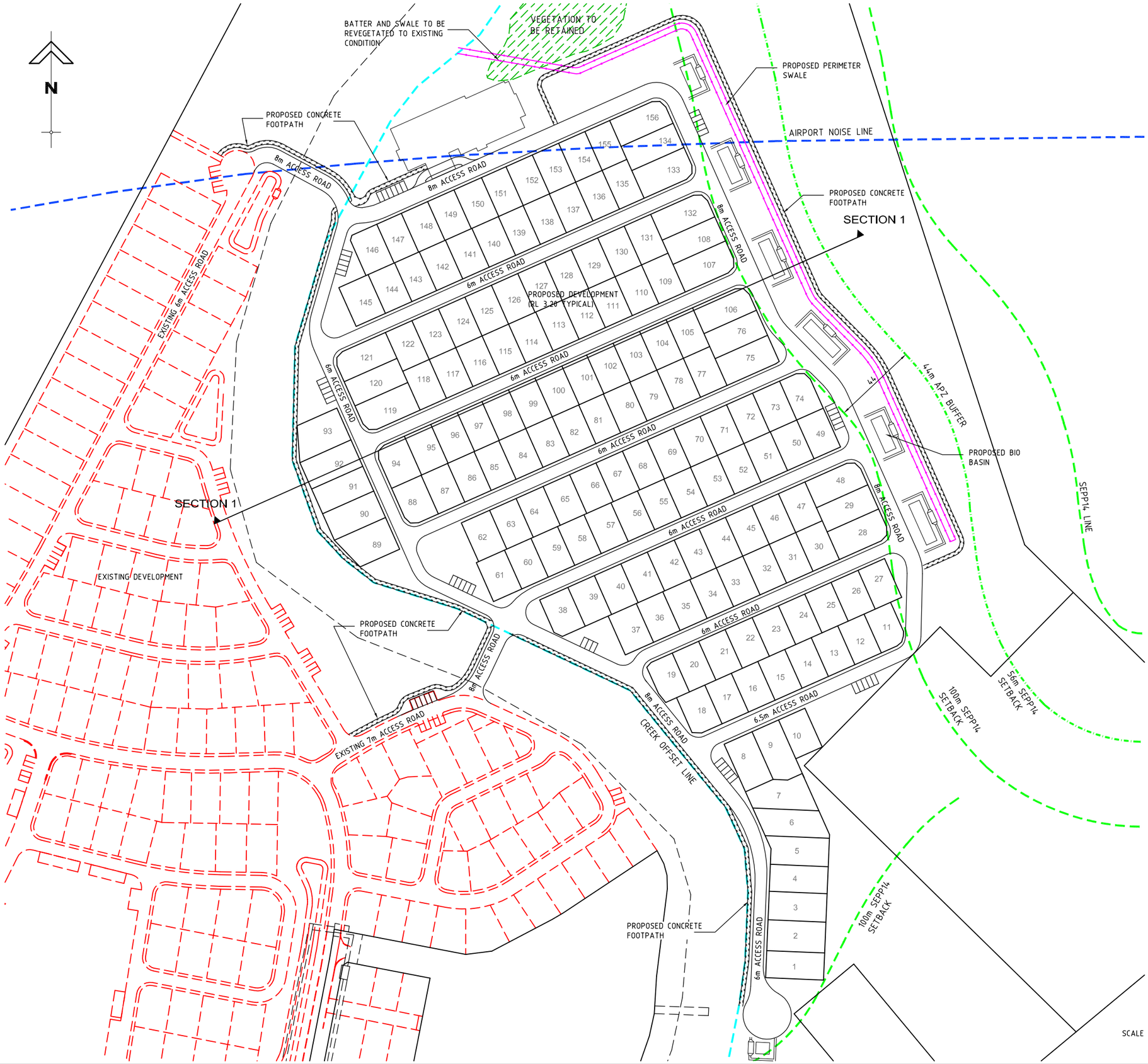
Figure 8B – Sampling Plan (Southern Portion)

Client: Palm Lake Works

Date: 29/01/2018
By: Craig Helbig

Not to scale. Illustration only.

Background aerial imagery from Sixmaps (imagery dated 2012).



PALM LAKE RESORT
BALLINA
CORKS LANE

FOR

PALM LAKE RESORTS

A1 ORIGINAL SIZE BEFORE REDUCTION

VER.	DESCRIPTION	DATE
D	VARIOUS AMENDMENTS	26-03-18
C	ROAD WIDTH AMENDMENTS	23-03-18
B	LAYOUT AMENDED	19-03-18
A	ORIGINAL ISSUE	05-03-18

BURCHILLS ENGINEERING SOLUTIONS
Level 2, Connaught Centre
26 Marine Parade, Southport QLD 4215
PO Box 3766, Australia Fair, Southport QLD 4215
Phone: +61 7 5509 6400
Fax: +61 7 5509 6411
Email: admin@burchills.com.au
Coote Burchills Engineering Pty Ltd
ABN 76 166 942 365

PROJECT:

DEVELOPMENT APPLICATION SCHEMATICS

DRAWING TITLE:

PROPOSED LAYOUT PLAN

DEVEL. APPLIC. No.: -	DATE: 26-03-18
PROJECT LEADER:	DEAN HARDWICK
DESIGNER:	PAUL COUCHMAN
DRAFTSPERSON:	PAUL COUCHMAN /JEREMY FLYNN
CHECKED:	

APPROVED FOR AND ON BEHALF OF
BURCHILLS ENGINEERING SOLUTIONS ABN 76 166 942 365

RPEQ No.:

SCALE: AS NOTED	DATUM: AHD	FULL SIZE: A1
PROJECT No.: BE150074-06	DRAWING No.: SK001	VERSION: D

PLOTTED: 26.03.2018 at 14:43
FILENAME: P:\2015\BE150074_Palm Lakes Resort, Ballina (JMP)\Civil\Acad\16\sketch\BE150074-06-SK001-D.DWG

ATTACHMENT 2

Site Photographs

Plate 1: View looking across the central portion of the site, towards the north-west. A stand of remnant vegetation is visible in the background.

Plate 2: Looking east from the central site portion. One of the regularly spaced earthen drains is visible in the foreground.

Plate 3: One of the drainage channels running adjacent to the site's northern portion.

Plate 4: Looking west along the site's access track toward the neighbouring Palm Lake development (under construction). The elevation difference between natural ground level (subject site) and the adjacent (filled) site can be seen.

Plate 5: Setting up to drill at one of the boreholes along the site's western boundary.

Plate 6: The typical geological profile of boreholes drilled across the site for the Acid Sulfate Soil (ASS) investigation. The profile includes silty sand profiles underlain by clay sand and sandy clay.

ATTACHMENT 3

Laboratory Certificates, Chain of Custody Documentation and Tabulated Results

eurofins

Procedure No: Form-55 **Sample Submission Form**

Client: ENV SOLUTIONS Quote No.: —

Customer Ref / Field Trial Number: 18012 Purchase Order: —

Sample descripton: SOIL

Test required: OCP, METALS

Condition on despatch: Hard Frozen Cold

Frozen Room Temp

Data Logger Included: —

Weight of Sample(s): ~500

Results to: Craig Hedley Contact number: 0405 364 626

Email address: CRAIG@ENVSOLUTIONS.COM.AU

Invoice to: As above

Sample Ref / ID	Description	Test Required	Sample date
QC2	SOIL	OCP & METALS	24/1
QC4	SOIL	" "	25/1

PLEASE SHIP SAMPLES TO:
Eurofins Agroscience Testing Pty Ltd
Unit F6, Building F, 16 Mars Road
Lane Cove West
New South Wales 2066 Tel: (02) 9900 8442

Jack Wallis 30/1/18
3:39 PM
582385

Approved on: 12/1/15 Approved by: A Westcott
File name: Version: No 15

eurofins | mgt

Melbourne
3-5 Kingston Town Close
Oakleigh Vic 3166
Phone : +61 3 8564 5000
NATA # 1261
Site # 1254 & 14271

Sydney
Unit F3, Building F
16 Mars Road
Lane Cove West NSW 2066
Phone : +61 2 9900 8400
NATA # 1261 Site # 18217

Brisbane
1/21 Smallwood Place
Murarrie QLD 4172
Phone : +61 7 3902 4600
NATA # 1261 Site # 20794

Perth
2/91 Leach Highway
Kewdale WA 6105
Phone : +61 8 9251 9600
NATA # 1261 Site # 23736

ABN – 50 005 085 521 e.mail : EnviroSales@eurofins.com web : www.eurofins.com.au

Sample Receipt Advice

Company name:	**ENV Solutions Pty Ltd**
Contact name:	Craig Helbig
Project name:	SOIL ANALYSIS
Project ID:	18012
COC number:	Not provided
Turn around time:	5 Day
Date/Time received:	Jan 30, 2018 3:59 PM
Eurofins | mgt reference:	**582385**

Sample information

☑ A detailed list of analytes logged into our LIMS, is included in the attached summary table.

☑ All samples have been received as described on the above COC.

☑ COC has been completed correctly.

☑ Attempt to chill was evident.

☑ Appropriately preserved sample containers have been used.

☑ All samples were received in good condition.

☑ Samples have been provided with adequate time to commence analysis in accordance with the relevant holding times.

☑ Appropriate sample containers have been used.

☒ Split sample sent to requested external lab.

☒ Some samples have been subcontracted.

N/A Custody Seals intact (if used).

Contact notes

If you have any questions with respect to these samples please contact:

Nibha Vaidya on Phone : +61 (2) 9900 8400 or by e.mail: NibhaVaidya@eurofins.com

Results will be delivered electronically via e.mail to Craig Helbig - craig@envsolutions.com.au.

Certificate of Analysis

ENV Solutions Pty Ltd
1/35 North Creek Road
Ballina
NSW 2478

Attention: **Craig Helbig**

Report **582385-S**
Project name SOIL ANALYSIS
Project ID 18012
Received Date Jan 30, 2018

Client Sample ID			**QC2**	**QC4**
Sample Matrix			**Soil**	**Soil**
Eurofins | mgt Sample No.			**S18-Ja24906**	**S18-Ja24907**
Date Sampled			**Jan 24, 2018**	**Jan 25, 2018**
Test/Reference	LOR	Unit		
Organochlorine Pesticides				
Chlordanes - Total	0.1	mg/kg	< 0.1	< 0.1
4.4'-DDD	0.05	mg/kg	< 0.05	< 0.05
4.4'-DDE	0.05	mg/kg	< 0.05	< 0.05
4.4'-DDT	0.05	mg/kg	< 0.05	< 0.05
a-BHC	0.05	mg/kg	< 0.05	< 0.05
Aldrin	0.05	mg/kg	< 0.05	< 0.05
b-BHC	0.05	mg/kg	< 0.05	< 0.05
d-BHC	0.05	mg/kg	< 0.05	< 0.05
Dieldrin	0.05	mg/kg	< 0.05	< 0.05
Endosulfan I	0.05	mg/kg	< 0.05	< 0.05
Endosulfan II	0.05	mg/kg	< 0.05	< 0.05
Endosulfan sulphate	0.05	mg/kg	< 0.05	< 0.05
Endrin	0.05	mg/kg	< 0.05	< 0.05
Endrin aldehyde	0.05	mg/kg	< 0.05	< 0.05
Endrin ketone	0.05	mg/kg	< 0.05	< 0.05
g-BHC (Lindane)	0.05	mg/kg	< 0.05	< 0.05
Heptachlor	0.05	mg/kg	< 0.05	< 0.05
Heptachlor epoxide	0.05	mg/kg	< 0.05	< 0.05
Hexachlorobenzene	0.05	mg/kg	< 0.05	< 0.05
Methoxychlor	0.2	mg/kg	< 0.2	< 0.2
Toxaphene	1	mg/kg	< 1	< 1
Aldrin and Dieldrin (Total)*	0.05	mg/kg	< 0.05	< 0.05
DDT + DDE + DDD (Total)*	0.05	mg/kg	< 0.05	< 0.05
Vic EPA IWRG 621 OCP (Total)*	0.1	mg/kg	< 0.1	< 0.1
Vic EPA IWRG 621 Other OCP (Total)*	0.1	mg/kg	< 0.1	< 0.1
Dibutylchlorendate (surr.)	1	%	112	122
Tetrachloro-m-xylene (surr.)	1	%	113	117
Heavy Metals				
Arsenic	2	mg/kg	< 2	2.3
Cadmium	0.4	mg/kg	< 0.4	< 0.4
Chromium	5	mg/kg	7.2	14
Copper	5	mg/kg	< 5	6.0
Lead	5	mg/kg	< 5	6.3
Mercury	0.1	mg/kg	< 0.1	< 0.1
Nickel	5	mg/kg	< 5	8.0
Zinc	5	mg/kg	6.0	25

Client Sample ID			QC2	QC4
Sample Matrix			**Soil**	**Soil**
Eurofins | mgt Sample No.			**S18-Ja24906**	**S18-Ja24907**
Date Sampled			**Jan 24, 2018**	**Jan 25, 2018**
Test/Reference	LOR	Unit		
% Moisture	1	%	18	33

Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.
A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results (regarding both quality and NATA accreditation).

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Organochlorine Pesticides	Sydney	Jan 31, 2018	14 Day
- Method: LTM-ORG-2220 OCP & PCB in Soil and Water			
Metals M8	Sydney	Jan 31, 2018	28 Day
- Method: LTM-MET-3040_R0 TOTAL AND DISSOLVED METALS AND MERCURY IN WATERS BY ICP-MS			
% Moisture	Sydney	Jan 30, 2018	14 Day
- Method: LTM-GEN-7080 Moisture			

ABN– 50 005 085 521
e.mail : EnviroSales@eurofins.com
web : www.eurofins.com.au

Melbourne
2-5 Kingston Town Close
Oakleigh VIC 3166
Phone : +61 3 8564 5000
NATA # 1261
Site # 1254 & 14271

Sydney
Unit F3, Building F
16 Mars Road
Lane Cove West NSW 2066
Phone : +61 2 9900 8400
NATA # 1261 Site # 18217

Brisbane
1/21 Smallwood Place
Murarrie QLD 4172
Phone : +61 7 3902 4600
NATA # 1261 Site # 20794

Perth
2/91 Leach Highway
Kewdale WA 6105
Phone : +61 8 9251 9600
NATA # 1261
Site # 23736

Company Name: ENV Solutions Pty Ltd
Address: 1/35 North Creek Road
Ballina
NSW 2478

Project Name: SOIL ANALYSIS
Project ID: 18012

Order No.:
Report #: 582385
Phone: 0421 519 354
Fax:

Received: Jan 30, 2018 3:59 PM
Due: Feb 6, 2018
Priority: 5 Day
Contact Name: Craig Helbig

Eurofins | mgt Analytical Services Manager : Nibha Vaidya

Sample Detail						Organochlorine Pesticides	Metals M8	Moisture Set
Melbourne Laboratory - NATA Site # 1254 & 14271								
Sydney Laboratory - NATA Site # 18217						X	X	X
Brisbane Laboratory - NATA Site # 20794								
Perth Laboratory - NATA Site # 23736								
External Laboratory								
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**			
1	QC2	Jan 24, 2018		Soil	S18-Ja24906	X	X	X
2	QC4	Jan 25, 2018		Soil	S18-Ja24907	X	X	X
Test Counts						2	2	2

Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil results are reported on a dry basis, unless otherwise stated.
3. All biota results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the Sample Receipt Advice.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

****NOTE:** pH duplicates are reported as a range NOT as RPD

Units

mg/kg: milligrams per kilogram

mg/L: milligrams per litre

ug/L: micrograms per litre

ppm: Parts per million

ppb: Parts per billion

%: Percentage

org/100mL: Organisms per 100 millilitres

NTU: Nephelometric Turbidity Units

MPN/100mL: Most Probable Number of organisms per 100 millilitres

Terms

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
LOR	Limit of Reporting.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
LCS	Laboratory Control Sample - reported as percent recovery.
CRM	Certified Reference Material - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
USEPA	United States Environmental Protection Agency
APHA	American Public Health Association
TCLP	Toxicity Characteristic Leaching Procedure
COC	Chain of Custody
SRA	Sample Receipt Advice
QSM	Quality Systems Manual ver 5.1 US Department of Defense
CP	Client Parent - QC was performed on samples pertaining to this report
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
TEQ	Toxic Equivalency Quotient

QC - Acceptance Criteria

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR : No Limit

Results between 10-20 times the LOR : RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

Surrogate Recoveries: Recoveries must lie between 50-150%-Phenols & PFASs

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.1 where no positive PFAS results have been reported have been reviewed and no data was affected.

QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. Organochlorine Pesticide analysis - where reporting LCS data, Toxaphene & Chlordane are not added to the LCS.
4. Organochlorine Pesticide analysis - where reporting Spike data, Toxaphene is not added to the Spike.
5. Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
6. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling.Therefore laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt.
7. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
8. Polychlorinated Biphenyls are spiked only using Aroclor 1260 in Matrix Spikes and LCS.
9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample.
10. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Quality Control Results

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank							
Organochlorine Pesticides							
Chlordanes - Total	mg/kg	< 0.1			0.1	Pass	
4.4'-DDD	mg/kg	< 0.05			0.05	Pass	
4.4'-DDE	mg/kg	< 0.05			0.05	Pass	
4.4'-DDT	mg/kg	< 0.05			0.05	Pass	
a-BHC	mg/kg	< 0.05			0.05	Pass	
Aldrin	mg/kg	< 0.05			0.05	Pass	
b-BHC	mg/kg	< 0.05			0.05	Pass	
d-BHC	mg/kg	< 0.05			0.05	Pass	
Dieldrin	mg/kg	< 0.05			0.05	Pass	
Endosulfan I	mg/kg	< 0.05			0.05	Pass	
Endosulfan II	mg/kg	< 0.05			0.05	Pass	
Endosulfan sulphate	mg/kg	< 0.05			0.05	Pass	
Endrin	mg/kg	< 0.05			0.05	Pass	
Endrin aldehyde	mg/kg	< 0.05			0.05	Pass	
Endrin ketone	mg/kg	< 0.05			0.05	Pass	
g-BHC (Lindane)	mg/kg	< 0.05			0.05	Pass	
Heptachlor	mg/kg	< 0.05			0.05	Pass	
Heptachlor epoxide	mg/kg	< 0.05			0.05	Pass	
Hexachlorobenzene	mg/kg	< 0.05			0.05	Pass	
Methoxychlor	mg/kg	< 0.2			0.2	Pass	
Toxaphene	mg/kg	< 1			1	Pass	
Method Blank							
Heavy Metals							
Arsenic	mg/kg	< 2			2	Pass	
Cadmium	mg/kg	< 0.4			0.4	Pass	
Chromium	mg/kg	< 5			5	Pass	
Copper	mg/kg	< 5			5	Pass	
Lead	mg/kg	< 5			5	Pass	
Mercury	mg/kg	< 0.1			0.1	Pass	
Nickel	mg/kg	< 5			5	Pass	
Zinc	mg/kg	< 5			5	Pass	
LCS - % Recovery							
Organochlorine Pesticides							
Chlordanes - Total	%	74			70-130	Pass	
4.4'-DDD	%	110			70-130	Pass	
4.4'-DDE	%	126			70-130	Pass	
4.4'-DDT	%	122			70-130	Pass	
a-BHC	%	119			70-130	Pass	
Aldrin	%	115			70-130	Pass	
b-BHC	%	114			70-130	Pass	
d-BHC	%	116			70-130	Pass	
Dieldrin	%	128			70-130	Pass	
Endosulfan I	%	122			70-130	Pass	
Endosulfan II	%	123			70-130	Pass	
Endosulfan sulphate	%	125			70-130	Pass	
Endrin	%	129			70-130	Pass	
Endrin aldehyde	%	106			70-130	Pass	
Endrin ketone	%	121			70-130	Pass	
g-BHC (Lindane)	%	122			70-130	Pass	
Heptachlor	%	114			70-130	Pass	

Test			Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Heptachlor epoxide			%	118			70-130	Pass	
Hexachlorobenzene			%	104			70-130	Pass	
Methoxychlor			%	113			70-130	Pass	
Toxaphene			%	84			70-130	Pass	
LCS - % Recovery									
Heavy Metals									
Arsenic			%	123			70-130	Pass	
Cadmium			%	126			70-130	Pass	
Chromium			%	128			70-130	Pass	
Copper			%	128			70-130	Pass	
Lead			%	94			70-130	Pass	
Mercury			%	98			70-130	Pass	
Nickel			%	98			70-130	Pass	
Zinc			%	130			70-130	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Spike - % Recovery									
Organochlorine Pesticides				Result 1					
4.4'-DDD	S18-Ja26211	NCP	%	129			70-130	Pass	
4.4'-DDE	S18-Ja26211	NCP	%	103			70-130	Pass	
4.4'-DDT	S18-Fe00383	NCP	%	109			70-130	Pass	
a-BHC	S18-Ja26211	NCP	%	104			70-130	Pass	
Aldrin	S18-Ja26211	NCP	%	102			70-130	Pass	
b-BHC	S18-Ja26211	NCP	%	92			70-130	Pass	
d-BHC	S18-Ja26211	NCP	%	99			70-130	Pass	
Dieldrin	S18-Ja26211	NCP	%	114			70-130	Pass	
Endosulfan I	S18-Ja26211	NCP	%	102			70-130	Pass	
Endosulfan II	S18-Ja26211	NCP	%	102			70-130	Pass	
Endosulfan sulphate	S18-Ja26211	NCP	%	104			70-130	Pass	
Endrin	S18-Ja26211	NCP	%	130			70-130	Pass	
Endrin aldehyde	S18-Ja26211	NCP	%	93			70-130	Pass	
Endrin ketone	S18-Ja26211	NCP	%	102			70-130	Pass	
g-BHC (Lindane)	S18-Ja26211	NCP	%	104			70-130	Pass	
Heptachlor	S18-Ja26211	NCP	%	96			70-130	Pass	
Heptachlor epoxide	S18-Ja26211	NCP	%	102			70-130	Pass	
Hexachlorobenzene	S18-Ja26211	NCP	%	86			70-130	Pass	
Methoxychlor	S18-Ja26211	NCP	%	85			70-130	Pass	
Toxaphene	S18-Fe01221	NCP	%	119			70-130	Pass	
Spike - % Recovery									
Heavy Metals				Result 1					
Arsenic	S18-Ja24768	NCP	%	103			70-130	Pass	
Cadmium	S18-Ja24768	NCP	%	105			70-130	Pass	
Chromium	S18-Ja24768	NCP	%	79			70-130	Pass	
Copper	S18-Ja24768	NCP	%	78			70-130	Pass	
Lead	S18-Ja24768	NCP	%	101			70-130	Pass	
Mercury	S18-Ja24768	NCP	%	106			70-130	Pass	
Nickel	S18-Ja24768	NCP	%	80			70-130	Pass	
Zinc	S18-Ja24768	NCP	%	80			70-130	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Duplicate									
Organochlorine Pesticides				Result 1	Result 2	RPD			
Chlordanes - Total	S18-Ja26211	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
4.4'-DDD	S18-Ja26211	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
4.4'-DDE	S18-Ja26211	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Duplicate									
Organochlorine Pesticides				Result 1	Result 2	RPD			
4.4'-DDT	S18-Ja26211	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
a-BHC	S18-Ja26211	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Aldrin	S18-Ja26211	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
b-BHC	S18-Ja26211	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
d-BHC	S18-Ja26211	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Dieldrin	S18-Ja26211	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endosulfan I	S18-Ja26211	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endosulfan II	S18-Ja26211	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endosulfan sulphate	S18-Ja26211	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endrin	S18-Ja26211	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endrin aldehyde	S18-Ja26211	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endrin ketone	S18-Ja26211	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
g-BHC (Lindane)	S18-Ja26211	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Heptachlor	S18-Ja26211	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Heptachlor epoxide	S18-Ja26211	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Hexachlorobenzene	S18-Ja26211	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Methoxychlor	S18-Ja26211	NCP	mg/kg	< 0.2	< 0.2	<1	30%	Pass	
Toxaphene	S18-Ja26211	NCP	mg/kg	< 1	< 1	<1	30%	Pass	
Duplicate									
Heavy Metals				Result 1	Result 2	RPD			
Arsenic	S18-Ja24767	NCP	mg/kg	5.6	6.7	17	30%	Pass	
Cadmium	S18-Ja24767	NCP	mg/kg	< 0.4	< 0.4	<1	30%	Pass	
Chromium	S18-Ja24767	NCP	mg/kg	18	19	4.0	30%	Pass	
Copper	S18-Ja24767	NCP	mg/kg	6.2	6.5	5.0	30%	Pass	
Lead	S18-Ja24767	NCP	mg/kg	15	18	19	30%	Pass	
Mercury	S18-Ja24767	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Nickel	S18-Ja24767	NCP	mg/kg	5.8	7.1	19	30%	Pass	
Zinc	S18-Ja24767	NCP	mg/kg	8.4	9.5	12	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
% Moisture	S18-Fe03157	NCP	%	8.9	7.4	18	30%	Pass	

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Comments

Authorised By

Nibha Vaidya Analytical Services Manager

Glenn Jackson
National Operations Manager

Final report - this Report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

RESULTS OF ACID SULFATE SOIL ANALYSIS

95 samples supplied by Env Solutions Pty Ltd on 25/01/18. Lab Job No.G6862
Analysis requested by Craig Helbig. Your Job: 18012

PO Box 248 BALLINA NSW 2478

Sample identification	EAL Lab Code	Texture	Moisture Content		pH_F and pH_{FOX}			
			(% moisture of total wet weight)	(g moisture / g of oven dry soil)	pH_F	pH_{FOX}	pH change	Reaction
Method Info.		**		**	*(In-house method S21)*			
S12 0-0.1	*G6862/1*	Medium	19.6	0.24	5.72	2.08	-3.64	Low
S12 0.5-0.6	*G6862/2*	Medium	22.2	0.29	4.46	1.87	-2.59	Very High
S12 1.0-1.1	*G6862/3*	Medium	22.6	0.29	4.54	2.02	-2.52	Very High
S12 1.5-1.6	*G6862/4*	Medium	23.8	0.31	5.19	2.06	-3.13	Very High
S12 1.9-2.0	*G6862/5*	Medium	21.9	0.28	5.16	2.14	-3.02	Very High
S6 0-0.1	*G6862/6*	Medium	22.2	0.29	6.76	1.94	-4.82	Low
S6 0.5-0.6	*G6862/7*	Medium	23.1	0.30	5.63	2.01	-3.62	Very High
S6 1.0-1.1	*G6862/8*	Medium	22.0	0.28	5.34	1.87	-3.47	Very High
S6 1.5-1.6	*G6862/9*	Medium	21.5	0.27	5.24	1.97	-3.27	Very High
S6 1.9-2.0	*G6862/10*	Medium	22.2	0.29	6.15	2.01	-4.14	Very High
S3 0-0.1	*G6862/11*	Medium	22.0	0.28	7.14	3.76	-3.38	Medium
S3 0.5-0.6	*G6862/12*	Medium	22.9	0.30	7.12	1.70	-5.42	Low
S3 1.0-1.1	*G6862/13*	Medium	22.6	0.29	6.09	1.96	-4.13	Very High
S3 1.5-1.6	*G6862/14*	Medium	20.6	0.26	6.92	2.08	-4.84	Very High
S3 1.9-2.0	*G6862/15*	Medium	22.8	0.30	7.02	2.14	-4.88	Low
S21 0-0.1	*G6862/16*	Medium	21.2	0.27	7.20	3.86	-3.34	Medium
S21 0.5-0.6	*G6862/17*	Coarse	18.5	0.23	7.95	3.28	-4.67	Low
S21 1.0-1.1	*G6862/18*	Coarse	22.5	0.29	5.76	2.14	-3.62	Very High
S21 1.5-1.6	*G6862/19*	Coarse	20.4	0.26	6.98	2.15	-4.83	Very High
S21 1.9-2.0	*G6862/20*	Coarse	20.3	0.25	7.21	2.26	-4.95	Very High
S26 0-0.1	*G6862/21*	Fine	29.3	0.41	7.18	4.08	-3.10	Medium
S26 0.5-0.6	*G6862/22*	Fine	22.8	0.30	7.07	4.01	-3.06	Medium
S26 1.0-1.1	*G6862/23*	Medium	22.2	0.29	5.95	2.06	-3.89	Very High
S26 1.5-1.6	*G6862/24*	Medium	22.8	0.29	5.32	2.04	-3.28	Very High
S26 1.9-2.0	*G6862/25*	Medium	20.2	0.25	6.22	2.11	-4.11	Low
SA2 0-0.1	*G6862/26*	Medium	19.7	0.25	6.54	3.70	-2.84	Medium
SA2 0.5-0.6	*G6862/27*	Medium	21.0	0.27	6.33	3.74	-2.59	Medium
SA2 1.0-1.1	*G6862/28*	Medium	21.5	0.27	5.29	2.03	-3.26	Very High
SA2 1.5-1.6	*G6862/29*	Coarse	20.6	0.26	5.16	2.34	-2.82	Very High
SA2 1.9-2.0	*G6862/30*	Medium	22.4	0.29	5.64	2.36	-3.28	Very High
S36 0-0.1	*G6862/31*	Medium	20.2	0.25	5.73	2.68	-3.05	Medium
S36 0.5-0.6	*G6862/32*	Medium	21.3	0.27	5.58	2.04	-3.54	Low
S36 1.0-1.1	*G6862/33*	Medium	25.7	0.35	5.68	1.91	-3.77	Very High
S36 1.5-1.6	*G6862/34*	Medium	24.0	0.32	5.78	2.04	-3.74	Very High
S36 1.9-2.0	*G6862/35*	Medium	23.4	0.31	5.87	2.03	-3.84	Very High
S53 0-0.1	*G6862/36*	Fine	20.9	0.26	5.18	2.48	-2.70	Medium
S53 0.5-0.6	*G6862/37*	Medium	20.4	0.26	6.47	2.84	-3.63	Medium
S53 1.0-1.1	*G6862/38*	Medium	23.6	0.31	5.56	2.00	-3.56	Very High
S53 1.5-1.6	*G6862/39*	Medium	23.1	0.30	6.05	2.07	-3.98	Very High
S53 1.9-2.0	*G6862/40*	Medium	21.9	0.28	6.12	2.10	-4.02	Low
S31 0-0.1	*G6862/41*	Fine	20.7	0.26	5.08	2.80	-2.28	Very High
S31 0.5-0.6	*G6862/42*	Medium	18.4	0.22	5.23	2.93	-2.30	Low
S31 1.0-1.1	*G6862/43*	Medium	21.2	0.27	4.34	2.08	-2.26	Medium
S31 1.5-1.6	*G6862/44*	Medium	23.7	0.31	4.71	2.10	-2.61	Low
S31 1.9-2.0	*G6862/45*	Medium	21.6	0.28	4.76	2.11	-2.65	High
S50 0-0.1	*G6862/46*	Medium	27.9	0.39	4.67	3.08	-1.59	Medium
S50 0.5-0.6	*G6862/47*	Medium	19.6	0.24	4.94	2.83	-2.11	Medium
S50 1.0-1.1	*G6862/48*	Medium	20.1	0.25	4.96	2.85	-2.11	Medium
S50 1.5-1.6	*G6862/49*	Medium	22.8	0.30	4.49	1.98	-2.51	Very High
S50 1.9-2.0	*G6862/50*	Medium	21.7	0.28	4.64	1.99	-2.65	Very High
S56 0-0.1	*G6862/51*	Medium	27.7	0.38	4.81	2.81	-2.00	Very High
S56 0.5-0.6	*G6862/52*	Fine	23.7	0.31	4.79	3.04	-1.75	Medium
S56 1.0-1.1	*G6862/53*	Fine	21.9	0.28	4.76	2.69	-2.07	Medium
S56 1.5-1.6	*G6862/54*	Medium	23.2	0.30	4.95	2.87	-2.08	Low
S56 1.9-2.0	*G6862/55*	Fine	21.6	0.27	4.71	2.22	-2.49	Very High
S70 0-0.1	*G6862/56*	Fine	23.6	0.31	5.35	3.95	-1.40	Medium
S70 0.5-0.6	*G6862/57*	Medium	21.9	0.28	7.37	5.29	-2.08	Medium
S70 1.0-1.1	*G6862/58*	Medium	22.3	0.29	6.90	2.26	-4.64	Very High
S70 1.5-1.6	*G6862/59*	Medium	22.2	0.29	6.05	2.17	-3.88	Very High
S70 1.9-2.0	*G6862/60*	Medium	22.3	0.29	6.22	2.24	-3.98	Very High
S73 0-0.1	*G6862/61*	Medium	29.4	0.42	6.26	2.00	-4.26	Very High
S73 0.5-0.6	*G6862/62*	Medium	18.1	0.22	4.80	2.70	-2.10	Medium
S73 1.0-1.1	*G6862/63*	Medium	21.4	0.27	4.87	3.27	-1.60	Low
S73 1.5-1.6	*G6862/64*	Medium	22.5	0.29	5.16	2.80	-2.36	Low
S73 1.9-2.0	*G6862/65*	Medium	20.4	0.26	4.62	2.28	-2.34	Very high
S67 0-0.1	*G6862/66*	Medium	17.0	0.20	5.08	3.04	-2.04	Low
S67 0.5-0.6	*G6862/67*	Coarse	15.2	0.18	5.76	3.69	-2.07	Medium
S67 1.0-1.1	*G6862/68*	Coarse	15.6	0.18	6.03	3.52	-2.51	Medium
S67 1.5-1.9	*G6862/69*	Medium	20.3	0.25	4.68	1.95	-2.73	Very high
S67 1.9-2.0	*G6862/70*	Medium	20.1	0.25	5.16	2.12	-3.04	Very high
S83 0-0.1	*G6862/71*	Medium	17.4	0.21	4.85	2.61	-2.24	Medium
S83 0.5-0.6	*G6862/72*	Medium	16.8	0.20	5.38	3.18	-2.20	Low
S83 1.0-1.1	*G6862/73*	Coarse	16.6	0.20	5.57	3.28	-2.29	Low
S83 1.5-1.6	*G6862/74*	Medium	20.9	0.26	4.38	2.43	-1.95	Very high
S83 1.9-2.0	*G6862/75*	Medium	20.7	0.26	4.99	2.21	-2.78	Very high
S82 0-0.1	*G6862/76*	Fine	18.9	0.23	4.81	2.64	-2.17	Low
S82 0.5-0.6	*G6862/77*	Coarse	13.4	0.16	4.95	2.78	-2.17	Low
S82 1.0-1.1	*G6862/78*	Medium	22.0	0.28	4.46	2.37	-2.09	Very high
S82 1.5-1.6	*G6862/79*	Medium	19.7	0.25	4.21	2.31	-1.90	Very high
S82 1.9-2.0	*G6862/80*	Medium	21.6	0.27	4.55	2.39	-2.16	Very high
S97 0-0.1	*G6862/81*	Medium	21.3	0.27	4.72	2.44	-2.28	High
S97 0.5-0.6	*G6862/82*	Medium	17.9	0.22	5.41	3.40	-2.01	Medium
S97 1.0-1.1	*G6862/83*	Medium	20.1	0.25	4.87	2.83	-2.04	Very high
S97 1.5-1.6	*G6862/84*	Coarse	21.7	0.28	4.85	2.33	-2.52	Very high
S97 1.9-2.0	*G6862/85*	Coarse	20.5	0.26	5.05	2.43	-2.62	Very high
S86 0-0.1	*G6862/86*	Coarse	14.3	0.17	5.05	2.99	-2.06	Low
S86 0.5-0.6	*G6862/87*	Medium	19.3	0.24	5.20	3.21	-1.99	Medium
S86 1.0-1.1	*G6862/88*	Medium	21.5	0.27	5.02	2.64	-2.38	Very high
S86 1.5-1.6	*G6862/89*	Medium	20.8	0.26	4.97	2.31	-2.66	Very high
S86 1.9-2.0	*G6862/90*	Medium	20.5	0.26	5.01	2.66	-2.35	Very high
S91 0-0.1	*G6862/91*	Medium	25.4	0.34	4.65	3.32	-1.33	Very high
S91 0.5-0.6	*G6862/92*	Coarse	14.8	0.17	5.50	3.47	-2.03	Medium
S91 1.0-1.1	*G6862/93*	Medium	19.5	0.24	5.11	2.74	-2.37	Very high
S91 1.5-1.6	*G6862/94*	Coarse	20.9	0.26	4.77	2.72	-2.05	Very high
S91 1.9-2.0	*G6862/95*	Coarse	21.5	0.27	4.80	2.33	-2.47	Very high

NOTES:

1. All analysis is reported on a dry weight (DW) basis, unless wet weight (WW) is specified.
2. Samples are dried and ground immediately upon arrival (unless supplied dried and ground).
3. Analytical procedures are sourced from Ahern CR, McElnea AE and Sullivan LA (2004). *Acid sulfate soil laboratory method guidelines*. Queensland Department of Natural Resources, Mines and Energy: Indooroopilly, Qld, Australia.
4. The Acid Base Accounting Equation is **Net Acidity = Actual Acidity + Retained Acidity + Potential Sulfidic Acidity (S_{Cr} or S_{NAS}) – Acid Neutralising Capacity/Fineness Factor** (Ahern et al. 2004 - full reference above).
5. Retained Acidity is required when the pH_{KCl} < 4.5 or where jarosite has been visually observed. Acid Neutralising Capacity is required when the Potential Sulfidic Acidity is greater than the texture dependent trigger and the pH_{KCl} is ≥ 6.5.
6. **An acid sulfate soil management plan is triggered by Net Acidity results greater than the texture dependent criterion: coarse texture ≥ 0.03% S or 19 mol H^+/t; medium texture ≥ 0.06% S or 37 mol H^+/t; fine texture ≥ 0.1% S or 62 mol H^+/t)** (Ahern *et al.* 2004 - full reference above)
7. For projects that disturb > 1000 tonnes of soil, the coarse trigger of ≥ 0.03% S must be applied in accordance with Ahern CR, Stone Y and Blunden B (1998). *Acid sulfate soils assessment guidelines*. Acid Sulfate Soil Management Advisory Committee: Wollongbar, NSW, Australia.
8. Acid sulfate soil texture triggers can be related to standard soil textures: coarse = sands to loamy sands; medium = sandy loams to light clays; fine = medium to heavy clays and silty clays (Ahern et al. 1998 - full reference above).
9. Bulk density is required to convert liming rates to soil volume based results. Field bulk density rings can be submitted to EAL for bulk density determination.
10. **The lime calculation includes a Safety Factor of 1.5 as a safety margin for acid neutralisation (Ahern et al. 2004). This is only applied to positive values. An increased Safety Factor may be required in some cases.**
11. A negative Net Acidity result indicates an excess acid neutralising capacity.
12. '..' is reported where a test is either not requested or not required. Where pH_{KCl} is < 4.5 or > 6.5, zero is reported for S_{NAS} and ANC in Net Acidity calculations, respectively.
13. Results refer to samples as received at the laboratory. This report is not to be reproduced except in full.
14. ** NATA accreditation does not cover the performance of this service.

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checked: .....
Graham Lancaster
Laboratory Manager

RESULTS OF ACID SULFATE SOIL ANALYSIS

95 samples supplied by Env Solutions Pty Ltd on 25/01/18. Lab Job No.G6862
Analysis requested by Craig Helbig. Your Job: 18012

PO Box 248 BALLINA NSW 2478

Sample identification	EAL Lab Code	Texture	Moisture Content		pH$_F$ and pH$_{FOX}$				KCl-extractable sulfur (S_{KCl})		Potential Sulfidic Acidity (Chromium Reducible Sulfur - CRS)		Actual Acidity (Titratable Actual Acidity - TAA)		Retained Acidity ($S_{KCl} - S_{SKCl}$)		Acid Neutralising Capacity (ANC_{BT})		Net Acidity (based on S_{CR})	Lime Calculation
			(% moisture of total wet weight)	(g moisture / g of oven dry soil)	pH$_F$	pH$_{FOX}$	pH change	Reaction	(% S_{KCl})	(equiv. mol H$^+$/t)	(% S_{CR})	(mol H$^+$/t)	pH$_{KCl}$	(mol H$^+$/t)	(%S_{SKCl})	(mol H$^+$/t)	(% $CaCO_3$)	(mol H$^+$/t)	(mol H$^+$/t)	(kg $CaCO_3$/t DW)
Method Info.		**		**	*(In-house method S21)*				**		*(In-house method S20)*		*(In-house method 16b)*		**		*(In-house method S14)*		**	**
S12 0-0.1	*G6862/1*	Medium	19.6	0.24	5.72	2.08	-3.64	Low	..	..	..	..	..	..	..	..	..	..	..	..
S12 0.5-0.6	*G6862/2*	Medium	22.2	0.29	4.46	1.87	-2.59	Very High	..	..	..	..	..	..	..	..	..	..	..	..
S12 1.0-1.1	*G6862/3*	Medium	22.6	0.29	4.54	2.02	-2.52	Very High	..	..	..	..	..	..	..	..	..	..	..	..
S12 1.5-1.6	*G6862/4*	Medium	23.8	0.31	5.19	2.06	-3.13	Very High	..	..	0.296	185	4.79	8	..	..	..	..	193	14.5
S12 1.9-2.0	*G6862/5*	Medium	21.9	0.28	5.16	2.14	-3.02	Very High	..	..	..	..	..	..	..	..	..	..	..	..
S6 0-0.1	*G6862/6*	Medium	22.2	0.29	6.76	1.94	-4.82	Low	..	..	..	..	..	..	..	..	..	..	..	..
S6 0.5-0.6	*G6862/7*	Medium	23.1	0.30	5.63	2.01	-3.62	Very High	..	..	..	..	..	..	..	..	..	..	..	..
S6 1.0-1.1	*G6862/8*	Medium	22.0	0.28	5.34	1.87	-3.47	Very High	..	..	..	..	..	..	..	..	..	..	..	..
S6 1.5-1.6	*G6862/9*	Medium	21.5	0.27	5.24	1.97	-3.27	Very High	..	..	..	..	..	..	..	..	..	..	..	..
S6 1.9-2.0	*G6862/10*	Medium	22.2	0.29	6.15	2.01	-4.14	Very High	..	..	0.373	233	5.52	3	..	..	..	..	235	17.6
S3 0-0.1	*G6862/11*	Medium	22.0	0.28	7.14	3.76	-3.38	Medium	..	..	0.012	7	6.23	2	..	..	..	..	9	0.7
S3 0.5-0.6	*G6862/12*	Medium	22.9	0.30	7.12	1.70	-5.42	Low	..	..	..	..	..	..	..	..	..	..	..	..
S3 1.0-1.1	*G6862/13*	Medium	22.6	0.29	6.09	1.96	-4.13	Very High	..	..	..	..	..	..	..	..	..	..	..	..
S3 1.5-1.6	*G6862/14*	Medium	20.6	0.26	6.92	2.08	-4.84	Very High	..	..	0.279	174	5.77	2	..	..	..	..	176	13.2
S3 1.9-2.0	*G6862/15*	Medium	22.8	0.30	7.02	2.14	-4.88	Low	..	..	..	..	..	..	..	..	..	..	..	..
S21 0-0.1	*G6862/16*	Medium	21.2	0.27	7.20	3.86	-3.34	Medium	..	..	..	..	..	..	..	..	..	..	..	..
S21 0.5-0.6	*G6862/17*	Coarse	18.5	0.23	7.95	3.28	-4.67	Low	..	..	..	..	..	..	..	..	..	..	..	..
S21 1.0-1.1	*G6862/18*	Coarse	22.5	0.29	5.76	2.14	-3.62	Very High	..	..	..	..	..	..	..	..	..	..	..	..
S21 1.5-1.6	*G6862/19*	Coarse	20.4	0.26	6.98	2.15	-4.83	Very High	..	..	..	..	..	..	..	..	..	..	..	..
S21 1.9-2.0	*G6862/20*	Coarse	20.3	0.25	7.21	2.26	-4.95	Very High	..	..	0.217	135	6.07	2	..	..	..	..	137	10.3
S26 0-0.1	*G6862/21*	Fine	29.3	0.41	7.18	4.08	-3.10	Medium	..	..	0.009	6	6.48	1	..	..	..	..	7	0.5
S26 0.5-0.6	*G6862/22*	Fine	22.8	0.30	7.07	4.01	-3.06	Medium	..	..	..	..	..	..	..	..	..	..	..	..
S26 1.0-1.1	*G6862/23*	Medium	22.2	0.29	5.95	2.06	-3.89	Very High	..	..	0.230	143	5.15	6	..	..	..	..	150	11.2
S26 1.5-1.6	*G6862/24*	Medium	22.8	0.29	5.32	2.04	-3.28	Very High	..	..	..	..	..	..	..	..	..	..	..	..
S26 1.9-2.0	*G6862/25*	Medium	20.2	0.25	6.22	2.11	-4.11	Low	..	..	..	..	..	..	..	..	..	..	..	..
SA2 0-0.1	*G6862/26*	Medium	19.7	0.25	6.54	3.70	-2.84	Medium	..	..	..	..	..	..	..	..	..	..	..	..
SA2 0.5-0.6	*G6862/27*	Medium	21.0	0.27	6.33	3.74	-2.59	Medium	..	..	..	..	..	..	..	..	..	..	..	..
SA2 1.0-1.1	*G6862/28*	Medium	21.5	0.27	5.29	2.03	-3.26	Very High	..	..	0.251	157	4.81	8	..	..	..	..	164	12.3
SA2 1.5-1.6	*G6862/29*	Coarse	20.6	0.26	5.16	2.34	-2.82	Very High	..	..	..	..	..	..	..	..	..	..	..	..
SA2 1.9-2.0	*G6862/30*	Medium	22.4	0.29	5.64	2.36	-3.28	Very High	..	..	..	..	..	..	..	..	..	..	..	..
S36 0-0.1	*G6862/31*	Medium	20.2	0.25	5.73	2.68	-3.05	Medium	..	..	..	..	..	..	..	..	..	..	..	..
S36 0.5-0.6	*G6862/32*	Medium	21.3	0.27	5.58	2.04	-3.54	Low	..	..	..	..	..	..	..	..	..	..	..	..
S36 1.0-1.1	*G6862/33*	Medium	25.7	0.35	5.68	1.91	-3.77	Very High	..	..	..	..	..	..	..	..	..	..	..	..
S36 1.5-1.6	*G6862/34*	Medium	24.0	0.32	5.78	2.04	-3.74	Very High	..	..	..	..	..	..	..	..	..	..	..	..
S36 1.9-2.0	*G6862/35*	Medium	23.4	0.31	5.87	2.03	-3.84	Very High	..	..	0.448	279	4.60	15	..	..	..	..	295	22.1
S53 0-0.1	*G6862/36*	Fine	20.9	0.26	5.18	2.48	-2.70	Medium	0.005	3	<0.005	0	4.33	62	0.011	5	..	..	67	5.0
S53 0.5-0.6	*G6862/37*	Medium	20.4	0.26	6.47	2.84	-3.63	Medium	..	..	..	..	..	..	..	..	..	..	..	..
S53 1.0-1.1	*G6862/38*	Medium	23.6	0.31	5.56	2.00	-3.56	Very High	..	..	..	..	..	..	..	..	..	..	..	..
S53 1.5-1.6	*G6862/39*	Medium	23.1	0.30	6.05	2.07	-3.98	Very High	..	..	..	..	..	..	..	..	..	..	..	..
S53 1.9-2.0	*G6862/40*	Medium	21.9	0.28	6.12	2.10	-4.02	Low	..	..	..	..	..	..	..	..	..	..	..	..
S31 0-0.1	*G6862/41*	Fine	20.7	0.26	5.08	2.80	-2.28	Very High	..	..	..	..	..	..	..	..	..	..	..	..
S31 0.5-0.6	*G6862/42*	Medium	18.4	0.22	5.23	2.93	-2.30	Low	..	..	..	..	..	..	..	..	..	..	..	..
S31 1.0-1.1	*G6862/43*	Medium	21.2	0.27	4.34	2.08	-2.26	Medium	..	..	..	..	..	..	..	..	..	..	..	..
S31 1.5-1.6	*G6862/44*	Medium	23.7	0.31	4.71	2.10	-2.61	Low	..	..	..	..	..	..	..	..	..	..	..	..
S31 1.9-2.0	*G6862/45*	Medium	21.6	0.28	4.76	2.11	-2.65	High	0.008	5	0.311	194	4.40	25	0.005	2	..	..	222	16.6
S50 0-0.1	*G6862/46*	Medium	27.9	0.39	4.67	3.08	-1.59	Medium	..	..	..	..	..	..	..	..	..	..	..	..
S50 0.5-0.6	*G6862/47*	Medium	19.6	0.24	4.94	2.83	-2.11	Medium	0.001	0	0.008	5	4.38	62	0.006	3	..	..	70	5.2
S50 1.0-1.1	*G6862/48*	Medium	20.1	0.25	4.96	2.85	-2.11	Medium	..	..	..	..	..	..	..	..	..	..	..	..
S50 1.5-1.6	*G6862/49*	Medium	22.8	0.30	4.49	1.98	-2.51	Very High	..	..	..	..	..	..	..	..	..	..	..	..
S50 1.9-2.0	*G6862/50*	Medium	21.7	0.28	4.64	1.99	-2.65	Very High	0.000	0	0.301	188	4.56	13	..	..	..	..	201	15.1
S56 0-0.1	*G6862/51*	Medium	27.7	0.38	4.81	2.81	-2.00	Very High	..	..	..	..	..	..	..	..	..	..	..	..
S56 0.5-0.6	*G6862/52*	Fine	23.7	0.31	4.79	3.04	-1.75	Medium	0.001	0	0.006	4	4.20	111	0.008	4	..	..	118	8.9
S56 1.0-1.1	*G6862/53*	Fine	21.9	0.28	4.76	2.69	-2.07	Medium	..	..	..	..	..	..	..	..	..	..	..	..
S56 1.5-1.6	*G6862/54*	Medium	23.2	0.30	4.95	2.87	-2.08	Low	..	..	..	..	..	..	..	..	..	..	..	..
S56 1.9-2.0	*G6862/55*	Fine	21.6	0.27	4.71	2.22	-2.49	Very High	..	..	..	..	..	..	..	..	..	..	..	..
S70 0-0.1	*G6862/56*	Fine	23.6	0.31	5.35	3.95	-1.40	Medium	..	..	..	..	..	..	..	..	..	..	..	..
S70 0.5-0.6	*G6862/57*	Medium	21.9	0.28	7.37	5.29	-2.08	Medium	..	..	..	..	..	..	..	..	..	..	..	..
S70 1.0-1.1	*G6862/58*	Medium	22.3	0.29	6.90	2.26	-4.64	Very High	0.000	0	0.566	353	5.25	8	..	..	..	..	361	27.1
S70 1.5-1.6	*G6862/59*	Medium	22.2	0.29	6.05	2.17	-3.88	Very High	..	..	..	..	..	..	..	..	..	..	..	..
S70 1.9-2.0	*G6862/60*	Medium	22.3	0.29	6.22	2.24	-3.98	Very High	..	..	..	..	..	..	..	..	..	..	..	..
S73 0-0.1	*G6862/61*	Medium	29.4	0.42	6.26	2.00	-4.26	Very High	0.002	1	0.019	12	4.21	170	0.012	6	..	..	188	14.1
S73 0.5-0.6	*G6862/62*	Medium	18.1	0.22	4.80	2.70	-2.10	Medium	..	..	..	..	..	..	..	..	..	..	..	..
S73 1.0-1.1	*G6862/63*	Medium	21.4	0.27	4.87	3.27	-1.60	Low	..	..	..	..	..	..	..	..	..	..	..	..
S73 1.5-1.6	*G6862/64*	Medium	22.5	0.29	5.16	2.80	-2.36	Low	..	..	..	..	..	..	..	..	..	..	..	..
S73 1.9-2.0	*G6862/65*	Medium	20.4	0.26	4.62	2.28	-2.34	Very high	..	..	..	..	..	..	..	..	..	..	..	..
S67 0-0.1	*G6862/66*	Medium	17.0	0.20	5.08	3.04	-2.04	Low	..	..	..	..	..	..	..	..	..	..	..	..
S67 0.5-0.6	*G6862/67*	Coarse	15.2	0.18	5.76	3.69	-2.07	Medium	..	..	..	..	..	..	..	..	..	..	..	..
S67 1.0-1.1	*G6862/68*	Coarse	15.6	0.18	6.03	3.52	-2.51	Medium	..	..	..	..	..	..	..	..	..	..	..	..
S67 1.5-1.9	*G6862/69*	Medium	20.3	0.25	4.68	1.95	-2.73	Very high	..	..	..	..	..	..	..	..	..	..	..	..
S67 1.9-2.0	*G6862/70*	Medium	20.1	0.25	5.16	2.12	-3.04	Very high	..	..	0.545	340	4.63	15	..	..	..	..	355	26.6
S83 0-0.1	*G6862/71*	Medium	17.4	0.21	4.85	2.61	-2.24	Medium	..	..	..	..	..	..	..	..	..	..	..	..
S83 0.5-0.6	*G6862/72*	Medium	16.8	0.20	5.38	3.18	-2.20	Low	..	..	..	..	..	..	..	..	..	..	..	..
S83 1.0-1.1	*G6862/73*	Coarse	16.6	0.20	5.57	3.28	-2.29	Low	..	..	..	..	..	..	..	..	..	..	..	..
S83 1.5-1.6	*G6862/74*	Medium	20.9	0.26	4.38	2.43	-1.95	Very high	..	..	..	..	..	..	..	..	..	..	..	..
S83 1.9-2.0	*G6862/75*	Medium	20.7	0.26	4.99	2.21	-2.78	Very high	..	..	0.357	223	4.62	20	..	..	..	..	242	18.2
S82 0-0.1	*G6862/76*	Fine	18.9	0.23	4.81	2.64	-2.17	Low	..	..	..	..	..	..	..	..	..	..	..	..
S82 0.5-0.6	*G6862/77*	Coarse	13.4	0.16	4.95	2.78	-2.17	Low	..	..	..	..	..	..	..	..	..	..	..	..
S82 1.0-1.1	*G6862/78*	Medium	22.0	0.28	4.46	2.37	-2.09	Very high	0.013	8	0.478	298	4.48	28	0.004	2	..	..	328	24.6
S82 1.5-1.6	*G6862/79*	Medium	19.7	0.25	4.21	2.31	-1.90	Very high	..	..	..	..	..	..	..	..	..	..	..	..
S82 1.9-2.0	*G6862/80*	Medium	21.6	0.27	4.55	2.39	-2.16	Very high	..	..	..	..	..	..	..	..	..	..	..	..
S97 0-0.1	*G6862/81*	Medium	21.3	0.27	4.72	2.44	-2.28	High	0.000	0	0.014	9	4.11	140	0.010	5	..	..	153	11.5
S97 0.5-0.6	*G6862/82*	Medium	17.9	0.22	5.41	3.40	-2.01	Medium	..	..	..	..	..	..	..	..	..	..	..	..
S97 1.0-1.1	*G6862/83*	Medium	20.1	0.25	4.87	2.83	-2.04	Very high	..	..	..	..	..	..	..	..	..	..	..	..
S97 1.5-1.6	*G6862/84*	Coarse	21.7	0.28	4.85	2.33	-2.52	Very high	..	..	..	..	..	..	..	..	..	..	..	..
S97 1.9-2.0	*G6862/85*	Coarse	20.5	0.26	5.05	2.43	-2.62	Very high	..	..	0.148	92	4.80	14	..	..	..	..	106	8.0
S86 0-0.1	*G6862/86*	Coarse	14.3	0.17	5.05	2.99	-2.06	Low	..	..	..	..	..	..	..	..	..	..	..	..
S86 0.5-0.6	*G6862/87*	Medium	19.3	0.24	5.20	3.21	-1.99	Medium	..	..	..	..	..	..	..	..	..	..	..	..
S86 1.0-1.1	*G6862/88*	Medium	21.5	0.27	5.02	2.64	-2.38	Very high	..	..	..	..	..	..	..	..	..	..	..	..
S86 1.5-1.6	*G6862/89*	Medium	20.8	0.26	4.97	2.31	-2.66	Very high	..	..	0.288	180	4.87	15	..	..	..	..	194	14.6
S86 1.9-2.0	*G6862/90*	Medium	20.5	0.26	5.01	2.66	-2.35	Very high	..	..	..	..	..	..	..	..	..	..	..	..
S91 0-0.1	*G6862/91*	Medium	25.4	0.34	4.65	3.32	-1.33	Very high	..	..	..	..	..	..	..	..	..	..	..	..
S91 0.5-0.6	*G6862/92*	Coarse	14.8	0.17	5.50	3.47	-2.03	Medium	..	..	<0.005	0	4.61	20	..	..	..	..	20	1.5
S91 1.0-1.1	*G6862/93*	Medium	19.5	0.24	5.11	2.74	-2.37	Very high	..	..	..	..	..	..	..	..	..	..	..	..
S91 1.5-1.6	*G6862/94*	Coarse	20.9	0.26	4.77	2.72	-2.05	Very high	..	..	..	..	..	..	..	..	..	..	..	..
S91 1.9-2.0	*G6862/95*	Coarse	21.5	0.27	4.80	2.33	-2.47	Very high	..	..	0.332	207	4.59	18	..	..	..	..	225	16.9

NOTES:

1. All analysis is reported on a dry weight (DW) basis, unless wet weight (WW) is specified.
2. Samples are dried and ground immediately upon arrival (unless supplied dried and ground).
3. Analytical procedures are sourced from Ahern CR, McElnea AE and Sullivan LA (2004). *Acid sulfate soil laboratory method guidelines*. Queensland Department of Natural Resources, Mines and Energy: Indooroopilly, Qld, Australia.
4. The Acid Base Accounting Equation is **Net Acidity = Actual Acidity + Retained Acidity + Potential Sulfidic Acidity (S_{CR} or S_{Cr}) − Acid Neutralising Capacity/Fineness Factor** (Ahern et al. 2004 - full reference above).
5. Retained Acidity is required when the pH$_{KCl}$ < 4.5 or where jarosite has been visually observed. Acid Neutralising Capacity is required when the Potential Sulfidic Acidity is greater than the texture dependent trigger and the pH$_{KCl}$ is ≥ 6.5.
6. **An acid sulfate soil management plan is triggered by Net Acidity results greater than the texture dependent criterion: coarse texture ≥ 0.03% S or 19 mol H$^+$/t; medium texture ≥ 0.06% S or 37 mol H$^+$/t; fine texture ≥ 0.1% S or 62 mol H$^+$/t)** (Ahern *et al.* 2004 - full reference above)
7. For projects that disturb > 1000 tonnes of soil, the coarse trigger of ≥ 0.03% S must be applied in accordance with Ahern CR, Stone Y and Blunden B (1998). *Acid sulfate soils assessment guidelines*. Acid Sulfate Soil Management Advisory Committee: Wollongbar, NSW, Australia.
8. Acid sulfate soil texture triggers can be related to standard soil textures: coarse = sands to loamy sands; medium = sandy loams to light clays; fine = medium to heavy clays and silty clays (Ahern et al. 1998 - full reference above).
9. Bulk density is required to convert liming rates to soil volume based results. Field bulk density rings can be submitted to EAL for bulk density determination.
10. **The lime calculation includes a Safety Factor of 1.5 as a safety margin for acid neutralisation (Ahern et al. 2004). This is only applied to positive values. An increased Safety Factor may be required in some cases.**
11. A negative Net Acidity result indicates an excess acid neutralising capacity.
12. '..' is reported where a test is either not requested or not required. Where pH$_{KCl}$ is < 4.5 or > 6.5, zero is reported for S_{NAS} and ANC in Net Acidity calculations, respectively.
13. Results refer to samples as received at the laboratory. This report is not to be reproduced except in full.
14. ** NATA accreditation does not cover the performance of this service.

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Environmental Analysis Laboratory, Southern Cross University,
Tel. 02 6620 3678, website: scu.edu.au/eal

checked: .....
Graham Lancaster
Laboratory Manager

RESULTS OF SOIL ANALYSIS

102 soil samples supplied by Env Solutions Pty Ltd on 30th January, 2018 - Lab Job No. G6927
Soil samples supplied were composited by EAL into 25 composite samples for analysis
Analysis requested by Craig Helbig. Your Job: 18012
PO Box 248 BALLINA NSW 2478

ANALYTE	METHOD REFERENCE	Sample 4 S4 0-0.15	Sample 50 S44 0-0.15	Sample 88 S82 0.2-0.5	Sample 91 S88 0-0.15	Sample 101 QC1 0-0.15	Sample 102 QC3 0-0.15	Composite Sample 1 C1 (S1,2,3,4)	Composite Sample 2 C2 (S6,7,10,11)	Composite Sample 3 C3 (S9,12,13,17)
	Job No.	G6927/4	G6927/50	G6927/88	G6927/91	G6927/101	G6927/102	G6927/C1	G6927/C2	G6927/C3
DEPTH (m)		0-0.15	0-0.15	0.2-0.5	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15
TEXTURE (SAND, CLAY, SILT)	** inhouse	Silt	Silt	Silt	Silt	Silt	Silt	Silt	Silt	Silt
MOISTURE %	** c	40	17	13	26	13	35	31	28	22
SILVER (mg/kg DW)	*a*	<1	..	<1	..	<1	<1	<1	<1	<1
ARSENIC (mg/kg DW)	*a*	3	..	1	..	1	3	1	4	1
LEAD (mg/kg DW)	*a*	5	..	2	..	2	5	5	4	3
CADMIUM (mg/kg DW)	*a*	<0.5	..	<0.5	..	<0.5	<0.5	<0.5	<0.5	<0.5
CHROMIUM (mg/kg DW)	*a*	12	..	8	..	8	12	11	12	11
COPPER (mg/kg DW)	*a*	6	..	4	..	4	6	6	5	4
MANGANESE (mg/kg DW)	*a*	21	..	10	..	10	21	25	30	14
NICKEL (mg/kg DW)	*a*	7	..	3	..	4	7	6	8	5
SELENIUM (mg/kg DW)	*a*	1	..	<1	..	<1	1	<1	<1	<1
ZINC (mg/kg DW)	*a*	18	..	7	..	7	21	18	17	9
MERCURY (mg/kg DW)	*a*	<0.05	..	<0.05	..	<0.05	<0.05	<0.05	<0.05	<0.05
IRON (% DW)	*a*	1.49	..	0.31	..	0.30	1.62	1.35	1.78	0.93
ALUMINIUM (% DW)	*a*	1.16	..	0.64	..	0.62	1.18	1.08	1.05	0.93
BERYLLIUM (mg/kg DW)	*a*	<1	..	<1	..	<1	<1	<1	<1	<1
BORON (mg/kg DW)	*a*	10	..	1	..	1	9	9	6	3
COBALT (mg/kg DW)	*a*	2	..	2	..	2	2	2	4	1
PESTICIDE ANALYSIS SCREEN										
DDT+DDE+DDD (mg/kg)	*c*	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aldrin + Dieldrin (mg/kg)	*c*	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chlordane (mg/kg)	*c*	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan (mg/kg)	*c*	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin (mg/kg)	*c*	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor (mg/kg)	*c*	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
HCB (mg/kg)	*c*	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor (mg/kg)	*c*	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Other Organochlorine Pesticides (mg/kg)	*c*	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyrifos (mg/kg)	*c*	..	<0.1	..	<0.1	..	..	..	..	..
Other Organophosphate Pesticides (mg/kg)	*c*	..	<0.1	..	<0.1	..	..	..	..	..
PCB's (mg/kg)	*c*	..	<0.2	..	<0.2	..	..	..	..	..
HYDROCARBON ANALYSIS RESULTS										
BTEX										
Benzene (mg/kg)	*c*	..	<0.5	..	<0.5	..	..	..	..	..
Toluene (mg/kg)	*c*	..	<0.5	..	<0.5	..	..	..	..	..
Ethylbenzene (mg/kg)	*c*	..	<0.5	..	<0.5	..	..	..	..	..
Total m+p-Xylenes (mg/kg)	*c*	..	<1	..	<1	..	..	..	..	..
o-Xylene (mg/kg)	*c*	..	<0.5	..	<0.5	..	..	..	..	..
Xylenes (ortho.meta & para)	*c*	..	<0.15	..	<0.15	..	..	..	..	..
Total BTEX (mg/kg)	*c*	..	<1	..	<1	..	..	..	..	..
Total Recoverable Hydrocarbons										
C10-C14 Fraction (mg/kg)	*c*	..	<50	..	<50	..	..	..	..	..
C15-C28 Fraction (mg/kg)	*c*	..	<100	..	<100	..	..	..	..	..
C29-C36 Fraction (mg/kg)	*c*	..	140	..	<100	..	..	..	..	..
Sum of C6-C36 (mg/kg)	*c*	..	<100	..	<100	..	..	..	..	..
>C10-C16 Fraction (mg/kg)	*c*	..	<50	..	<50	..	..	..	..	..
>C10-C16 less Naphthalene (mg/kg)	*c*	..	<50	..	<50	..	..	..	..	..
>C16-C34 Fraction (mg/kg)	*c*	..	140	..	<100	..	..	..	..	..
>C34-C40 Fraction (mg/kg)	*c*	..	<100	..	<100	..	..	..	..	..

METHODS REFERENCE

a. 1:3Nitric/HCl digest - APHA 3125 ICPMS
b. 1:3Nitric/HCl digest - APHA 3120 ICPOES
c. Analysis sub-contracted - Envirolab report no. 184393
*** denotes these test procedure or calculation are as yet not NATA accredited but quality control data is available*

NOTES

1a. HIL A ⁑ Residential with garden/accessible soil (home grown produce <10% fruit and vegetable intake (no poultry), also includes childcare centres, preschools and primary schools.
1b. HIL B ⁑ Residential with minimal opportunities for soil access; includes dwellings with fully and permanently paved yard space such as high-rise buildings and apartments.
1c. HIL C ⁑ Public open space such as parks, playgrounds, playing fields (e.g. ovals), secondary schools and footpaths. This does not include undeveloped public open space.
1d. HIL D ⁑ Commercial/industrial, includes premises such as shops, offices, factories and industrial sites.
(REFERENCE: Health Investigation Guidelines from NEPM (National Environmental Protection, Assessment of Site Contamination, Measure), 2013; Schedule B1).
2. Environmental Soil Quality Guidelines, Page 40, ANZECC, 1992.

NATA
Accreditation No. 14960.
Accredited for compliance with ISO/IEC 17025.

Additional NOTES

DW = Dry Weight. na = no guidelines available

Organochlorine pesticide (OC's) screen: (HCB, alpha-BHC, gamma-BHC, Heptachlor, delta-BHC, Aldrin, Heptachlor Epoxide, gamma-Chlordane, alpha-chlordane, Endosulfan 1, pp-DDE, Dieldrin, Endrin, pp-DDD, Endosulfan 2, pp-DDT, Endrin Aldehyde, Endosulfan Sulphate, Methoxychlor)

Organophosphorus pesticide (OP's) screen: (Azinphos-methyl (Guthion), Bromophos-ethyl, Chlorpyriphos, Chlorpyriphos-methyl, Diazinon, Dichlorvos, Dimethoate, Ethion, Fenitrothion, Malathion, Parathion, Ronnel)

PCB's = Polychloriniated Biphenyls (Arochlor 1016, 1232, 1242, 1248, 1254, 1260)

checked:.....

Composite Sample 4 C4 (S16,15,14,22)	Composite Sample 5 C5 (S19,20,21,5)	Composite Sample 6 C6 (S26,27,8,33)	Composite Sample 7 C7 (S28,29,35,36)	Composite Sample 8 C8 (S34,51,42,43)	Composite Sample 9 C9 (S52,53,60,61)	Composite Sample 10 C10 (S18,23,24,25)	Composite Sample 11 C11 (S31,32,40,41)	Composite Sample 12 C12 (S30,37,38,39)	Composite Sample 13 C13 (S45,44,54,62)	Composite Sample 14 C14 (S96,69,70,71)	Composite Sample 15 C15 (S46,47,55,56)	Composite Sample 16 C16 (S63,64,72,78)	Composite Sample 17 C17 (S48,49,98,99)
G6927/C4	*G6927/C5*	*G6927/C6*	*G6927/C7*	*G6927/C8*	*G6927/C9*	*G6927/C10*	*G6927/C11*	*G6927/C12*	*G6927/C13*	*G6927/C14*	*G6927/C15*	*G6927/C16*	*G6927/C17*
0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15	0-0.15
Silt	Silt	Silt	Silt	Silt	Silt	Silt	Silt	Silt	Silt	Silt	Silt	Silt	Silt
30	24	30	26	24	37	30	28	33	32	26	26	25	30
<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
4	3	6	3	3	4	2	3	4	3	4	3	3	2
4	3	4	4	2	4	5	5	5	5	6	7	8	6
<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
14	11	14	14	10	14	14	17	18	14	18	23	21	18
5	4	4	5	3	5	6	7	8	8	8	9	11	8
42	28	98	16	39	40	16	18	26	22	46	43	55	21
9	7	9	7	6	9	7	9	10	8	10	12	11	10
<1	<1	1	<1	<1	1	1	1	1	<1	1	1	<1	<1
20	18	53	12	14	25	14	17	21	20	31	27	33	18
<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	<0.05	0.06	0.05	<0.05
1.88	1.47	3.02	1.37	2.05	2.15	1.15	1.42	2.38	2.03	2.86	3.21	2.80	1.59
1.32	1.02	1.27	1.31	0.85	1.34	1.37	1.65	1.83	1.45	1.69	2.18	2.12	1.88
<1	<1	<1	<1	<1	1	1	1	1	<1	<1	<1	<1	1
8	7	6	2	4	3	2	2	2	1	2	1	2	1
4	3	7	2	3	4	2	3	3	3	4	4	4	3
<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
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Composite Sample 18	Composite Sample 19	Composite Sample 20	Composite Sample 21	Composite Sample 22	Composite Sample 23	Composite Sample 24	Composite Sample 25	*RESIDENTIAL A Guideline Limit*		*COMMERCIAL/ INDUSTRIAL D Guideline Limit*		*Background*
C18 (S57,58,65 ,66)	C19 (S50,100,5 9,67)	C20 (S73,74,79 ,80)	C21 (S68,75,76 ,77)	C22 (S81,84,86 ,82)	C23 (S83,85,88 ,89)	C24 (S87,93,91 ,90)	C25 (S92,94,95 ,97)	*Composite - Column A*	*Individual - Column A*	*Composite - Column D*	*Individual - Column D*	*Range*
G6927/C18	*G6927/C19*	*G6927/C20*	*G6927/C21*	*G6927/C22*	*G6927/C23*	*G6927/C24*	*G6927/C25*	*See note 1a*	*See note 1a*	*See note 1d*	*See note 1d*	*See note 2*
0-0.15	0-0.5	0-0.15	0-0.15	0-0.5	0-0.2	0-0.15	0-1					
Silt	Silt	Silt	Silt	Silt	Silt	Silt	Silt	..	..	..	..	..
34	28	27	30	24	22	23	20	..	..	..	..	..
<1	<1	<1	<1	<1	<1	<1	<1	*na*	*na*	*na*	*na*	*na*
3	3	2	2	2	3	3	2	*25*	*100*	*750*	*3,000*	*0.2-30*
6	5	5	5	4	5	6	4	*75*	*300*	*375*	*1,500*	*<2-200*
<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	*5*	*20*	*225*	*900*	*0.04-2.0*
17	19	18	16	17	19	22	13	*(<25)*	*(<100)*	*(<900)*	*(<3,600)*	*0.5-110*
9	7	7	8	6	8	6	5	*1,500*	*6,000*	*60,000*	*240,000*	*1-190*
20	23	28	20	26	26	33	24	*950*	*3,800*	*15,000*	*60,000*	*4 - 12,600*
9	9	9	7	8	9	9	6	*100*	*400*	*1,500*	*6,000*	*2-400*
1	1	<1	1	<1	<1	1	<1	*50*	*200*	*2,500*	*10,000*	*na*
21	20	22	17	19	20	23	17	*1,850*	*7,400*	*100,000*	*400,000*	*2-180*
0.05	0.05	0.07	<0.05	<0.05	<0.05	<0.05	<0.05	*10*	*40*	*183*	*730*	*0.001-0.1*
1.90	2.20	1.98	1.10	2.03	2.41	2.69	1.62	*na*	*na*	*na*	*na*	*na*
1.80	1.81	1.68	1.57	1.52	1.76	1.94	1.09	*na*	*na*	*na*	*na*	*na*
1	<1	<1	1	<1	<1	<1	<1	*15*	*60*	*125*	*500*	*na*
1	1	1	1	1	1	2	1	*1,125*	*4,500*	*75,000*	*300,000*	*na*
3	3	3	2	3	3	4	2	*25*	*100*	*1,000*	*4,000*	*na*
<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	*60*	*240*	*900*	*3,600*	*<0.1*
<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	*2*	*6*	*11*	*45*	*<0.1*
<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	*13*	*50*	*133*	*530*	*<0.1*
<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	*68*	*270*	*500*	*2,000*	*<0.1*
<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	*3*	*10*	*25*	*100*	*<0.1*
<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	*2*	*6*	*13*	*50*	*<0.1*
<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	*3*	*10*	*20*	*80*	*<0.1*
<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	*75*	*300*	*625*	*2,500*	*<0.1*
<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	..	..	..	..	*<0.1*
..	..	..	..	..	..	..	..	*40*	*160*	*500*	*2,000*	*<0.1*
..	..	..	..	..	..	..	..	..	..	..	..	*<0.1*
..	..	..	..	..	..	..	..	*0.25*	*1.00*	*1.75*	*7.00*	*<0.2*
..	..	..	..	..	..	..	..	*0.1*	*0.5*	..	..	..
..	..	..	..	..	..	..	..	*40*	*160*	..	..	..
..	..	..	..	..	..	..	..	*13.8*	*55*	..	..	..
..	..	..	..	..	..	..	..	*10*	*40*	..	..	..
..	..	..	..	..	..	..	..	*10*	*40*	..	..	..
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..	..	..	..	..	..	..	..	*250*	*1,000*	*250*	*1,000*	..
..	..	..	..	..	..	..	..	*875*	*3,500*	*1,250*	*5,000*	..
..	..	..	..	..	..	..	..	*2,500*	*10,000*	*2,500*	*10,000*	..

checked:.....

(*) Place COCs in snaplock bag (*)

CHAIN OF CUSTODY

eal Environmental Analysis Laboratory
Division of Research
Southern Cross University

PO Box 157 (Military Road)
LISMORE NSW 2480
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Submitting Client Details

Quote Id:
Job Ref:
Company Name: ENV Solutions Pty Ltd
Contact Person: ~~James Foster~~ Craig Helbig
Phone:
Mobile: ~~0421519354~~ 0405 364 626
Fax: Craig
Email: ~~james~~@envsolutions.com.au
Postal Address:

Billing Client Details

ABN: 600788814
Company Name: ENV Solutions Pty Ltd
Contact Person: James Foster
Phone:
Mobile: 0421519354
Fax:
Email: james@envsolutions.com.au
Postal Address: 1/17 Grandview Street
East Ballina NSW 2478

This section will be destroyed after being processed. Do NOT provide your CVV number, you will be contacted by phone or email when this is required.

Payment Method:
☐ Purchase Order
☐ Cheque
☑ Invoice (prior approval required)
☐ Credit Card Mastercard / Visa No: _____/_____/_____/_____

Exp. Date: Name on Card: CVV: by phone

	Date	Signed
Relinquished By: CRAIG HELBIG	25/1/18	
Preservation: None / Ice / Ice bricks / Acidified / Filtered / Other: Frozen		
Received By:	25/1/18	AH
Condition on receipt: Ambient / Cool / Frozen / Other:		

Comments:

Marketing Survey – where did you find us?
☐ Word of mouth ☐ Magazine ☐ Google search ☐ Other

Sample Analysis Request

Price List Code (e.g. SW-PACK-06)

(*) Analysis will depend on AS-PACK-007 results – TBA

Lab Sample No.	Sample ID	Sample Depth	Sampling Date	Your Client	Crop ID	Sample Type (e.g. water, leaf, soil)	(*) AS-PACK-007	AS-PACK-006 (*)	SS-PACK-008			(*)				
1	S12	0-0.1	24/1/18	18012	N/A	Soil	✓									
2	↓	0.5-0.6	↓	↓	↓	↓	✓									
3		1.0-1.1					✓									
4		1.5-1.6					✓									
5	↓	1.9-2.0	↓	↓	↓	↓	✓									

CHAIN OF CUSTODY

Comments:

Marketing Survey – where did you find us?
☐ Word of mouth ☐ Magazine ☐ Google search ☐ Other

Sample Analysis Request

Price List Code (e.g. SW-PACK-06)

Lab Sample No.	Sample ID	Sample Depth	Sampling Date	Your Client	Crop ID	Sample Type (e.g. water, leaf, soil)	AS-PACK-007	(*) AS-PACK-008	SS-PACK-008			(*) Analysis will depend on AS-PACK-007 results				
	S6	0-0.1	24/1/18	18012	N/A	Soil	✓									
	↓	0.5-0.6	↓	↓	↓	↓	✓									
		1.0-1.1					✓									
		1.5-1.6					✓									
		1.9-2.0					✓									
	S3	0-0.1					✓									
	↓	0.5-0.6					✓									
		1.0-1.1					✓									
		1.5-1.6					✓									
		1.9-2.0					✓									
	S21	0-0.1					✓									
	↓	0.5-0.6					✓									
		1.0-1.1					✓									
		1.5-1.6					✓									
		1.9-2.0					✓									
	~~0.3-0.4~~						TBA - not sent ← No sample									
	S26	0-0.1					✓									
	↓	0.5-0.6					✓									
		1.0-1.1					✓									
		1.5-1.6					✓									
		1.9-2.0					✓									

CHAIN OF CUSTODY

Comments:

Marketing Survey – where did you find us?
☐ Word of mouth ☐ Magazine ☐ Google search ☐ Other

Sample Analysis Request

Price List Code (e.g. SW-PACK-06)

Lab Sample No.	Sample ID	Sample Depth	Sampling Date	Your Client	Crop ID	Sample Type (e.g. water, leaf, soil)	AS-PACK-0007	AS-PACK-0008 (*)	SS-PACK-0008							
	SA2	0-0.1	24/1/18	18012	N/A	Soil	✓									
	↓	0.5-0.6	↓	↓	↓	↓	✓									
		1.0-1.1					✓									
		1.5-1.6					✓									
	↓	1.9-2.0					✓									
	S36	0-0.1					✓									
	↓	0.5-0.6					✓									
		1.0-1.1					✓									
		1.5-1.6					✓									
	↓	1.9-2.0					✓									
	S53	0-0.1					✓									
	↓	0.5-0.6					✓									
		1.0-1.1					✓									
		1.5-1.6					✓									
	↓	1.9-2.0					✓									
	S31	0-0.1					✓									
	↓	0.5-0.6					✓									
		1.0-1.1					✓									
		1.5-1.6					✓									
	↓	1.9-2.0	↓	↓	↓	↓	✓									

(*) Analysis will depend on AS-PACK 0007 results - TBA

CHAIN OF CUSTODY

Comments:

Marketing Survey – where did you find us?
☐ Word of mouth ☐ Magazine ☐ Google search ☐ Other

Sample Analysis Request

Price List Code (e.g. SW-PACK-06)

Lab Sample No.	Sample ID	Sample Depth	Sampling Date	Your Client	Crop ID	Sample Type (e.g. water, leaf, soil)	ES-PACK-007	* ES-PACK-008	SS-PACK-008		* Analysis will depend on AS-PACK-007 results - TBA				
	S50	0-0.1	~~24~~ 1/18	18012	N/A	Soil	✓								
		0.5-0.6					✓								
		1.0-1.1					✓								
		1.5-1.6					✓								
		1.9-2.0					✓								
	~~S55~~	~~0.4-0.5~~					TBA - not sent - no sample.								
	S56	0-0.1					✓								
		0.5-0.6					✓								
		1.0-1.1					✓								
		1.5-1.6					✓								
		1.9-2.0					✓								
	S70	0-0.1					✓								
		0.5-0.6					✓								
		1.0-1.1					✓								
		1.5-1.6					✓								
		1.9-2.0					✓								
	S73	0-0.1					✓								
		0.5-0.6					✓								
		1.0-1.1					✓								
		1.5-1.6					✓								
		1.9-2.0					✓								

CHAIN OF CUSTODY

Comments:

Marketing Survey – where did you find us?
☐ Word of mouth ☐ Magazine ☐ Google search ☐ Other

Sample Analysis Request

Price List Code (e.g. SW-PACK-06)

Lab Sample No.	Sample ID	Sample Depth	Sampling Date	Your Client	Crop ID	Sample Type (e.g. water, leaf, soil)	AS-PACK-0007	* AS-PACK-0008	SS-PACK-0001			* Analysis with depen on AS-PACK-00 results - TBA			
	S67	0-0.1	24/1/18	18012	N/A	Soil	✓								
		0.5-0.6					✓								
		1.0-1.1					✓								
		1.5-1.6					✓								
		1.9-2.0					✓								
	S83	0-0.1					✓								
		0.5-0.6					✓								
		1.0-1.1					✓								
		1.5-1.6					✓								
		1.9-2.0					✓								
		0.1-0.2					TBA - not sent - no sample.								
	S82	0-0.1					✓								
		0.5-0.6					✓								
		1.0-1.1					✓								
		1.5-1.6					✓								
		1.9-2.0					✓								
		0.2-0.5					TBA - not sent - no sample								
	S97	0-0.1					✓								
		0.5-0.6					✓								
		1.0-1.1					✓								
		1.5-1.6					✓								
		1.9-2.0					✓								
		0.9-1.0					TBA - not sent no sample								

CHAIN OF CUSTODY

Comments:

Marketing Survey – where did you find us?
☐ Word of mouth ☐ Magazine ☐ Google search ☐ Other

Sample Analysis Request

Price List Code (e.g. SW-PACK-06)

Lab Sample No.	Sample ID	Sample Depth	Sampling Date	Your Client	Crop ID	Sample Type (e.g. water, leaf, soil)	AS-PACK-007	* AS-PACK-008	SS-PACK-008			* Analysis will depend on AS-PACK-008 results – TBA				
	S86	0-0.1	24/1/18	18012	N/A	Soil	✓									
		0.5-0.6	–				✓									
		1.0-1.1	–				✓									
		1.5-1.6	–				✓									
		1.9-2.0	–				✓									
	~~S82-QC1~~	–					TBA – not sent									
	~~S82-QC2~~	–					TBA – not sent									
	S91	0-0.1M														
		0.5-0.6														
		1.0-1.1														
		1.5-1.6														
		1.9-2.0														

Sample Receipt Notification (SRN)

Project:	**EAL/G6862**
Customer:	Env Solutions Pty Ltd
Contact:	Craig Helbig
Client Job ID:	18012
No. of Samples	95 x Soil
Date Received:	25 JAN 2018
Comments:	Standard Request
Biller:	**Env Solutions Pty Ltd** - Accounts Payable

Southern Cross University
PO Box 157 Lismore NSW 2480

T: (02) 6620 3678
F: (02) 6620 3957
E: eal@scu.edu.au
W: scu.edu.au/eal
ABN: 41 995 651 524

Test Request

Sample Text ID	Client Sample ID	Acid Sulfate Soil pH-F and pH-FOX Testing	AS-PACK-007
G6862/001	S12 0-0.1	1	
G6862/002	S12 0.5-0.6	1	
G6862/003	S12 1.0-1.1	1	
G6862/004	S12 1.5-1.6	1	
G6862/005	S12 1.9-2.0	1	
G6862/006	S6 0-0.1	1	
G6862/007	S6 0.5-0.6	1	

Sample Receipt Notification (SRN) for EAL/G6862

		Acid Sulfate Soil pH-F and pH-FOX Testing	AS-PACK-007
G6862/008	S6 1.0-1.1	1	
G6862/009	S6 1.5-1.6	1	
G6862/010	S6 1.9-2.0	1	
G6862/011	S3 0-0.1	1	
G6862/012	S3 0.5-0.6	1	
G6862/013	S3 1.0-1.1	1	
G6862/014	S3 1.5-1.6	1	
G6862/015	S3 1.9-2.0	1	
G6862/016	S21 0-0.1	1	
G6862/017	S21 0.5-0.6	1	
G6862/018	S21 1.0-1.1	1	
G6862/019	S21 1.5-1.6	1	
G6862/020	S21 1.9-2.0	1	
G6862/021	S26 0-0.1	1	
G6862/022	S26 0.5-0.6	1	

Sample Receipt Notification (SRN) for EAL/G6862

		Acid Sulfate Soil pH-F and pH-FOX Testing	AS-PACK-007
G6862/023	S26 1.0-1.1	1	
G6862/024	S26 1.5-1.6	1	
G6862/025	S26 1.9-2.0	1	
G6862/026	SA2 0-0.1	1	
G6862/027	SA2 0.5-0.6	1	
G6862/028	SA2 1.0-1.1	1	
G6862/029	SA2 1.5-1.6	1	
G6862/030	SA2 1.9-2.0	1	
G6862/031	S36 0-0.1	1	
G6862/032	S36 0.5-0.6	1	
G6862/033	S36 1.0-1.1	1	
G6862/034	S36 1.5-1.6	1	
G6862/035	S36 1.9-2.0	1	
G6862/036	S53 0-0.1	1	
G6862/037	S53 0.5-0.6	1	

Sample Receipt Notification (SRN) for EAL/G6862

		Acid Sulfate Soil pH-F and pH-FOX Testing	AS-PACK-007
G6862/038	S53 1.0-1.1	1	
G6862/039	S53 1.5-1.6	1	
G6862/040	S53 1.9-2.0	1	
G6862/041	S31 0-0.1	1	
G6862/042	S31 0.5-0.6	1	
G6862/043	S31 1.0-1.1	1	
G6862/044	S31 1.5-1.6	1	
G6862/045	S31 1.9-2.0	1	
G6862/046	S50 0-0.1	1	
G6862/047	S50 0.5-0.6	1	
G6862/048	S50 1.0-1.1	1	
G6862/049	S50 1.5-1.6	1	
G6862/050	S50 1.9-2.0	1	
G6862/051	S56 0-0.1	1	
G6862/052	S56 0.5-0.6	1	

Sample Receipt Notification (SRN) for EAL/G6862

		Acid Sulfate Soil pH-F and pH-FOX Testing	AS-PACK-007
G6862/053	S56 1.0-1.1	1	
G6862/054	S56 1.5-1.6	1	
G6862/055	S56 1.9-2.0	1	
G6862/056	S70 0-0.1	1	
G6862/057	S70 0.5-0.6	1	
G6862/058	S70 1.0-1.1	1	
G6862/059	S70 1.5-1.6	1	
G6862/060	S70 1.9-2.0	1	
G6862/061	S73 0-0.1	1	
G6862/062	S73 0.5-0.6	1	
G6862/063	S73 1.0-1.1	1	
G6862/064	S73 1.5-1.6	1	
G6862/065	S73 1.9-2.0	1	
G6862/066	S67 0-0.1	1	
G6862/067	S67 0.5-0.6	1	

Sample Receipt Notification (SRN) for EAL/G6862

		Acid Sulfate Soil pH-F and pH-FOX Testing	AS-PACK-007
G6862/068	S67 1.0-1.1	1	
G6862/069	S67 1.5-1.9	1	
G6862/070	S67 1.9-2.0	1	
G6862/071	S83 0-0.1	1	
G6862/072	S83 0.5-0.6	1	
G6862/073	S83 1.0-1.1	1	
G6862/074	S83 1.5-1.6	1	
G6862/075	S83 1.9-2.0	1	
G6862/076	S82 0-0.1	1	
G6862/077	S82 0.5-0.6	1	
G6862/078	S82 1.0-1.1	1	
G6862/079	S82 1.5-1.6	1	
G6862/080	S82 1.9-2.0	1	
G6862/081	S97 0-0.1	1	
G6862/082	S97 0.5-0.6	1	

Sample Receipt Notification (SRN) for EAL/G6862

		Acid Sulfate Soil pH-F and pH-FOX Testing	AS-PACK-007
G6862/083	S97 1.0-1.1	1	
G6862/084	S97 1.5-1.6	1	
G6862/085	S97 1.9-2.0	1	
G6862/086	S86 0-0.1	1	
G6862/087	S86 0.5-0.6	1	
G6862/088	S86 1.0-1.1	1	
G6862/089	S86 1.5-1.6	1	
G6862/090	S86 1.9-2.0	1	
G6862/091	S91 0-0.1	1	
G6862/092	S91 0.5-0.6	1	
G6862/093	S91 1.0-1.1	1	
G6862/094	S91 1.5-1.6	1	
G6862/095	S91 1.9-2.0	1	
Total		95	

Sample Receipt Notification (SRN) for EAL/G6862

Test Descriptions

Test List Item	Item Description
AS-PACK-007	**Acid Sulfate Soil pH-F and pH-FOX Testing** Moisture, Drying, Grinding Peroxide pH Screening

(*) Place COCs in snaplock bag (*)

CHAIN OF CUSTODY

eal Environmental Analysis Laboratory
Division of Research
Southern Cross University

PO Box 157 (Military Road)
LISMORE NSW 2480
P| 02 6620 3678 F| 02 6620 3957
eal@scu.edu.au, www.scu.edu.au/eal

Submitting Client Details

Quote Id:
Job Ref:
Company Name: ENV Solutions Pty Ltd
Contact Person: ~~James Foster~~ Craig Helbig
Phone:
Mobile: ~~0421519354~~ 0405 364 626
Fax: Craig
Email: ~~james~~@envsolutions.com.au
Postal Address:

Billing Client Details

ABN: 600788814
Company Name: ENV Solutions Pty Ltd
Contact Person: James Foster
Phone:
Mobile: 0421519354
Fax:
Email: james@envsolutions.com.au
Postal Address: 1/17 Grandview Street
East Ballina NSW 2478

This section will be destroyed after being processed. Do NOT provide your CVV number, you will be contacted by phone or email when this is required.

Payment Method:
☐ Purchase Order
☐ Cheque
☑ Invoice (prior approval required)
☐ Credit Card Mastercard / Visa No: _____/_____/_____/_____

Exp. Date: Name on Card: CVV: by phone

	Date	Signed
Relinquished By: CRAIG HELBIG	25/1/18	
Preservation: None / Ice / Ice bricks / Acidified / Filtered / Other: Frozen		
Received By:	25/1/18	AH
Condition on receipt: Ambient / Cool / Frozen / Other:		

Comments:

Marketing Survey – where did you find us?
☐ Word of mouth ☐ Magazine ☐ Google search ☐ Other

Sample Analysis Request

Price List Code (e.g. SW-PACK-06)

(*) Analysis will depend on AS-PACK-007 results – TBA

Lab Sample No.	Sample ID	Sample Depth	Sampling Date	Your Client	Crop ID	Sample Type (e.g. water, leaf, soil)	(*) AS-PACK-007	AS-PACK-006 (*)	SS-PACK-008			(*)				
1	S12	0-0.1	24/1/18	18012	N/A	Soil	✓									
2	↓	0.5-0.6	↓	↓	↓	↓	✓									
3		1.0-1.1					✓									
4		1.5-1.6					✓									
5	↓	1.9-2.0	↓	↓	↓	↓	✓									

CHAIN OF CUSTODY

Comments:

Marketing Survey – where did you find us?
☐ Word of mouth ☐ Magazine ☐ Google search ☐ Other

Sample Analysis Request

Price List Code (e.g. SW-PACK-06)

Lab Sample No.	Sample ID	Sample Depth	Sampling Date	Your Client	Crop ID	Sample Type (e.g. water, leaf, soil)	AS-PACK-007	(*) AS-PACK-008	SS-PACK-008			(*) Analysis will depend on AS-PACK-007 results				
	S6	0-0.1	24/1/18	18012	N/A	Soil	✓									
	↓	0.5-0.6	↓	↓	↓	↓	✓									
		1.0-1.1					✓									
		1.5-1.6					✓									
		1.9-2.0					✓									
	S3	0-0.1					✓									
	↓	0.5-0.6					✓									
		1.0-1.1					✓									
		1.5-1.6					✓									
		1.9-2.0					✓									
	S21	0-0.1					✓									
	↓	0.5-0.6					✓									
		1.0-1.1					✓									
		1.5-1.6					✓									
		1.9-2.0					✓									
	~~0.3-0.4~~						TBA - not sent ← No sample									
	S26	0-0.1					✓									
	↓	0.5-0.6					✓									
		1.0-1.1					✓									
		1.5-1.6					✓									
		1.9-2.0					✓									

CHAIN OF CUSTODY

Comments:

Marketing Survey – where did you find us?
☐ Word of mouth ☐ Magazine ☐ Google search ☐ Other

Sample Analysis Request

Price List Code (e.g. SW-PACK-06)

Lab Sample No.	Sample ID	Sample Depth	Sampling Date	Your Client	Crop ID	Sample Type (e.g. water, leaf, soil)	AS-PACK-0007	AS-PACK-0008 (*)	SS-PACK-0008							
	SA2	0-0.1	24/1/18	18012	N/A	Soil	✓									
	↓	0.5-0.6	↓	↓	↓	↓	✓									
		1.0-1.1					✓									
		1.5-1.6					✓									
	↓	1.9-2.0					✓									
	S36	0-0.1					✓									
	↓	0.5-0.6					✓									
		1.0-1.1					✓									
		1.5-1.6					✓									
	↓	1.9-2.0					✓									
	S53	0-0.1					✓									
	↓	0.5-0.6					✓									
		1.0-1.1					✓									
		1.5-1.6					✓									
	↓	1.9-2.0					✓									
	S31	0-0.1					✓									
	↓	0.5-0.6					✓									
		1.0-1.1					✓									
		1.5-1.6					✓									
	↓	1.9-2.0	↓	↓	↓	↓	✓									

(*) Analysis will depend on AS-PACK 0007 results - TBA

CHAIN OF CUSTODY

Comments:

Marketing Survey – where did you find us?
☐ Word of mouth ☐ Magazine ☐ Google search ☐ Other

Sample Analysis Request

Price List Code (e.g. SW-PACK-06)

Lab Sample No.	Sample ID	Sample Depth	Sampling Date	Your Client	Crop ID	Sample Type (e.g. water, leaf, soil)	ES-PACK-007	* ES-PACK-008	SS-PACK-008		* Analysis will depend on AS-PACK-007 results - TBA				
	S50	0-0.1	~~24~~ 1/18	18012	N/A	Soil	✓								
		0.5-0.6					✓								
		1.0-1.1					✓								
		1.5-1.6					✓								
		1.9-2.0					✓								
	~~S55~~	~~0.4-0.5~~					TBA - not sent - no sample.								
	S56	0-0.1					✓								
		0.5-0.6					✓								
		1.0-1.1					✓								
		1.5-1.6					✓								
		1.9-2.0					✓								
	S70	0-0.1					✓								
		0.5-0.6					✓								
		1.0-1.1					✓								
		1.5-1.6					✓								
		1.9-2.0					✓								
	S73	0-0.1					✓								
		0.5-0.6					✓								
		1.0-1.1					✓								
		1.5-1.6					✓								
		1.9-2.0					✓								

CHAIN OF CUSTODY

Comments:

Marketing Survey – where did you find us?
☐ Word of mouth ☐ Magazine ☐ Google search ☐ Other

Sample Analysis Request

Price List Code (e.g. SW-PACK-06)

Lab Sample No.	Sample ID	Sample Depth	Sampling Date	Your Client	Crop ID	Sample Type (e.g. water, leaf, soil)	AS-PACK-0007	* AS-PACK-0008	SS-PACK-0001			* Analysis with depen on AS-PACK-00 results - TBA			
	S67	0-0.1	24/1/18	18012	N/A	Soil	✓								
		0.5-0.6					✓								
		1.0-1.1					✓								
		1.5-1.6					✓								
		1.9-2.0					✓								
	S83	0-0.1					✓								
		0.5-0.6					✓								
		1.0-1.1					✓								
		1.5-1.6					✓								
		1.9-2.0					✓								
		0.1-0.2					TBA - not sent - no sample.								
	S82	0-0.1					✓								
		0.5-0.6					✓								
		1.0-1.1					✓								
		1.5-1.6					✓								
		1.9-2.0					✓								
		0.2-0.5					TBA - not sent - no sample								
	S97	0-0.1					✓								
		0.5-0.6					✓								
		1.0-1.1					✓								
		1.5-1.6					✓								
		1.9-2.0					✓								
		0.9-1.0					TBA - not sent no sample								

CHAIN OF CUSTODY

Comments:

Marketing Survey – where did you find us?
☐ Word of mouth ☐ Magazine ☐ Google search ☐ Other

Sample Analysis Request

Price List Code (e.g. SW-PACK-06)

Lab Sample No.	Sample ID	Sample Depth	Sampling Date	Your Client	Crop ID	Sample Type (e.g. water, leaf, soil)	AS-PACK-007	* AS-PACK-008	SS-PACK-008			* Analysis will depend on AS-PACK-008 results – TBA				
	S86	0-0.1	24/1/18	18012	N/A	Soil	✓									
		0.5-0.6	–				✓									
		1.0-1.1	–				✓									
		1.5-1.6	–				✓									
		1.9-2.0	–				✓									
	~~S82-QC1~~	–					TBA – not sent									
	~~S82-QC2~~	–					TBA – not sent									
	S91	0-0.1M														
		0.5-0.6														
		1.0-1.1														
		1.5-1.6														
		1.9-2.0														

Sample Receipt Notification (SRN)

Project:	**EAL/G6862**
Customer:	Env Solutions Pty Ltd
Contact:	Craig Helbig
Client Job ID:	18012
No. of Samples	95 x Soil
Date Received:	25 JAN 2018
Comments:	2/2/18 added AS-PACK-008 to 24 selected samples
Biller:	**Env Solutions Pty Ltd** - Accounts Payable

Southern Cross University
PO Box 157 Lismore NSW 2480

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E: eal@scu.edu.au
W: scu.edu.au/eal
ABN: 41 995 651 524

		Test Request	
		AS-PACK-007	AS-PACK-008
Sample Text ID	**Client Sample ID**	Acid Sulfate Soil pH-F and pH-FOX Testing	Net Acidity - Complete
G6862/001	S12 0-0.1	1	0
G6862/002	S12 0.5-0.6	1	0
G6862/003	S12 1.0-1.1	1	0
G6862/004	S12 1.5-1.6	1	1
G6862/005	S12 1.9-2.0	1	0
G6862/006	S6 0-0.1	1	0
G6862/007	S6 0.5-0.6	1	0

Sample Receipt Notification (SRN) for EAL/G6862

		Acid Sulfate Soil pH-F and pH-FOX Testing	Net Acidity - Complete
		AS-PACK-007	AS-PACK-008
G6862/008	S6 1.0-1.1	1	0
G6862/009	S6 1.5-1.6	1	0
G6862/010	S6 1.9-2.0	1	1
G6862/011	S3 0-0.1	1	1
G6862/012	S3 0.5-0.6	1	0
G6862/013	S3 1.0-1.1	1	0
G6862/014	S3 1.5-1.6	1	1
G6862/015	S3 1.9-2.0	1	0
G6862/016	S21 0-0.1	1	0
G6862/017	S21 0.5-0.6	1	0
G6862/018	S21 1.0-1.1	1	0
G6862/019	S21 1.5-1.6	1	0
G6862/020	S21 1.9-2.0	1	1
G6862/021	S26 0-0.1	1	1
G6862/022	S26 0.5-0.6	1	0

Sample Receipt Notification (SRN) for EAL/G6862

		Acid Sulfate Soil pH-F and pH-FOX Testing	Net Acidity - Complete
		AS-PACK-007	AS-PACK-008
G6862/023	S26 1.0-1.1	1	1
G6862/024	S26 1.5-1.6	1	0
G6862/025	S26 1.9-2.0	1	0
G6862/026	S32 0-0.1	1	0
G6862/027	S32 0.5-0.6	1	0
G6862/028	S32 1.0-1.1	1	1
G6862/029	S32 1.5-1.6	1	0
G6862/030	S32 1.9-2.0	1	0
G6862/031	S36 0-0.1	1	0
G6862/032	S36 0.5-0.6	1	0
G6862/033	S36 1.0-1.1	1	0
G6862/034	S36 1.5-1.6	1	0
G6862/035	S36 1.9-2.0	1	1
G6862/036	S53 0-0.1	1	1
G6862/037	S53 0.5-0.6	1	0

Sample Receipt Notification (SRN) for EAL/G6862

		Acid Sulfate Soil pH-F and pH-FOX Testing	Net Acidity - Complete
		AS-PACK-007	AS-PACK-008
G6862/038	S53 1.0-1.1	1	0
G6862/039	S53 1.5-1.6	1	0
G6862/040	S53 1.9-2.0	1	0
G6862/041	S31 0-0.1	1	0
G6862/042	S31 0.5-0.6	1	0
G6862/043	S31 1.0-1.1	1	0
G6862/044	S31 1.5-1.6	1	0
G6862/045	S31 1.9-2.0	1	1
G6862/046	S50 0-0.1	1	0
G6862/047	S50 0.5-0.6	1	1
G6862/048	S50 1.0-1.1	1	0
G6862/049	S50 1.5-1.6	1	0
G6862/050	S50 1.9-2.0	1	1
G6862/051	S56 0-0.1	1	0
G6862/052	S56 0.5-0.6	1	1

Sample Receipt Notification (SRN) for EAL/G6862

		Acid Sulfate Soil pH-F and pH-FOX Testing	Net Acidity - Complete
		AS-PACK-007	AS-PACK-008
G6862/053	S56 1.0-1.1	1	0
G6862/054	S56 1.5-1.6	1	0
G6862/055	S56 1.9-2.0	1	0
G6862/056	S70 0-0.1	1	0
G6862/057	S70 0.5-0.6	1	0
G6862/058	S70 1.0-1.1	1	1
G6862/059	S70 1.5-1.6	1	0
G6862/060	S70 1.9-2.0	1	0
G6862/061	S73 0-0.1	1	1
G6862/062	S73 0.5-0.6	1	0
G6862/063	S73 1.0-1.1	1	0
G6862/064	S73 1.5-1.6	1	0
G6862/065	S73 1.9-2.0	1	0
G6862/066	S67 0-0.1	1	0
G6862/067	S67 0.5-0.6	1	0

Sample Receipt Notification (SRN) for EAL/G6862

		Acid Sulfate Soil pH-F and pH-FOX Testing	Net Acidity - Complete
		AS-PACK-007	AS-PACK-008
G6862/068	S67 1.0-1.1	1	0
G6862/069	S67 1.5-1.9	1	0
G6862/070	S67 1.9-2.0	1	1
G6862/071	S83 0-0.1	1	0
G6862/072	S83 0.5-0.6	1	0
G6862/073	S83 1.0-1.1	1	0
G6862/074	S83 1.5-1.6	1	0
G6862/075	S83 1.9-2.0	1	1
G6862/076	S82 0-0.1	1	0
G6862/077	S82 0.5-0.6	1	0
G6862/078	S82 1.0-1.1	1	1
G6862/079	S82 1.5-1.6	1	0
G6862/080	S82 1.9-2.0	1	0
G6862/081	S97 0-0.1	1	1
G6862/082	S97 0.5-0.6	1	0

Sample Receipt Notification (SRN) for EAL/G6862

		Acid Sulfate Soil pH-F and pH-FOX Testing	Net Acidity - Complete
		AS-PACK-007	AS-PACK-008
G6862/083	S97 1.0-1.1	1	0
G6862/084	S97 1.5-1.6	1	0
G6862/085	S97 1.9-2.0	1	1
G6862/086	S86 0-0.1	1	0
G6862/087	S86 0.5-0.6	1	0
G6862/088	S86 1.0-1.1	1	0
G6862/089	S86 1.5-1.6	1	1
G6862/090	S86 1.9-2.0	1	0
G6862/091	S91 0-0.1	1	0
G6862/092	S91 0.5-0.6	1	1
G6862/093	S91 1.0-1.1	1	0
G6862/094	S91 1.5-1.6	1	0
G6862/095	S91 1.9-2.0	1	1
Total		**95**	**24**

Sample Receipt Notification (SRN) for EAL/G6862

Test Descriptions

Test List Item	Item Description
AS-PACK-007	**Acid Sulfate Soil pH-F and pH-FOX Testing** Moisture, Drying, Grinding Peroxide pH Screening Routine TAT of 3 days with a reduced surcharge of 50% for 24 h TAT (limited to 15 samples)
AS-PACK-008	**Net Acidity - Complete** Moisture, Drying, Grinding TAA, CRS (ANC INCLUDED when pH > 6.5 and SNAS INCLUDED when pH < 4.5)

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eal Environmental Analysis Laboratory
Division of Research
Southern Cross University

PO Box 157 (Military Road)
LISMORE NSW 2480
P| 02 6620 3678 F| 02 6620 3957
eal@scu.edu.au, www.scu.edu.au/eal

Submitting Client Details

Quote Id:
Job Ref: 18012
Company Name: ENV Solutions Pty Ltd
Contact Person: ~~James Foster~~ CRAIG HELBIG
Phone:
Mobile: ~~0421519354~~ 0405 364 626
Fax:
Email: CRAIG ~~james~~@envsolutions.com.au
Postal Address:

Billing Client Details

ABN: 600788814
Company Name: ENV Solutions Pty Ltd
Contact Person: James Foster
Phone:
Mobile: 0421519354
Fax:
Email: james@envsolutions.com.au
Postal Address: 1/17 Grandview Street
East Ballina NSW 2478

This section will be destroyed after being processed. Do NOT provide your CVV number, you will be contacted by phone or email when this is required.

Payment Method:
☐ Purchase Order
☐ Cheque
☐ Invoice (prior approval required)
☐ Credit Card Mastercard / Visa No: _____/_____/_____/_____

Exp. Date: Name on Card: CVV: by phone

Relinquished By: D. FICK	29/1/18	Signed C. Helbig
Preservation: None / Ice / Ice bricks / Acidified / Filtered / Other:		
Received By: IS	30.1.18	
Condition on receipt: Ambient / Cool / Frozen / Other:		

Comments:
Please individually ~~&~~ Analyse S4 and S02 in addition to composite.

Marketing Survey – where did you find us?
☐ Word of mouth ☐ Magazine ☐ Google search ☐ Other

Sample Analysis Request

Price List Code (e.g. SW-PACK-06)

Lab Sample No.	Sample ID	Sample Depth	Sampling Date	Your Client	Crop ID	Sample Type (e.g. water, leaf, soil)	COMPOSITE	SS-PACK-008	SS-PACK-017	SS-PACK-014						
1	S1	0-0.15				SOIL	✓									
2	S2	↑				↑	✓									
3	S3						✓									
4	S4	↓				↓	✓	✓		✱	Individual	analysis				✱
	C1	0-0.15				SOIL		✓				also S4				

C1 = S1, S2, S3, S4

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Comments:

Marketing Survey – where did you find us?
☐ Word of mouth ☐ Magazine ☐ Google search ☐ Other

Lab Sample No.	Sample ID		Sample Depth	Sampling Date	Your Client	Crop ID	Sample Type (e.g. water, leaf, soil)	Sample Analysis Request Price List Code (e.g. SW-PACK-06) COMPOSITE	SS-PACK-008
5	S6	C2	0-0.15				SOIL	✓	
6	S7		↑				↑	✓	
7	S10							✓	
8	S11							✓	
	C2								✓
9	~~S8~~ S9	C3						✓	
10	S12							✓	
11	S13							✓	
12	S17							✓	
	C3								✓
13	S16	C4						✓	
14	S15							✓	
15	S14							✓	
16	S22							✓	
	C4								✓
17	S19	C5						✓	
18	S20							✓	
19	S21		↓				↓	✓	
20	S5		0-0.15				SOIL	✓	

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Comments:

Marketing Survey – where did you find us?
☐ Word of mouth ☐ Magazine ☐ Google search ☐ Other

Lab Sample No.	Sample ID		Sample Depth	Sampling Date	Your Client	Crop ID	Sample Type (e.g. water, leaf, soil)	Sample Analysis Request Price List Code (e.g. SW-PACK-06) COMPOSITE	 SS-PACK-008
	C5		0-				SOIL		✓
21	S26	C6	0-0.1					✓	
22	S27		0					✓	
23	S8		0					✓	
24	S33		0					✓	
	C6		0						✓
25	S28	C7	0					✓	
26	S29		0					✓	
27	S35		0					✓	
28	S36		0-0.1					✓	
	C7		0						✓
29	S34	C8	0					✓	
30	S51		0					✓	
31	S42		0-0.1					✓	
32	S43		0					✓	
	C8		0						✓
33	S52	C9	0					✓	
34	S53		0-0.1					✓	
35	S60		0-0.1					✓	
36	S61		0-0.1				SOIL	✓	

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Comments:

Marketing Survey – where did you find us?
☐ Word of mouth ☐ Magazine ☐ Google search ☐ Other

Sample Analysis Request

Price List Code (e.g. SW-PACK-06)

Lab Sample No.	Sample ID		Sample Depth	Sampling Date	Your Client	Crop ID	Sample Type (e.g. water, leaf, soil)	Composite	SS-PACK-008	SS-PACK-017	SS-PACK-014						
	C9						SOIL		✓								
37	S18		0				↓	✓									
38	S23		0					✓									
39	S24	C10	0-0.1					✓									
40	S25		0-0.1					✓									
	C10		-						✓								
41	S31		0-0.1					✓									
42	S32	C11	0-0.1					✓									
43	S40		0					✓									
44	S41		0					✓									
	C11								✓								
45	S30		0-0.1					✓									
46	S37		0-0.1					✓									
47	S38	C12	0-0.1					✓									
48	S39		0					✓									
	C12								✓								
49	S45		0-0.1					✓									
50	S~~44~~		0					✓		✓	✓						
51	S 54	C13	0-0.1					✓									
52	S ~~62~~		0				SOIL	✓									

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Comments:

Marketing Survey – where did you find us?
☐ Word of mouth ☐ Magazine ☐ Google search ☐ Other

Lab Sample No.	Sample ID	Sample Depth	Sampling Date	Your Client	Crop ID	Sample Type (e.g. water, leaf, soil)	Sample Analysis Request — Price List Code (e.g. SW-PACK-06): Composite	SS-PACK-008
	C13							✓
53	S96	0					✓	
54	~~S60~~ S69 (C14)	S69	as per Craig 30/1.	0			✓	
55	S70 (C14)	0-0.1					✓	
56	S71 (C14)	0					✓	
	C14							✓
	S46 (C15)	0-0.1					✓	
	S47 (C15)	0					✓	
	S55 (C15)	0					✓	
60	S56 (C15)	0-0.1					✓	
	C15	0						✓
	S63 (C16)	0					✓	
	S64 (C16)	0					✓	
	S72 (C16)	0					✓	
64	S78 (C16)	0					✓	
	C16							✓
	S48 (C17)	0					✓	
	S49 (C17)	0					✓	
	S98 (C17)	0					✓	

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Comments:

Marketing Survey – where did you find us?
☐ Word of mouth ☐ Magazine ☐ Google search ☐ Other

Lab Sample No.	Sample ID		Sample Depth	Sampling Date	Your Client	Crop ID	Sample Type (e.g. water, leaf, soil)	Sample Analysis Request Price List Code (e.g. SW-PACK-06) COMPOSITE	SS-PACK-008								
68	S99		0					✓									
	C17								✓								
	S57	C18	0					✓									
	S58		0					✓									
	S65		0					✓									
72	S66		0					✓									
	C18								✓								
	S50	C19	0·4-0·5					✓									
	S100		0					✓									
	S59		0					✓									
76	S67		0-0·1					✓									
	C19								✓								
	S73	C20	0·0-0·1					✓									
	S74		0					✓									
	S79		0					✓									
80	S80		0					✓									
	C20								✓								
	S68	C21	0					✓									
	S75		0					✓									

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Comments:

Marketing Survey – where did you find us?
☐ Word of mouth ☐ Magazine ☐ Google search ☐ Other

Lab Sample No.	Sample ID	Sample Depth	Sampling Date	Your Client	Crop ID	Sample Type (e.g. water, leaf, soil)	Sample Analysis Request — Price List Code (e.g. SW-PACK-06): Composite	SS-PACK-008	SS-PACK-017	SS-PACK-014						
	S76 } C21	0					✓									
84	S77 }	0					✓									
	C21							✓								
	S81 }	0					✓									
	S84 } C22	0					✓									
	S86 }	0-0.1					✓									
88	S82 }	0.2-0.5					✓	✓	(*)	Individual analysis also – S82 (*)						
	C22							✓								
89	S83 }	0.1-0.2					✓									
90	S85 } C23	0					✓									
91	S88 }	0					✓		✓	✓						
92	S89 }	0					✓									
	C23							✓								
	S87 }	0					✓									
	S93 }	0					✓									
	S91 } C24	0-0.1					✓									
96	S90 }	0					✓									
	C24							✓								
	S92	0					✓									

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Comments:

Marketing Survey – where did you find us?
☐ Word of mouth ☐ Magazine ☐ Google search ☐ Other

Sample Analysis Request

Price List Code (e.g. SW-PACK-06)

Lab Sample No.	Sample ID	Sample Depth	Sampling Date	Your Client	Crop ID	Sample Type (e.g. water, leaf, soil)	Composite	SS-PACK-008								
	S94	0					✓									
	S95 (25)	0					✓									
100	S97	0-9-1-0					✓									
	C25							✓								
101	QC1	0						✓								
102	QC3	0						✓								

Katie Whitney

From: Craig Helbig <craig@envsolutions.com.au>
Sent: Tuesday, 30 January 2018 12:37 PM
To: Katie Whitney
Cc: 'Ollie Fick'
Subject: Sample jars received this morning for project 18012 - Palm Lake Works

Hi Katie,

Sorry about the mislabelling – here's what we'll do:

- For all sample jars with a depth interval marked on them, please record that depth interval against the sample on your SRA and report (when it's ready).
- For all sample jars without a depth interval marked on them, these samples were collected from 0 – 0.15 m. Please record this depth interval on the SRA and report.

Regards,

Craig Helbig
Senior Environmental Scientist/Toxicologist
ENV Solutions Pty Ltd
ABN) 58 600 788 814
P) 0405 364 626
E) craig@envsolutions.com.au
W) www.envsolutions.com.au

Sample Receipt Notification (SRN)

Project:	**EAL/G6927**
Customer:	Env Solutions Pty Ltd
Contact:	Craig Helbig
Client Job ID:	18012
No. of Samples	102 x soil; 25 x Composites.
Date Received:	30 JAN 2018
Comments:	C1=1-4 to 97-100=C25
Biller:	**Env Solutions Pty Ltd** - Accounts Payable

Southern Cross University
PO Box 157 Lismore NSW 2480

T: (02) 6620 3678
F: (02) 6620 3957
E: eal@scu.edu.au
W: scu.edu.au/eal
ABN: 41 995 651 524

Test Request

Sample Text ID	Client Sample ID	Contaminated Site Assessment 3	Pesticide Screen 1b	Petroleum Compounds Assessment 1a	Sample Compositing
		SS-PACK-008	SS-PACK-014	SS-PACK-017	SS-PREP-004
G6927/(C)001	Samples(1,2,3,4)	1	0	0	0
G6927/(C)002	Samples(5,6,7,8)	1	0	0	0
G6927/(C)003	Samples(9,10,11,12)	1	0	0	0
G6927/(C)004	Samples(13,14,15,16)	1	0	0	0
G6927/(C)005	Samples(17,18,19,20)	1	0	0	0
G6927/(C)006	Samples(21,22,23,24)	1	0	0	0
G6927/(C)007	Samples(25,26,27,28)	1	0	0	0

Sample Receipt Notification (SRN) for EAL/G6927

		Contaminated Site Assessment 3	Pesticide Screen 1b	Petroleum Compounds Assessment 1a	Sample Compositing
		SS-PACK-008	SS-PACK-014	SS-PACK-017	SS-PREP-004
G6927/(C)008	Samples(29,30,31,32)	1	0	0	0
G6927/(C)009	Samples(33,34,35,36)	1	0	0	0
G6927/(C)010	Samples(37,38,39,40)	1	0	0	0
G6927/(C)011	Samples(41,42,43,44)	1	0	0	0
G6927/(C)012	Samples(45,46,47,48)	1	0	0	0
G6927/(C)013	Samples(49,50,51,52)	1	0	0	0
G6927/(C)014	Samples(53,54,55,56)	1	0	0	0
G6927/(C)015	Samples(57,58,59,60)	1	0	0	0
G6927/(C)016	Samples(61,62,63,64)	1	0	0	0
G6927/(C)017	Samples(65,66,67,68)	1	0	0	0
G6927/(C)018	Samples(69,70,71,72)	1	0	0	0
G6927/(C)019	Samples(73,74,75,76)	1	0	0	0
G6927/(C)020	Samples(77,78,79,80)	1	0	0	0
G6927/(C)021	Samples(81,82,83,84)	1	0	0	0
G6927/(C)022	Samples(85,86,87,88)	1	0	0	0

Sample Receipt Notification (SRN) for EAL/G6927

		Contaminated Site Assessment 3	Pesticide Screen 1b	Petroleum Compounds Assessment 1a	Sample Compositing
		SS-PACK-008	SS-PACK-014	SS-PACK-017	SS-PREP-004
G6927/(C)023	Samples(89,90,91,92)	1	0	0	0
G6927/(C)024	Samples(93,94,95,96)	1	0	0	0
G6927/(C)025	Samples(97,98,99,100)	1	0	0	0
G6927/001	S1 0-0.15	0	0	0	1
G6927/002	S2 0-0.15	0	0	0	1
G6927/003	S3 0-0.15	0	0	0	1
G6927/004	S4 0-0.15	1	0	0	1
G6927/005	S6 0-0.15	0	0	0	1
G6927/006	S7 0-0.15	0	0	0	1
G6927/007	S10 0-0.15	0	0	0	1
G6927/008	S11 0-0.15	0	0	0	1
G6927/009	S9 0-0.15	0	0	0	1
G6927/010	S12 0-0.15	0	0	0	1
G6927/011	S13 0-0.15	0	0	0	1
G6927/012	S17 0-0.15	0	0	0	1

Sample Receipt Notification (SRN) for EAL/G6927

		Contaminated Site Assessment 3	Pesticide Screen 1b	Petroleum Compounds Assessment 1a	Sample Compositing
		SS-PACK-008	SS-PACK-014	SS-PACK-017	SS-PREP-004
G6927/013	S16 0-0.15	0	0	0	1
G6927/014	S15 0-0.15	0	0	0	1
G6927/015	S14 0-0.15	0	0	0	1
G6927/016	S22 0-0.15	0	0	0	1
G6927/017	S19 0-0.15	0	0	0	1
G6927/018	S20 0-0.15	0	0	0	1
G6927/019	S21 0-0.15	0	0	0	1
G6927/020	S5 0-0.15	0	0	0	1
G6927/021	S26 0-0.1	0	0	0	1
G6927/022	S27 0-0.15	0	0	0	1
G6927/023	S8 0-0.15	0	0	0	1
G6927/024	S33 0-0.15	0	0	0	1
G6927/025	S28 0-0.15	0	0	0	1
G6927/026	S29 0-0.15	0	0	0	1
G6927/027	S35 0-0.15	0	0	0	1

Sample Receipt Notification (SRN) for EAL/G6927

		Contaminated Site Assessment 3	Pesticide Screen 1b	Petroleum Compounds Assessment 1a	Sample Compositing
		SS-PACK-008	SS-PACK-014	SS-PACK-017	SS-PREP-004
G6927/028	S36 0-0.1	0	0	0	1
G6927/029	S34 0-0.15	0	0	0	1
G6927/030	S51 0-0.15	0	0	0	1
G6927/031	S42 0-0.1	0	0	0	1
G6927/032	S43 0-0.15	0	0	0	1
G6927/033	S52 0-0.15	0	0	0	1
G6927/034	S53 0-0.1	0	0	0	1
G6927/035	S60 0-0.1	0	0	0	1
G6927/036	S61 0-0.1	0	0	0	1
G6927/037	S18 0-0.15	0	0	0	1
G6927/038	S23 0-0.15	0	0	0	1
G6927/039	S24 0-0.1	0	0	0	1
G6927/040	S25 0-0.1	0	0	0	1
G6927/041	S31 0-0.1	0	0	0	1
G6927/042	S32 0-0.1	0	0	0	1

Sample Receipt Notification (SRN) for EAL/G6927

		Contaminated Site Assessment 3	Pesticide Screen 1b	Petroleum Compounds Assessment 1a	Sample Compositing
		SS-PACK-008	SS-PACK-014	SS-PACK-017	SS-PREP-004
G6927/043	S40 0-0.15	0	0	0	1
G6927/044	S41 0-0.15	0	0	0	1
G6927/045	S30 0-0.1	0	0	0	1
G6927/046	S37 0-0.1	0	0	0	1
G6927/047	S38 0-0.1	0	0	0	1
G6927/048	S39 0-0.15	0	0	0	1
G6927/049	S45 0-0.1	0	0	0	1
G6927/050	S44 0-0.15	0	1	1	1
G6927/051	S54 0-0.1	0	0	0	1
G6927/052	S62 0-0.15	0	0	0	1
G6927/053	S96 0-0.15	0	0	0	1
G6927/054	S69 0-0.15	0	0	0	1
G6927/055	S70 0-0.1	0	0	0	1
G6927/056	S71 0-0.15	0	0	0	1
G6927/057	S46 0-0.1	0	0	0	1

Sample Receipt Notification (SRN) for EAL/G6927

		Contaminated Site Assessment 3	Pesticide Screen 1b	Petroleum Compounds Assessment 1a	Sample Compositing
		SS-PACK-008	SS-PACK-014	SS-PACK-017	SS-PREP-004
G6927/058	S47 0-0.15	0	0	0	1
G6927/059	S55 0-0.15	0	0	0	1
G6927/060	S56 0-0.1	0	0	0	1
G6927/061	S63 0-0.15	0	0	0	1
G6927/062	S64 0-0.15	0	0	0	1
G6927/063	S72 0-0.15	0	0	0	1
G6927/064	S78 0-0.15	0	0	0	1
G6927/065	S48 0-0.15	0	0	0	1
G6927/066	S49 0-0.15	0	0	0	1
G6927/067	S98 0-0.15	0	0	0	1
G6927/068	S99 0-0.15	0	0	0	1
G6927/069	S57 0-0.15	0	0	0	1
G6927/070	S58 0-0.15	0	0	0	1
G6927/071	S65 0-0.15	0	0	0	1
G6927/072	S66 0-0.15	0	0	0	1

Sample Receipt Notification (SRN) for EAL/G6927

		Contaminated Site Assessment 3	Pesticide Screen 1b	Petroleum Compounds Assessment 1a	Sample Compositing
		SS-PACK-008	SS-PACK-014	SS-PACK-017	SS-PREP-004
G6927/073	S50 0.4-0.5	0	0	0	1
G6927/074	S100 0-0.15	0	0	0	1
G6927/075	S59 0-0.15	0	0	0	1
G6927/076	S67 0-0.1	0	0	0	1
G6927/077	S73 0-0.1	0	0	0	1
G6927/078	S74 0-0.15	0	0	0	1
G6927/079	S79 0-0.15	0	0	0	1
G6927/080	S80 0-0.15	0	0	0	1
G6927/081	S68 0-0.15	0	0	0	1
G6927/082	S75 0-0.15	0	0	0	1
G6927/083	S76 0-0.15	0	0	0	1
G6927/084	S77 0-0.15	0	0	0	1
G6927/085	S81 0-0.15	0	0	0	1
G6927/086	S84 0-0.15	0	0	0	1
G6927/087	S86 0-0.1	0	0	0	1

Sample Receipt Notification (SRN) for EAL/G6927

		Contaminated Site Assessment 3	Pesticide Screen 1b	Petroleum Compounds Assessment 1a	Sample Compositing
		SS-PACK-008	SS-PACK-014	SS-PACK-017	SS-PREP-004
G6927/088	S82 0.2-0.5	1	0	0	1
G6927/089	S83 0.1-0.2	0	0	0	1
G6927/090	S85 0-0.15	0	0	0	1
G6927/091	S88 0-0.15	0	1	1	1
G6927/092	S89 0-0.15	0	0	0	1
G6927/093	S87 0-0.15	0	0	0	1
G6927/094	S93 0-0.15	0	0	0	1
G6927/095	S91 0-0.1	0	0	0	1
G6927/096	S90 0-0.15	0	0	0	1
G6927/097	S92 0-0.15	0	0	0	1
G6927/098	S94 0-0.15	0	0	0	1
G6927/099	S95 0-0.15	0	0	0	1
G6927/100	S97 0.9-1.0	0	0	0	1
G6927/101	QC1 0-0.15	1	0	0	0
G6927/102	QC3 0-0.15	1	0	0	0

Sample Receipt Notification (SRN) for EAL/G6927

	Contaminated Site Assessment 3	Pesticide Screen 1b	Petroleum Compounds Assessment 1a	Sample Compositing
	SS-PACK-008	SS-PACK-014	SS-PACK-017	SS-PREP-004
Total	**29**	**2**	**2**	**100**

Sample Receipt Notification (SRN) for EAL/G6927

Test Descriptions

Test List Item	Item Description
SS-PREP-004	**Sample Compositing** EAL can composite samples and store the individual samples for at least 2 months to allow for individual testing if required. Charge per individual sample used in the composite.
SS-PACK-008	**Contaminated Site Assessment 3** Dry and Grind Basic Texture Metals (Cu, Pb, Cd, Zn, As, Se, Fe, Mn, Ag, Cr, Ni, Al, Hg, B, Co, Be) Pesticides (OCs) SUBCONTRACTED
SS-PACK-014	**Pesticide Screen 1b** Pesticide (OCs, OPs, PCBs) SUBCONTRACTED
SS-PACK-017	**Petroleum Compounds Assessment 1a** TPH(C10-C36) and BTEX (equivalent to TPHC6- C9) SUBCONTRACTED

ATTACHMENT 3

NSW Waste Classification Guidelines; Part 4: Acid Sulfate Soils (ASS)

Waste classification guidelines

Part 4: Acid sulfate soils

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Contents

Classifying wastes into groups that pose similar risks to the environment and human health facilitates their management and appropriate disposal. It is the responsibility of those who generate waste to classify that waste. To assist waste generators classify the wastes they produce, the EPA has developed the *Waste Classification Guidelines* ('the Guidelines') which are a step-by-step process for classifying waste.

Generators and waste facilities must carefully follow the procedures in these Guidelines to ensure they comply with applicable laws in classifying their waste and safeguard protection of the environment and human health.

The Guidelines are comprised of the following sections, of which this document is Part 4:

Overview of the Guidelines

Part 1: Classifying waste

Part 2: Immobilisation of waste

Part 3: Waste containing radioactive material

Part 4: Acid sulfate soils

All sections of the Guidelines are available for download from the EPA website at www.epa.nsw.gov.au/waste/classification.htm.

Introduction

Acid sulfate soils (ASS) are those naturally occurring sediments and soils which contain sulfides, mainly iron sulfide and iron disulfide or their precursors. Exposure of these sulfides in the soil to oxygen – often as a result of drainage or excavation – can produce sulfuric acid, which may have a significant impact on the environment. Leaching of sulfuric acid into waterways can cause serious water quality problems, resulting in fish kills and damage to infrastructure, such as floodgates and bridges.

ASS are most commonly found in NSW along the coast and they need to be managed appropriately to avoid major environmental damage.

The NSW *Acid Sulfate Soils Manual*[1] (the ASS Manual) provides 'best practice' guidance for planning, assessing and managing activities in areas prone to developing ASS. The manual is available from the NSW Department of Planning: phone 1300 305 695.

Using this part of the Guidelines

This part of the EPA Waste Classification Guidelines (the Guidelines) applies to acid sulfate soils which are unable to be managed on-site. In these cases, off-site disposal to landfill is often the most appropriate management option.

Waste generators need to assess the status of ASS at their point of generation, using the techniques outlined in the ASS Manual. The ASS Manual also provides guidance for on-site management, while this part of the Waste Classification Guidelines details disposal requirements for ASS that need to be transported and managed off-site.

This document has advice on dealing with both 'potential' ASS and 'actual' ASS. The two types are often found together in the same soil profile, with actual ASS generally overlying potential ASS horizons.

Potential acid sulfate soils

Potential ASS are soils that contain iron sulfides or sulfidic materials that have not been exposed to air and thus are not oxidised. The pH of these soils in their undisturbed state is 5.5 or more, making them neutral or slightly alkaline. If not managed appropriately, potential ASS pose a considerable environmental risk: disturbance and exposure to air may render them severely acidic.

Handling potential acid sulfate soils prior to disposal

Potential ASS must be kept wet at all times during excavation and subsequent handling, transport and storage, until they can be disposed of safely. They must be received at the proposed disposal point within 16 hours of being dug up.

[1] Stone Y, Ahem, CR and Blunden, B 1998. *Acid Sulphate Soils Manual 1998*. Acid Sulphate Soils Management Advisory Committee (ASSMAC), Wollongbar, NSW.

Disposal of potential acid sulfate soils *below* the water table

Potential ASS may be disposed of in water below the permanent water table, provided:

- this occurs before they have had a chance to oxidise, i.e. within 24 hours of excavation

and

- they meet the definition of 'virgin excavated natural material' (VENM) under the *Protection of the Environment Operations Act 1997*, even though they contain sulfidic ores or soils.

Landfills must be licensed by the EPA to dispose of potential ASS below the water table. EPA's Environment Line has details on facilities able to accept this waste: phone 131 555.

Potential ASS must be disposed of within 8 hours of their receipt at a landfill and kept wet at all times until their burial at least two metres below the lowest historical level of the water table at the disposal site.

Documentation must be provided to the occupier of the landfill for each truckload of potential ASS received, indicating that the soil's excavation, transport and handling have been in accordance with the ASS Manual, thus preventing the generation of acid.

The occupier of the disposal site must also test the pH of each load of soil received immediately prior to its placement under water using the test method(s) in the ASS Manual (Methods 21A and/or 21Af). These details, together with the pH of the soil recorded at the time of its extraction, must be retained by the occupier of the landfill site.

The disposal site's licence will outline what documentation needs to be kept and for how long.

Soil that has dried out, undergone any oxidation of its sulfidic minerals, or which has a pH of less than 5.5 must be treated by neutralisation and disposed of at a landfill that can lawfully accept it (see **Disposal of actual acid sulfate soils** below).

The pH of the water at the landfill into which the potential ASS is placed must not be less than 6.0 at any time. Landfill licence conditions require the occupiers of potential ASS disposal sites to regularly monitor the pH of ground and surface waters at their premises.

Disposal of potential acid sulfate soils *above* the water table

Where potential ASS cannot be classified as VENM or a suitable underwater disposal site at a landfill is not available, the soil must be treated in accordance with the neutralising techniques in the ASS Manual. After treatment the soil should be chemically assessed in accordance with Step 5 in Part 1 of the Waste Classification Guidelines, available at www.epa.nsw.gov.au/waste/classification.htm. This will determine whether any other contaminants are present in the material. When the classification has been established, the soil should be disposed of to a landfill that can lawfully accept that class of waste.

Actual acid sulfate soils

Actual ASS contain highly acidic soil horizons or layers resulting from the aeration of soil materials that are rich in sulfides, primarily iron sulfide. This oxidation produces more hydrogen ions than the sediment is able to neutralise, resulting in soils with a pH of 5.5 or less when measured in dry season conditions. These soils can usually be identified by the presence of pale yellow mottles and coatings of jarosite.

Treatment of actual acid sulfate soils prior to disposal

Actual ASS must be treated by the generator of the waste before they can be considered for disposal. Treatment should be in accordance with the neutralising techniques outlined in the ASS Manual.

Disposal of actual acid sulfate soils

Following neutralisation, the generator of the waste must chemically assess the soil in accordance with Step 5 of Part 1 of the Waste Classification Guidelines. This will determine whether there are any other contaminants that may affect how the waste is classified for disposal.

Once classified, the waste must be taken to a landfill licensed to accept that class of waste.

Prior arrangements should be made with the occupier of the landfill to ensure that it is licensed to accept the waste. The landfill should be informed that the actual ASS has been treated in accordance with the neutralising techniques outlined in the ASS Manual and that the waste has also been classified in accordance with Part 1 of the Waste Classification Guidelines.

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Scope of Engagement / Statement of Limitations

This report has been prepared by ENV Solutions Pty Ltd (ENV), ABN 58600788814, at the request of Palm Lake Works for the purpose of providing an acid sulfate soil management plan (ASSMP) for the subject site and is not to be used for any other purpose or by any other person or corporation.

This report has been prepared based on the information provided to us and from other information obtained as a result of enquiries made by us. ENV accepts no responsibility for any loss or damage suffered howsoever arising to any person or corporation who may use or rely on this document for a purpose other than that described above.

ENV declares that it does not have, nor expects to have, a beneficial interest in the subject project.

To avoid this advice being used inappropriately it is recommended that you consult with ENV before conveying the information to another who may not fully understand the objectives of the report. This report is meant only for the subject site/project and should not be applied to any other.

ENV has used a degree of care and skill ordinarily exercised in similar investigations by reputable members of the environmental industry in Australia at the date of this document. No other warranty, express or implied, is made or intended. Each section of this report must be read in conjunction with the whole of this report, including the appendices and attachments.

The conclusions presented in this report are based on a limited investigation of conditions with specific sampling locations chosen to be as representative as possible under the circumstances.

ENV's professional opinions contained in this report are subject to modification if additional information is obtained through further investigation, observation or validation testing and analysis during remedial activities. In some cases, further testing and analysis may be required, which may result in a further report with different conclusions.