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File Ref: LRM2017/0069
Your Ref: DP17/0371A

Dear Mr Da Rocha,

Re: Conditions 2(i) to (iv) of Development Permit DP17/0371A – N.T. Portion 03192 (Bynoe)

The Land Management Unit (LMU) provides the following advice regarding development permit conditions relating to preparation and implementation of an Erosion and Sediment Control Plan (ESCP) for the Seafarms development at Bynoe.

Condition 2(i) requires the proponent to engage a Certified Professional in Erosion and Sediment Control (CPESC) to prepare an Erosion and Sediment Control Plan (ESCP) in accordance with IECA standards.

LMU confirms that the ESCP author holds current CPESC accreditation, namely:

Ian Hollingsworth, CPESC 00008254, Expiry: 14/09/2019

Condition 2(ii) requires the proponent to engage an independent CPESC to review the ESCP and provide written confirmation that it has been prepared in accordance with IECA standards.

LMU confirms that the ESCP has been reviewed and deemed to be in accordance with IECA standards by an independent person with CPESC accreditation, namely:

Tim Elder, CPESC 00004399, Expiry: 05/08/2019

Condition 2(iii) requires the proponent to inform the consent authority of the identity of the two parties relating to condition 2(i) and 2(ii) prior to their engagement.

LMU confirms that this information was provided via email dated 5 October 2018.

Condition 2(iv)(a) requires the proponent to provide the ESCP to the consent authority; and **Condition 2(iv)(b)** requires the proponent to provide written confirmation from the independent CPESC that the ESCP is in accordance with IECA standards.

LMU confirms that the following documents were received via email from Senior Approvals Manager Kate McBean (CO2 Australia) on 01 March 2019:

- Point Ceylon Breeding and Maturation Facility, 2019 erosion and sediment control plan supporting documentation (J000073_PointCeylon_ESCP_rev1_ver4, dated 12/2/19).
- ESCP Sheets 1-11 Rev1 Ver 1(Sheets 1-4 & 6-11 dated 7/2/19; Sheet 5 dated 11/2/19).
- Attachment 2 (J000073_SoilFactualReport_rev0-v3, dated 18/1/19).
- Attachment 3 (Doc: HOR20181217001).
- Review of Project Sea Dragon ESCP (Bynoe) 4 (ID 175341)

Accordingly, LMU considers this condition to have been satisfied. LMU has compiled the above documents into a single document, filename "Seafarms_DP17-0371A_ESCP.pdf"

This advice is provided on the basis that the developer and / or consultant is not absolved from full responsibility for the correctness, accuracy and implementation of effective management of erosion and sediment control for the duration of the development.

The proponent is reminded of the following development permit conditions relating to implementation of the ESCP which are required to be satisfied:

Condition 3 requires the permit holder to ensure that the independent CPESC (Auditor) undertakes the following:

- (i) Monitors onsite implementation of the ESCP during clearing works, in accordance with the requirements outlined in the ESCP
- (ii) Report to the consent authority within 7 days of each monitoring site inspection regarding compliance with the ESCP
- (iii) Inspect the site within one day after post-clearing site stabilisation measures have been implemented; and
- (iv) Report to the consent authority within 7 days of the post-clearing site stabilisation site inspection regarding compliance with the ESCP

Condition 4(i) requires the permit holder (and contractors) to comply with the ESCP at all times, and **Condition 4(ii)** requires the permit holder (and contractors) to ensure that appropriate erosion and sediment controls are effectively implemented to prevent erosion occurring within the permitted clearing area and sediment from leaving the site.

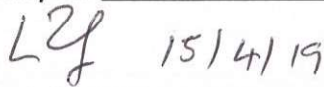
Condition 13(i) prevents the permit holder from varying the ESCP accepted by this letter without prior written approval from the consent authority.

Yours sincerely



Ashley Beagley
Senior Land Management Officer

22 March 2019

Document No:	Seafarms_DP17-0371A_ESCP.pdf	referred to in
Permit No:	DP17/0371A	issued by
The Consent Authority on:		
		
DELEGATE OF THE MINISTER FOR INFRASTRUCTURE, PLANNING AND LOGISTICS		

CC. Kate McBean, Senior Approvals Manager - CO2 Australia
Tim Elder, CPESC - Ecoz

THIS LETTER FORMS PART OF THE ACCEPTED ESCP AND SHOULD NOT BE REMOVED

Point Ceylon Breeding and Maturation Facility, 2019 erosion and sediment control plan supporting documentation

Project Sea Dragon Point Ceylon, NT PORTION 03192 BYNOE

Prepared for
seafarms Pty Ltd

Project J000073
Date: Tuesday, 12 February 2019



Document History

Document details

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Report prepared for	seafarms Pty Ltd		
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Document status and review

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4	Ian Hollingsworth	MF, WH, KM	12 February 2019
Tim Elder (Ecoz)			

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Revision	Electronic	Paper	Issued to
1	1		Warren Harries (Construction Manager, seafarms), Kate McBean (Environment Manager, seafarms), Meghan Farr (Environment Specialist, seafarms)



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Erosion and Sediment Control Plan

ESCP Sheet 1 – Access Road

ESCP Sheet 2 – Seawater Intake Pipeline & Settling Pond

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ESCP Sheet 4 – Technical Notes

ESCP Sheet 5 – Explanatory Notes

ESCP Sheet 6 – Design Specifications: Diversion Bank, Flow Control Berm

ESCP Sheet 7 – Design Specifications: Revegetation

ESCP Sheet 8 – Design Specifications: Stockpiles Mitre Drains

ESCP Sheet 9 – Design Specifications: Temporary Culverts

ESCP Sheet 10 – Design Specifications: Cross Fall Drainage

ESCP Sheet 11 – Design Specifications: Brush Mulch, Erosion Control Blanket

This Erosion and Sediment Control Plan satisfies the following requirements:

- i. The intent and minimum standards established by all relevant local, state and federal policies relating to erosion and sediment control
- ii. Review and approval by personnel suitably trained and experienced (to a degree appropriate given the type and size of the land disturbance) in each of the following categories: construction, soil science, hydrology/hydraulics, and site revegetation and rehabilitation.
- iii. Is both reasonable and practicable.
- iv. Contains enough information to allow appropriate implementation of the plans(s)

Signature:

Planner

Name: Dr Ian Hollingsworth CPESC 8254

Date:

11 February 2019



Erosion & Sediment Control Plan Supporting Documentation

Project Sea Dragon Construction 2019

Point Ceylon Breeding and Maturation Facility

Local Authority: N.T. PORTION 03192 BYNOE

Proponent: *seafarms* Pty Ltd

1 Introduction

seafarms engaged Dr Ian Hollingsworth CPESC 8254, Horizon Environmental Soil Survey & Evaluation (HESSE) to develop an ESCP for Project Sea Dragon Breeding and Maturation Facility 2019 civil works, Point Ceylon, NT (the Project). The ESCP was prepared to address the requirements of condition 2 of Development Permit issued under the NT Planning Act (DP17/0371) for this work, namely:

- i. ESCPs are to be prepared in accordance with Key Principles of Erosion and Sediment Control as specified in the IECA Best Practice Erosion and Sediment Control Guidelines 2008.
- ii. engage a person who holds a current certification as a CPESC with IECA (auditor) to review the ESCP and provide written confirmation that the ESCP was prepared in accordance with the Key Principles of erosion and sediment control as specified in the IECA Best Practice Erosion and Sediment Control guidelines 2008 (or higher standard);

seafarms engaged Tim Elder CPESC 4399 as the auditor to satisfy condition ii above.

seafarms plan to limit the extent of clearing to that required for construction planned for the 2019 dry season. The area is a small fraction of the area covered under the approved clearing permit area under the project development permit (DP17/0371). The ESCP comprising erosion and sediment controls for 2019 civil works is set out in:

ESCP Sheet 1 - erosion and sediment controls for the access road.

ESCP Sheet 2 – erosion and sediment controls for the seawater intake pipeline and settlement ponds

ESCP Sheet 3 – erosion and sediment controls for the Breeding and Maturation Centre, Discharge Ponds and Discharge Pipeline.

ESCP Sheet 4 – technical specifications

ESCP Sheet 5 to Sheet 8 – erosion and sediment control design specifications

This documentation presented here supports the technical and design specifications in the ESCP.

Certification of this ESCP encompasses the design and management documentation. Information from this ESCP should not be extracted and or used in isolation without prior consultation with HESSE. To provide effective erosion and sediment control it is critical that proposed erosion and sediment controls as nominated within the drawings are coordinated with the construction program. If a deviation from the proposed design is envisaged and or experienced, and or if information provided is considered to be ambiguous or unclear, consultation with Ian Hollingsworth, Horizon Environmental Soil Survey and Evaluation, (HESSE) is required.

This ESCP plan when provided by HESSE as revision, 'Final' or subsequent numbered revisions, is considered to be certified with the Approver being a Certified Professional in Erosion and Sediment Control (CPESC). The ESCP includes the relevant calculations and design information for the nominated major ESC measures to be installed in disturbed catchments within the 2019 works area.



The status of the revision of the ESCP should be checked with the recipients tabulated at the start of the document.

1.1 Design Principles

This plan aims to prevent land degradation from erosion and to intercept and treat sediment laden runoff arising from construction by applying erosion and sediment control best practice guidelines (IECA, 2008) that include the following design principles:

1. Appropriately integrate the development into the site
2. Integrate erosion and sediment control into site and construction planning
3. Develop effective and flexible ESCP based on anticipated soil, weather, and construction conditions
4. Minimise the extent and duration of soil disturbance
5. Control water movement across the site
6. Minimise soil erosion
7. stabilise disturbed areas
8. Maximise sediment retention on site
9. Maintain all ESC measures in proper working order at all times
10. Monitor the site and adjust ESC practices to maintain the required performance standard.

1.2 Scope of work

The following cleared areas for 2019 civil works included for erosion and sediment control plans (ESCP) are:

1. Seawater intake pipeline (10x300 m)
2. Settlement ponds (1 Ha)
3. Broodstock maturation centre (6.5 Ha)
4. Discharge pond and pump station (1.5 Ha)
5. Discharge pipeline (10x850 m)
6. Access road (7900 m).

The drawings for tender relating to work areas addressed in this report are set out in Project Sea Dragon Point Ceylon Brood Stock Maturation Centre 2019 C025 Construction Package Earthworks for access roads, building platforms, hardstands & water storage ponds (**ATTACHMENT 1**).

1.3 Environmental Legislation and Approvals

1.3.1 Relevant Legislation

In the NT a person, or persons conducting land-disturbing development, has responsibility for the prevention and control of land degradation, and care of resources under three main Acts: The Waste Management and Pollution Control Act, the Soil Conservation and Land Utilisation Act and the Water Act. Under the Waste Management and Pollution Control Act all personnel have a “General Environmental Duty” to prevent or minimise pollution or environmental harm and a “Duty to Notify” of incidents if the incident is causing or threatening to cause pollution in the conduct of the activity; the incident causes or threatens to cause pollution resulting in material or serious environmental harm. The person conducting the activity must notify the NT Environmental Protection Authority (NTEPA) in accordance with subsection (3) of the Act, as soon as practicable after (and in any case within 24 hours after) first becoming aware of the incident or the time he or she ought reasonably be expected to have become aware of the incident. Failure to comply with the notification directions carries an environmental offence level 4. The Soil Conservation and Land Utilisation Act assists in protecting sensitive areas and reducing the downstream impact of sediment.

The Water Act (1969) provides for the investigation, use, control, protection, management and administration of water resources in the NT to sustain beneficial uses.



1.3.2 Project Approvals

The Development Permit (DP17/0371) for N.T. Portion 03192 BYNOE issued to clear native vegetation on the site contains conditions relating to the development of Erosion and Sediment Control Plans (ESCP).

1.4 Existing environment

1.4.1 Climate

The mean annual rainfall is 1778 mm (Dum In Mirrie Arstrip). The seasonally wet monsoonal climate supports woodland savanna vegetation in upland areas. Diverse mangrove vegetation fringes the coastline. The rainfed growing season is from November to March. Water erosion risk is associated with intense storms and prolonged heavy rainfall occurring during the wet season, which begins with isolated storms from September prior to the onset of monsoon trough in November December. The wet season typically extends until April. Runoff coefficients are in the order of 30% of rainfall (Vardavas, 1998; East *et al.*, 1987), i.e. approximately 400 mm rainfall occurs as runoff. This average annual catchment runoff rate is comparable to the 30-40 minute duration single storm runoff rates on sandy loam agricultural soils referred to in IECA Best Practice Chapter A3 Table A12 to estimate runoff volume for sizing sediment controls.

During the dry season from May to September there is risk of dust during construction.

Monthly erosion risk rating is given in **Table 1**. The construction schedule avoids potentially high and extreme rainfall erosion risk from November to March.

1.4.2 Geography and soils

The project area at the end of a peninsula, Point Ceylon, in Bynoe Harbour is on gently undulating rises (9-30 m relief) in a 'residual' landscape formed from deeply weathered Proterozoic gneiss or granite and sandstone. There are extensive areas of ferricrete that outcrop on the residual weathered rock landscape. The residual, weathered landscape has shallow to moderately deep soils supporting tall woodlands dominated by *Corymbia bleeseri*, in areas of shallow soils and ferricrete, and *E miniata*/*E tetradonta* on deep, gravelly soils.

A Cretaceous mudstone, the Darwin Member of the Bathurst Island Formation, which occurs elsewhere in the Darwin region and on the Tiwi Islands, onlaps the coastline discontinuously around Point Ceylon and forms relatively level plains of limited extent above the tidal zone. Land gradients are gentle (<3%). The coastline is fringed with quaternary sediments on extensive inter-tidal flats. The rock is deeply weathered into a lateritic profile with extensive areas of ferricrete outcrop and small areas of sandy Cretaceous sediments.

Away from the coast, overland flow of soil saturation excess generates runoff, while low topography controls surface hydrology in the wet season towards near coastal swamps. There are no surface permanent water bodies away from the marine environment.

Highly erosive monsoon rainfall generates sheet flow of eroded sediment the across the gently undulating upland terrain, which acts as a transport surface aggrading broad near coastal seasonal swamps with up to 0.5 m of sandy wash. These areas support low *Melaleuca viridiflora* and tall *Melaleuca leucadendra* woodlands.

Quaternary sediments in the intertidal zone of the estuary support diverse mangrove and underlain by Proterozoic gneiss.



1.5 Soil properties

Soil properties in the factual soil report (**ATTACHMENT 2**) are summarised in **Table 2** to **Table 4**. Residual soils are shallow to moderately deep (0.5 m deep) well drained gravelly formed in weathered rock with ironstone outcropping in the seawater settlement pond, broodstock maturation facility and access road. Fertility constraints in the surface soils in these areas associated with low pH and low nutrient levels and availability for rapid revegetation. Colluvial soils over weathered mudstone in the discharge ponds.

1.5.1 Receiving Environment Protection

Coastal mangroves are recognised sensitive environmental receptors downstream from the project. There is an existing access road that follows the ridge line to the end of Point Ceylon. The work areas, apart from the seawater intake and discharge pipelines are remote from the mangrove habitat.

2 Risk assessment

2.1 Erosion hazard

The total score of 19 on the erosion hazard assessment form **Table 5** exceeded the default trigger level score of 17 indicating that the risk level, which reflects the area that will be disturbed, warranted a detailed ESCP.

Rainfall erosion risk is high to extreme during the wet season and very low from May to September (**Table 1**). The proposed layout, including avoiding excavation of coastal and concentrated flow lines, and scheduling of work between May and September is designed to reduce reliance on sediment control during construction. Dust is likely to be a problem during dry season construction.

2.2 Soil loss estimation

The project area is at the discharge side of the drainage system adjacent to the sea. The access road follows the ridge along Point Ceylon. There are no sizable catchments receiving runoff from the works. Runoff reports directly via overland flow to the coastal environment.

Average soil loss rate estimates were made for each of the areas that will be disturbed during construction using the Revised Universal Soil Loss Equation (RUSLE):

$$A = R \times K \times LS \times C \times P$$

Where:

A = annual soil loss due to sheet and rill erosion (t/ha/yr)

R = rainfall erosivity factor

K = soil erodibility factor

LS = topographic factor derived from slope length and gradient

C = cover and management factor

Soil loss estimation used the annual rainfall erosivity, R factor=11994, for Darwin Airport (**Table 1**) and soil erodibility, K- factors (IECA Tables E4) inferred from soil factual reporting (**ATTACHMENT 2**). Soil properties in each work area are summarised in **Table 4**.

RUSLE parameters and catchment properties that were used to calculate average annual soil loss rate for bare soil conditions, that represent the highest risk situation when works are underway and before revegetation is implemented, are shown in **Table 6**. The soil gravel content that was identified across the work areas provides significant erosion resistant cover on bare soil (Hollingsworth, 2019).



The 0.03 C factor for revegetated treatments including brush mulch on disturbed areas and jute mesh on pond embankments and revegetation techniques that were selected provides 75-80% erosion resistant cover, accounting for the combined additive cover of gravel content (**Table 4**) and erosion control techniques.

Estimated soil loss rates are relatively low (**Table 7**). Erosion risk for disturbed areas and external pond embankment batters are low.

Revegetation methods incorporating topsoil spreading, rapid grass cover seed mix and brush mulching on external pond batters and disturbed areas is appropriate to manage the level of erosion risk according to IECA best practice. Revegetation reduces the soil loss rate by 50% on embankments and a factor of 10 on extensive areas of bare soil.

2.3 Sediment control

Type 3 sediment control standards are appropriate to manage the estimated average annual soil loss rates (IECA Table 4.5.1). The plan includes installing berms constructed from stockpiled topsoil above and below areas of disturbance, and stockpiled cleared vegetation, to adequately account for the risks.

The implementation of these sediment controls is independent of time of year. This plan applies to works planned in the dry season May – September.

Erosion and sediment controls are adequate to meet IECA best practice guidelines if works continue into the wet season (October – March). However, trafficability in work areas will be greatly reduced once the soils become saturated, after approximately 300 mm of rain.

In this event ESCP would be reviewed with subcontractors for civil works to reassess controls needed to manage temporary access.

3 Construction plan

Compacted hardstands, ponds and crowned gravel access roads are set out in plans from the tender information package (**ATTACHMENT 1**). Internal embankments on raw seawater settlement ponds and broodstock maturation centre waste seawater treatment ponds are HDPE (high density polyethylene lined). External embankments are earth-lined with 50 mm of topsoil and revegetated.

3.1 Schedule

Construction is planned for the dry season between April and October in 2019. Erosion and sediment controls are required to be in place before the 1 October.

3.2 Environmental Management Plan

Environmental management strategies for managing risks to existing environmental values are documented in the Project Sea Dragon Core Breeding Centre and Broodstock Maturation Centre Environmental Management Plan (EMP) (Seafarms, 2018). This ESCP will form part of the overall EMP and references to supporting environmental management strategies and contingency measures from Project Sea Dragon EMP.

3.3 Clearing management

Clearing will be constrained within the clearing permit area to the immediate vicinity of facilities planned for construction in 2019 (**ATTACHMENT 1**). Topsoil to 100mm deep will be pushed with cleared vegetation using an excavator/bulldozer and stockpiled following the vegetation management, land and soil, and erosion control strategies in EMP Appendix C. Clearing will be managed to minimise disturbance outside of the construction areas.



3.4 Site Drainage

Surface drainage is shallow, and poorly defined. The access road follows the crest of the peninsula and has small discontinuous areas of upslope catchment. The settlement pond, sea water intake, broodstock maturation facility, discharge waste water pond and pipeline are located close to the coast in a low relief, gently undulating landscape with sparse, disintegrated drainage that is dominated by sheet, or overland, rather than concentrated flow to the coast. There are extensive areas of swamp woodland with poorly drained soils formed in colluvium or granite around the discharge waste water ponds. Elsewhere, in the residual landscape soils are well drained and generally gravelly.

4 Erosion and sediment control design

The IECA standards applied to erosion and sediment control design are listed in **Table 8**.

4.1 Hydraulic Design

Intensity-frequency-duration (IDF) rainfall (**Table 9**) for Point Ceylon was calculated on the Bureau of Meteorology website (<http://www.bom.gov.au/hydro/has/cdirswebx/>).

50% annual exceedance probability rainfall design storm event was used for temporary structures such as temporary creek crossings, rock filter dams, and drainage diversion banks.

10% annual exceedance probability rainfall design storm event was used for extreme event procedures.

4.1.1 Design discharge catchment, clean water above discharge ponds

DESIGN DISCHARGE, CATCHMENT

Step 1 Exceedance probability for design storm

One hour 10% exceedance probability rainfall (**Table 9**) $I_{10} = 68.8$ mm

Step 2 Effective catchment area, $A = 2$ Ha

Step 3 Coefficient of discharge (C)

From **IECA Table A5**, for a I_{10} of 68.8 and construction site, high permeability, $C_{10}=0.70$

From **IECA Table A7**, for a 50% exceedance probability, Frequency Factor $F_v=0.85$,

Step 4 Time of concentration (t_c)

(a) Initial sheet flow travel time

From **IECA Figure A3**, vegetated, 2% slope, flow path length 380m, $t_1=18$ min

(b) Channel flow travel time

Grass lined diversion bank design,

(a) 0.5% slope, 380 m length, $v = 1.5$ m/s channel flow time $t_2 = 5$ min

$t_c = t_1 + t_2 = 18 + 5$, $t_c = 23$ min

Step 5 Partial area effect – NIL

Step 6 Design average rainfall intensity,

50% exceedance probability, 20 min duration **Table 9**, $I_{50\%,20m} = 25$ mm (75 mm/hr)

Step 7 Design peak discharge, Rational method, $Q = CIA/360$



$$(a) C = F_y \times C_{10} = 0.70 \times 0.85, C = 0.595$$

$$(b) Q = 0.595 \times 75 \times 2 / 360$$

DESIGN DISCHARGE, $Q = 0.25 \text{ m}^3/\text{sec}$

4.1.2 Diversion Bank Design

SYMBOL ON ESCP SHEET 3 – DB-1 (IECA Design Fact Sheet Diversion Banks Part 3:Grass lined)

STEP 1 – Design discharge, $Q = 0.4 \text{ m}^3/\text{sec}$

STEP 2 – CROSS SECTIONAL PROFILE IECA Table A30a parabolic IECA Design Fact Sheet Flow diversion bank Part 3, grass lined back push drain, gravelly, 70% cover

$$b = 2, y = 0.2, T = 1.2$$

STEP 3 – Allowable flow velocity, $V = 2 \text{ m/s}$, Table 19 70% grass cover, 1% grade

STEP 4 – Maximum allowable flow depth $T = 1.2 \text{ m}$, Table 5, $V = 0.7 \text{ m/s}$, $S = 0.5\%$

STEP 5 -Manning's $n = 0.1$, Table 20 S 1%, $R = 0.1$, $n = 0.12$

STEP 6 – Cross sectional flow area, $A = 0.2$, $R = 0.1$, $P = 1.22$

STEP 7 – Maximum allowable flow capacity, Table 27 $Q = 0.945 \text{ m}^3/\text{s}$

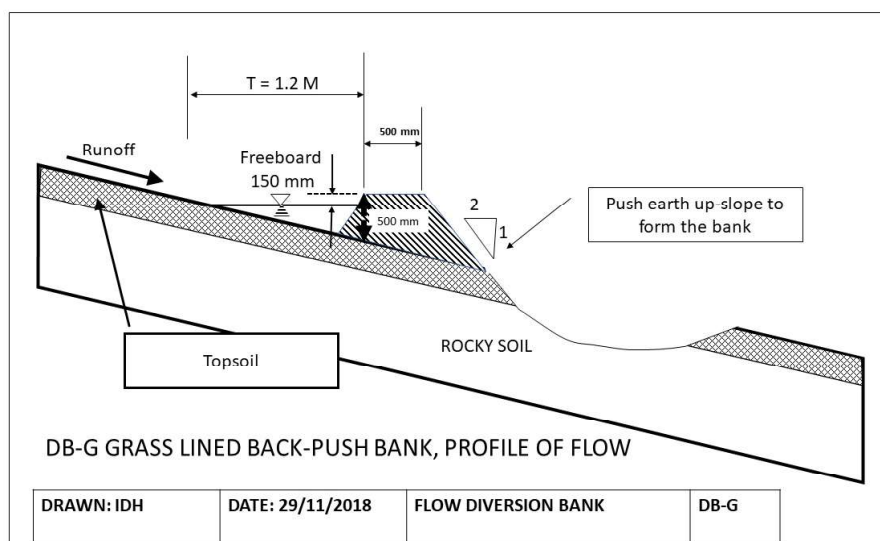
Table 13 land slope 2%, bank grade 0.5% $Q = 17.6 \text{ L/s}$, $0.02 \text{ m}^3/\text{s}$

Maximum flow capacity $0.945 \text{ m}^3/\text{s}$ (STEP 7) > design discharge $0.09 \text{ m}^3/\text{s}$ (Step 4)

STEP 8 – Required freeboard, 150 mm (IECA Design Fact Sheet Diversion Banks Part 1: general, Table 1)

STEP 9 – Machinery access via access road.

STEP 10 – Flow diversion bank dimensions



DB-G Profile of back-push bank



5 Explanatory notes

5.1 Technique selection

1. Technique selection across catchments and work areas consistent with low erosion hazard and TYPE 3 sediment control standards are listed in **Table 10**.

5.2 Drainage control

2. Review the need for drainage diversion, **DB-1**, and temporary culverts **TC-1** to **TC-7** once detailed engineering design is completed.
3. Install earth lined diversion bund, **DB-1**, shown on ESCP Sheet 3, to divert clean water catchment runoff (2 Ha) from the discharge ponds area.
4. Refer to approved construction plans for installation of permanent structures.
5. Install scour protection on temporary culvert inlets and outlets **TC-1** to **TC-7**.
6. Discharge diverted drainage under access roads through culverts **TC-1** and **TC-2**.
7. Install temporary culverts **TC-3** to **TC-7** on the main access road.
8. Divert up-slope stormwater flow around work areas using stockpiled topsoil and vegetation to construct flow control berms (**CB-1**, **CB-2**, **CB-3** and as required by the operational activity) to mitigate against early wet season flows and the risk that work extends into October.
9. Construct crowned gravel roads with table drains according to engineering specifications.
10. Install mitre drains (**MD**) approximately 60m apart from the top of slopes 2-4% to divert road drainage to level outlets, 7 to 10 m wide on stable, vegetated or rocky ground.
11. Maintain existing access roads with cross drainage by grading from both edges to the centre, then spreading evenly to maintain crossfall drainage.

5.3 Erosion control

12. Set out work areas to limit traffic disturbance and clearing to within 5m of planned construction activities.
13. Implement dust control using water trucks as required in work areas to maintain moist soil conditions and mitigate excessive dust. Add soil binders according to manufacturer's specifications and advice if needed to stabilise soil against dusting.
14. Strip and stockpile topsoil (0-100 mm maximum depth) around work area boundaries (**TS**).
15. Re-spread stockpiled topsoil (minimum depth 50 mm) over disturbed areas outside of the broodstock and maturation facility infrastructure.
16. Apply temporary revegetation (**R**) that incorporates rapid growing grass species with fertiliser, and lime amendment to treat soil constraints to promote rapid revegetation.
17. Install jute mesh erosion control blanket (**ECB**) on revegetated, topsoiled external pond batters. Alternatively apply a chemical soil stabiliser, which is verified to *seafarms* satisfaction, non-toxic to growth stages of prawns at the Point Ceylon facility according to the manufacturers specification..
18. Brush mulch (**BM**) revegetated, disturbed areas associated with construction activity other than the pond area to return these areas to natural woodland cover.

5.4 Sediment control

19. Maintain separation indicated on plans between earthworks and drainage lines or the coastline.
20. Install mulch berms (**MB**) to intercept runoff from topsoil stockpiles to mitigate drainage and sediment control risk if construction extends into October.



5.5 Revegetation plan

21. Refer to topsoil and cleared vegetation management in EMP APPENDIX C. Revegetation measures are listed for this ESCP in **Table 11**.
22. . The revegetation plan for the site is to establish grass cover on re-spread topsoil pond embankments and to use cleared vegetation as a brush mulch to stabilise disturbed areas, thereby reducing erosion. A grass mix suited to revegetation for soil conservation in the Top End (Hadden, 1993) is used in the ESCP revegetation specification (**R**).
23. The revegetation specification (**R**) includes amendments to treat soil constraints to revegetation in the topsoil that include low fertility associated with low nutrient levels and pH<5.5, and the subsoil and the subsoil that include sub-soil sodicity in the discharge waste water pond area.

6 ESCP Management

6.1 Plan implementation

24. Refer to clearing management in Tender Technical Specifications. Hand clear and remove vegetation in seawater intake pipeline and discharge pipeline corridors to minimise soil disturbance. Excavation in the pipeline corridors is not permitted.
25. Follow the installation sequence in **Table 12**
26. .Refer to the roles and responsibilities for erosion and sediment control plan implementation listed in **Table 13**
27. Erosion and sediment controls are adequate to meet IECA best practice guidelines if works continue into the wet season (October – March). However, trafficability in work areas will be greatly reduced once the soils become saturated, after approximately 300 mm of rain.
28. In this event ESCP would be reviewed with subcontractors for civil works to reassess controls needed to manage temporary access.

6.2 Site Inspection

29. Example site inspection forms are provided in **ATTACHMENT 3**.
30. Objectives, targets and indicators for erosion and sediment management are listed in **Table 14**.
31. Inspect drainage and sediment control measures:
 - daily while work is occurring
 - weekly when work is not occurring on site
 - within 24 hours of expected rainfall
 - within 18 hours of a rainfall event of sufficient intensity and duration to cause runoff on-site.
32. Record environmentally relevant incidents in a field log that is accessible to all relevant regulatory agencies.
33. Review water quality at baseline water quality monitoring sites in Bynoe Harbour and Wheatley Creek against Project Sea Dragon interim water quality guidelines.
34. Adaptively manage unforeseen erosion and sediment issues identified from baseline water quality monitoring and site inspections that compromise objectives
35. Subcontractors are responsible for ensuring that work does not extend outside of designated areas. This will be monitored during weekly inspections, with the requirement for amended ESCPs to be determined by a CPESC.



6.3 Plan updates and amendments

36. The process for updating and amending the ESCP in response to inspection activity and advice on revised construction plan scope of work is documented in **Table 15**.
37. Operational inspection forms and check lists to support ESCP implementation are provided in **ATTACHMENT 3**.
38. Contractors need to get approval for changes to this ESCP as per Project Sea Dragon Tender 4 Technical Specifications by a registered CPESC to ensure that ESCP implementation is in accordance with IECA Guidelines (IECA, 2008).
39. ESCP implementation will be reviewed and updated and amended as required by a registered CPESC prior to onset of the 2019 wet season and at the end of the 2019 wet season to ensure that ESCP implementation is in accordance with IECA Guidelines (IECA, 2008).

7 Limitations

Horizon Environmental Soil Survey and Evaluation (HESSE) has prepared advice on Project Sea Dragon Package 1 erosion and sediment control in accordance with direction from Peter Stubbs, Project Sea Dragon Area Manager, on the 5 July 2018. This conceptual advice is provided for the exclusive use of **seafarms** for this work package only and for the purpose(s) described in the report. It should not be used for other projects. In preparing this report HESSE has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the surface and sub-surface conditions only at the specific sampling or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of anthropogenic influences. Such changes may occur after field testing has been completed.

HESSE's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by HESSE in this report may be limited by undetected variations in ground conditions between sampling locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

This report must be read in conjunction with all of the attached notes and should be kept in its entirety without separation of individual pages or sections. HESSE cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion given in this report.



8 References

- East, T. J., Cull, R. F. & Duggan, K. (1987). Surface runoff yields and sediment transport processes near Ranger. In *Alligator Rivers Region Research Institute Annual Research Summary, 1985-86*, 17-20 Canberra: Australian Government Publishing Service.
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- Seafarms (2018). Project Sea Dragon Stage 1 Legume Grow-Out Facility Environmental Management Plan In *Project Sea Dragon Stage 1 EMP* (Ed CO2). seafarms, CO2.
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- IECA (2008) DESIGN DRAWINGS.



TABLES

**Table 1 Monthly rainfall erosion risk 2 year average recurrence interval**

Month	% of annual rainfall	R¹	Erosion risk rating²
January	29	3752	extreme
February	22	2781	extreme
March	18	2124	extreme
April	5	514	high
May	1	0	Very low
June	0	0	Very low
July	0	0	Very low
August	0	0	Very low
September	1	0	Very low
October	3	322	High
November	6	906	High
December	15	1775	High
ANNUAL		11994	

¹ DENR rainfall erosivity in the Darwin Daly region from a daily rainfall erosivity model and 5km gridded rainfall data; ² IECA Table G2



Table 2 Soil morphology

<i>Landform - Vegetation</i>	<i>Soil type</i>	<i>Property</i>			<i>Work area</i>					
		<i>Slope (%)</i>	<i>Acid sulfate risk</i>	<i>Erosion risk</i>	<i>Seawater Intake</i>	<i>Settlement Pond</i>	<i>Breeding & maturation</i>	<i>Discharge Pond</i>	<i>Discharge pipeline</i>	<i>Access road</i>
Tidal flat, mangroves & samphire on estuarine sediment	Intertidal Hydrosol, poorly drained	0	VH	L	X			X		
Plains, M viridiflora on ferricrete, granite, mudstone	Gravelly, Sandy, Clay loamy, Hydrosol, poorly drained	0<5	Nil	M	X	X	X	X	X	X
Gently undulating Low rises, E tetradonta, E miniata on ferricrete, granite, siltstone	Gravelly, Shallow Gravelly, Loamy, Clay loamy, Brown Kandosols, well drained	<6	Nil		X	X	X	X		X
Plains, mixed woodland over ferricrete and granite	Shallow Gravelly, Loamy, Clay loamy, Brown Kandosols, imperfectly drained	<3	Nil	M				X		
Plains, E tetradonta, E miniata	Shallow, Gravelly Loam, Clay loamy, Red and Brown Kandosols, well drained	<3	Nil					X		
Gently undulating plains, C. bleeseri, E tetradonta woodland	Gravelly, moderately deep, Loamy, clay loamy, Brown Tenosols	<3	Nil	M						X
Steep scarps with extensive rock outcrop on rises, E tetradonta woodland	Gravelly, Well drained, shallow Brown loam, clay loam, Rudosols (CH5600, 5500, 5360, 5310, 5300, 5200)	15<25	Nil	V						X
Plains sorghum grassland on ferricrete pavement	Gravelly, sandy, very shallow, Brown Rudosols, well drained		N	L						X

**Table 3 Soil chemical fertility in areas identified with cut and fill**

<i>Area</i>	<i>Depth (m)</i>	<i>Salinity</i>	<i>Sodicity</i>	<i>Low pH</i>	<i>Chemical infertility</i>
Settlement Ponds	0-0.2			X	X
	0.5-0.7			X	X
Broodstock Maturation Centre	0-0.2			X	X
	0.5-0.7			X	X
Discharge Pond	0-0.2			X	X
	0.5-0.7	X	X		X
Access road	0-0.2			X	X
	0.5-0.7			X	X

**Table 4 Soil physical properties**

<i>Area</i>	<i>Depth (m)</i>	<i>Dry bulk density</i>	<i>Texture class</i>	<i>Emmerson dispersion class</i>	<i>pH</i>	<i>ESP (%)</i>	<i>Surface Gravel</i>	<i>K factor¹</i>
Seawater Intake	0-0.2	1.1±0.1	Silt loam	5	4.3-6.2	>15	2-10%	0.055
	0.5-0.7	1.3±0.2	Silty clay	5	6.4-7.5	>15	2-10%	0.025
Settlement Ponds	0-0.2		Loamy sand	3b	5.5-6.5	2-8	>90%	0.02
	0.5-0.7		Sandy loam	3b			50-90%	0.03
Broodstock Maturation Centre	0-0.2		Loamy sand	3b	5.5-6.5	2-8	50-90%	0.02
	0.5-0.7		Sandy loam	3b			20-50%	0.03
Discharge Pond	0-0.2		Loamy sand	3b	5.5-6.5	2-8	20-50%	0.02
	0.5-0.7		Sandy clay loam	3b			20-50%	0.043
Discharge Pipeline	0-0.2	1.4±0.2	Silt loam	5	4.5-6.5	>15	20-50%	0.055
	0.5-0.7	1.3±0.2	Silty clay	5	6.4-7.5	>15	20-50%	0.025
Access road	0-0.2		Loamy sand	3b			50-90%	0.02
	0.5-0.7		Sandy loam	3b			50-90%	0.03

¹ IECA Table E4 Default soil erodibility K-factors based on soil texture class



Table 5 Erosion hazard assessment form Point Ceylon

Condition	Points	Score	Trigger
AVERAGE SLOPE OF DISTURBANCE AREA [1]		1	
- not more than 3% [3% : 33H:1V] - more than 3% but not more than 5% [5% = 20H:1V] - more than 5% but not more than 10% [10% = 10H:1V] - more than 10% but not more than 15% [15% : 6.7H:1V] - more than 15%	0 1 2 4 6		4
SOIL CLASSIFICATION GROUP (AS1726) [2]		0	
- GW, GP, GM, GC - SW, SP, OL, OH - SM, SC, MH, CH - ML, CL, or if <i>imported fill</i> is used, or if soils are untested	0 1 2 3		
EMERSON (DISPERSION) CLASS NUMBER [3]		2	
- Class 4, 6, 7, or 8 - Class 5 - Class 3, (default value if soils are untested) - Class 1 or 2	0 2 4 6		6
DURATION OF SOIL DISTURBANCE [4]		4	
- not more than 1 month - more than 1 month but not more than 4 months - more than 4 months but not more than 6 months - more than 6 months	0 2 4 6		6
AREA OF DISTURBANCE [5]		6	
- not more than 1000 m² - more than 1000 m² but not more than 5000 m² - more than 5000 m² but not more than 1 ha - more than 1 ha but not more than 4 ha - more than 4 ha	0 1 2 4 6		4
WATERWAY DISTURBANCE [6]		0	
- No disturbance to a watercourse, open drain or channel - Involves disturbance to a constructed open drain or channel - Involves disturbance to a natural watercourse	0 1 2		2
REHABILITATION METHOD [7]		4	
Percentage of area (relative to total disturbance) revegetated by seeding without light mulching (i.e. worst-case revegetation method). - not more than 1% - more than 1% but not more than 5% - more than 5% but not more than 10% - more than 10%	0 1 2 4		
RECEIVING WATERS [8]		0	
- Saline waters only - Freshwater body (e.g. creek or freshwater lake or river)	0 2		
SUBSOIL EXPOSURE [9]		0	
- No subsoil exposure except of service trenches - Subsoils are likely to be exposed	0 2		
EXTERNAL CATCHMENTS [10]		0	
- No external catchment - External catchment diverted around the soil disturbance - External catchment not diverted around the soil disturbance	0 1 2		
ROAD CONSTRUCTION [11]		2	
- No road construction - Involves road construction works	0 2		
pH OF SOILS TO BE REVEGETATED [12]		0	
- more than pH 5.5 but less than pH 8 - other pH values, or if soils are untested	0 1		
Total Score ^[13]		19 high risk	17

**Table 6** RUSLE soil loss assessment factors

Parameter	Source	Factor values	
R ¹ factor (Sept-Oct weighted average annual R factor 3603)	DENR	11994	
K - Soil erodibility ²	IECA Table E5	Topsoil 0.02	Subsoil 0.03
LS - factor	IECA Table E3		
Settlement pond		0.2	
Broodstock maturation		0.2	
Discharge pond & pump station		0.17	
Access road		1	
C - Cover factor bare soil	IECA Table E9	Settlement Ponds	0.03 0.1
	IECA Table E9	Broodstock Maturation	0.1 0.45
	IECA Table E9	Discharge Pond/Pump	0.45 0.45
	IECA Table E9	Access road	0.1 0.1
	IECA Table E9	Pond Embankments	0.03 0.1
C - Cover factor revegetated	IECA Table E9	0.03 NA ⁴	
P Erosion control	IECA Table E11	Work area RIPPED	0.8
	Loose soil to 300 mm depth		
	IECA Table E11	Work area COMPACTED	1.3
	compacted and smooth (construction default)		

¹ DENR tabulated R factors for the NT listed in **Table 1** for Darwin Airport

² maximum K factors in **Table 4**

³ Cover factor from based on Soil Factual Report gravel content summarised in **Table 4**.

⁴ NA – not applicable, the revegetated surface is topsoiled

**Table 7 Sediment control standard based on soil loss rate¹**

STAGE 1 SOIL LOSS CALCULATIONS - RUSLE EROSION RISK						
WORK AREA	SHEET 2 SETTLEMENT PONDS	SHEET 3 BROODSTOCK MATURATION	SHEET 3 DISCHARGE POND & PUMP STATION	SHEET 1 ACCESS ROAD POND EMBANKMENT		
Undisturbed (Ha)	0	0	0	0	0	0
Disturbed (Ha)	1	6.5	1.5	10	10	10
Total catchment area (Ha)	1	6.5	1.5	10	10	10
RUSLE FACTORS						
Rainfall erosivity - R	11994	11994	11994	11994	11994	11994
Topsoil erodibility - K	0.02	0.02	0.02	0.02	0.02	0.02
Subsoil erodibility - K	0.03	0.03	0.03	0.03	0.03	0.03
Slope length - L (m)	100	100	50	200	3	3
Slope gradient - S (%)	1	1	1	3	50	50
Length/Gradient (LS-factor)	0.2	0.2	0.17	1	1.88	1.88
Erosion control practice - P compacted (IECA Table E11)	0.8	0.8	0.8	0.8	0.8	0.8
Erosion control practice - P loose (IECA Table E11)	1.3	1.3	1.3	1.3	1.3	1.3
Ground cover in disturbed area - C revegetated (IECA Table E9)	0.03	0.03	0.03	0.03	0.03	0.03
Ground cover in disturbed area - C bare soil** (IECA Table E9)	0.1	0.1	0.45	0.1	0.1	0.1
ESTIMATED SOIL LOSS						
TOPSOIL Compacted and smooth Soil Loss (T/Ha/yr) revegetated	NA	NA	NA	NA	NA	NA
TOPSOIL Compacted and smooth Soil Loss (T/Ha/yr) bare soil	4	4	15	19	36	36
SUBSOIL Compacted and smooth Soil Loss (T/Ha/yr) revegetated	NA	NA	NA	NA	NA	NA
SUBSOIL Compacted and smooth Soil Loss (T/Ha/yr) bare soil	6	6	22	29	54	54
TOPSOIL Loose to 300 mm Soil Loss (T/Ha/yr) - revegetated	1	1	1	6	11	11
TOPSOIL Loose to 300 mm Soil Loss (T/Ha/yr) - bare soil	4	4	15	19	36	36
SEDIMENT CONTROL TYPE	TYPE 3	TYPE 3	TYPE 3	TYPE 3	TYPE 3	TYPE 3
EROSION HAZARD	VERY LOW	VERY LOW	VERY LOW	VERY LOW	VERY LOW	VERY LOW

¹ IECA Table 4.5.1; ** C factor includes gravel content estimate summarised in Table 4.

**Table 8 Design standards**

Issue	Context	Design standard
DRAINAGE Temporary drainage structure	IECA Table 4.3.1 anticipated design life < 12 months IECA Drainage flow Diversion design fact sheet Table 1	50% exceedance probability Earth lined banks and channels 300mm hydraulic freeboard
EROSION CONTROL	IECA Table 4.4.1	Low risk - operations during average monthly rainfall less than 100 mm
LAND CLEARING	IECA Table 4.4.7	All reasonable and practicable steps taken to apply best practice erosion control measures to completed earth works, or otherwise stabilised such works, prior to anticipated rainfall – including existing unstable, undisturbed, soil surfaces under the management or control of the building/construction works. Disturbed surfaces stabilised with minimum 80% cover of rock or vegetation (dead or alive) within 20 days of work completion, or similar cover to comparable undisturbed areas Soil stockpiles and unfinished earthworks suitably stabilised if disturbance is expected to be suspended for more than 5 days.
SEDIMENT CONTROL	IECA Table 4.5.1 Soil loss rate (t/ha/y) Table 4.5.3 Sheet flow	< 75 – TYPE 3 Default sediment control techniques Type 3 – buffer zone, filter fence, compost/mulch berm CONTROLS NEED TO BE IN PLACE BEFORE THE 1 OCTOBER.
STOCKPILE MANAGEMENT	IECA Table 4.6.1 Table 4.6.2	Upslope- drainage diversion; cover - vegetation or mulch Downslope - woven sediment fence or earth bund

**Table 9 Design rainfall statistics (IFD table)**

Copyright Commonwealth of Australia 2016 Bureau of Meteorology (ABN 92 637 533 532)												
All Design Rainfall Depth (mm)												
Issued:	29-Jan-19											
Location L Point Ceylon												
Requested Latitude	-15.0875		Longitude	129.3875								
Nearest gr Latitude	15.0875 (S		Longitude	129.3875 (E)								
	Exceedance Annual Exceedance Probability (AEP)											
Duration	Duration in	12EY	6EY	4EY	3EY	2EY	0.5EY	0.2EY	1 in 200	1 in 500	1 in 1000	1 in 2000
1 min	1	1.56	1.79	2.14	2.34	2.58	3.59	4.23	7.14	8.43	9.5	10.7
2 min	2	2.99	3.43	3.98	4.29	4.66	6.38	7.54	12.3	14.5	16.3	18.3
3 min	3	4.13	4.76	5.58	6.05	6.59	9.01	10.7	17.6	20.7	23.3	26.1
4 min	4	5.09	5.9	7	7.63	8.36	11.5	13.5	22.5	26.6	29.9	33.5
5 min	5	5.94	6.92	8.29	9.08	10	13.7	16.2	27.2	32.1	36.1	40.5
10 min	10	9.09	10.8	13.3	14.8	16.6	23.1	27.3	46.2	54.5	61.5	69
15 min	15	11.2	13.5	16.9	18.9	21.3	30.1	35.5	60.1	71	80.1	89.8
20 min	20	12.8	15.5	19.5	22	25	35.6	42	71	83.9	94.5	106
25 min	25	14	17	21.6	24.5	27.9	40.1	47.3	79.9	94.3	106	119
30 min	30	15	18.3	23.4	26.5	30.3	43.8	51.7	87.4	103	116	130
45 min	45	16.9	20.9	27	30.8	35.5	52.1	61.7	105	124	139	156
1 hour	60	18.1	22.6	29.3	33.6	39	57.8	68.8	118	139	156	175
1.5 hour	90	19.5	24.5	32.2	37.1	43.5	65.4	78.5	137	162	182	204
2 hour	120	20.3	25.6	33.9	39.3	46.3	70.4	85.2	152	179	202	226
3 hour	180	21.2	26.9	36.1	42.1	50	77.3	94.7	176	207	234	262
4.5 hour	270	22	28.1	38.1	44.8	53.6	84.3	105	204	241	272	305
6 hour	360	22.6	29	39.6	46.8	56.3	89.6	113	228	269	304	341
9 hour	540	23.9	30.7	42.2	50.1	60.8	98.4	126	269	318	359	403
12 hour	720	25.2	32.3	44.6	53	64.7	106	137	305	360	406	456
18 hour	1080	27.9	35.6	49	58.5	71.7	119	157	365	431	486	546
24 hour	1440	30.6	38.8	53.2	63.5	78	131	175	416	491	553	621
30 hour	1800	33.2	42	57.2	68.2	84	142	190	460	543	613	687
36 hour	2160	35.6	44.9	61	72.6	89.5	153	205	498	588	664	744
48 hour	2880	40.2	50.4	67.9	80.7	99.6	171	231	563	663	746	834
72 hour	4320	47.8	59.2	79.2	94.1	116	202	272	651	764	855	953
96 hour	5760	53.1	65.4	87.7	104	129	225	301	704	823	918	1020
120 hour	7200	56.5	69.2	93.6	112	139	242	321	733	854	953	1060
144 hour	8640	58.1	70.9	97.4	117	146	254	333	746	867	969	1070
168 hour	10080	58.2	71	99.4	121	151	262	340	748	868	973	1080

**Table 10 ESCP Control technique selection**

Sub-catchment	Label	Technique
<i>Limits to disturbance</i>		mark out limits to restrict work within 5m of construction footprint
<i>Erosion controls</i>	R	External pond batter revegetation
	R	Disturbed area revegetation
<i>Drainage controls</i>		
<i>2 Ha clean water</i>	DB-1	Earth lined bank, 100 m long; 1% gradient
	TC-1	Temporary culvert
	TC-2	Temporary culvert
<i>Access track</i>	TC-3 to -7	Temporary culvert

Table 11 Revegetation plan

Item	Application	Description																
Long-term revegetation	completion of work package	Roughen and decompact worked and disturbed surfaces. Remove grader, or dozer windrows that potentially concentrate overland flow. Re-spread stockpiled topsoil to 50mm minimum depth. Apply recommended revegetation seed mix (below) with brush mulch (BM), or as specified in landscaping plans.																
Short-term stabilisation	Treat stockpiles and disturbed areas	Apply recommended cover mix (R)																
		<table><tr><th>Scientific and common names</th><th>Recommended sowing rate</th></tr><tr><td><i>Chloris gayana</i> (Rhodes grass)</td><td>5kg/ha</td></tr><tr><td><i>Stylosanthes hamata</i> (Verano Stylo - a legume)</td><td>10 kg/ha</td></tr><tr><td><i>Cynodon dactylon</i> (Green Couch)</td><td>5kg/ha</td></tr><tr><td><i>Paspalum notatum</i> (Bahia Grass)</td><td>5kg/ha</td></tr><tr><td>NPK fertiliser</td><td>300 kg/ha</td></tr><tr><td>Lime</td><td>2000 kg/ha</td></tr><tr><td>Surface treatment</td><td>Roughen compacted bare surfaces by ripping, scarifying, ploughing up to 0.3m depth perpendicular to slope.</td></tr></table>	Scientific and common names	Recommended sowing rate	<i>Chloris gayana</i> (Rhodes grass)	5kg/ha	<i>Stylosanthes hamata</i> (Verano Stylo - a legume)	10 kg/ha	<i>Cynodon dactylon</i> (Green Couch)	5kg/ha	<i>Paspalum notatum</i> (Bahia Grass)	5kg/ha	NPK fertiliser	300 kg/ha	Lime	2000 kg/ha	Surface treatment	Roughen compacted bare surfaces by ripping, scarifying, ploughing up to 0.3m depth perpendicular to slope.
Scientific and common names	Recommended sowing rate																	
<i>Chloris gayana</i> (Rhodes grass)	5kg/ha																	
<i>Stylosanthes hamata</i> (Verano Stylo - a legume)	10 kg/ha																	
<i>Cynodon dactylon</i> (Green Couch)	5kg/ha																	
<i>Paspalum notatum</i> (Bahia Grass)	5kg/ha																	
NPK fertiliser	300 kg/ha																	
Lime	2000 kg/ha																	
Surface treatment	Roughen compacted bare surfaces by ripping, scarifying, ploughing up to 0.3m depth perpendicular to slope.																	
MONITORING	Monthly	Implement temporary revegetation measures by 30 days prior to the nominated site shutdown date.																
COMPLIANCE	Completion of work	Target: stabilisation of work areas and pond embankments Target 80% cover (INCLUDING GRAVEL AND MULCH) prior to on-set of monsoons in Nov-Dec																

**Table 12 Installation sequence**

Item	Sheet	Installed	Removed
WORK LIMITS – WITHIN 5M OF WORK	1, 2, 3	Prior to site disturbance according to 2019 Point Ceylon Stage 1 engineering plans, and within the clearing permit area.	Project completion
MITRE DRAINS (MD) 60M APART STARTING BELOW THE TOP OF THE SLOPE	1, 2,	Prior to installing culverts	Review when permanent roadway construction is completed
CULVERTS (TC)	1, 2,	After installing mitre drains	Review when permanent roadway construction is completed
DRAINAGE DIVERSION BANK, DB-1	2	Prior to clearing vegetation.	Project completion, replace, or review, against detailed engineering plans for road drainage in the Breeding & Maturation Centre and Discharge Ponds
CLEAR AND GRUB VEGETATION FOLLOWING EMP SPECIFICATION	1,2,3	Prior to construction works	Permanent
STOCKPILE AND MANAGE TOPSOIL AND CLEARED VEGETATION (TS) FOLLOWING SPECIFICATION IN THE EMP		At site clearing	When construction is completed
REVEGETATE (R) FOLLOWING SPECIFICATION IN THE EMP		When construction is completed	Permanent

**Table 13 Roles and responsibilities**

CONTACT	CONTACT DETAILS
CONSTRUCTION MANAGER	WARREN HARRIES PHONE: 0477 774 901 EMAIL: WARREN.HARRIES@SEAFARMS.COM.AU NOTE: SITE SPECIFIC MANAGER AND OH&S PERSONNEL WILL BE APPOINTED AS PROJECT DEVELOPS
ENVIRONMENTAL MANAGER KATE MCBEAN	ENVIRONMENTAL MANAGER KATE MCBEAN PHONE: 07 3248 0211 EMAIL: KATE.MCBEAN@CO2AUSTRALIA.COM.AU NOTE: SITE SPECIFIC MANAGER AND OH&S PERSONNEL WILL BE APPOINTED AS PROJECT DEVELOPS
SEAFARMS LTD 24-HOUR EMERGENCY CONTACT (WITHIN SEAFARMS)	REFER PROPONENT ABOVE ROD DYER
ESCP DEVELOPER	IAN HOLLINGSWORTH, HORIZON ENVIRONMENTAL SOIL SURVEY & EVALUATION; PHONE: 0457 717858; EMAIL: IAN.HOLLINGSWORTH@HORIZONESSE.COM
ESCP AUDITOR	TIM ELDER, ECOZ ENVIRONMENTAL CONSULTANTS; EMAIL: TIM.ELDER@ECOZ.COM.AU

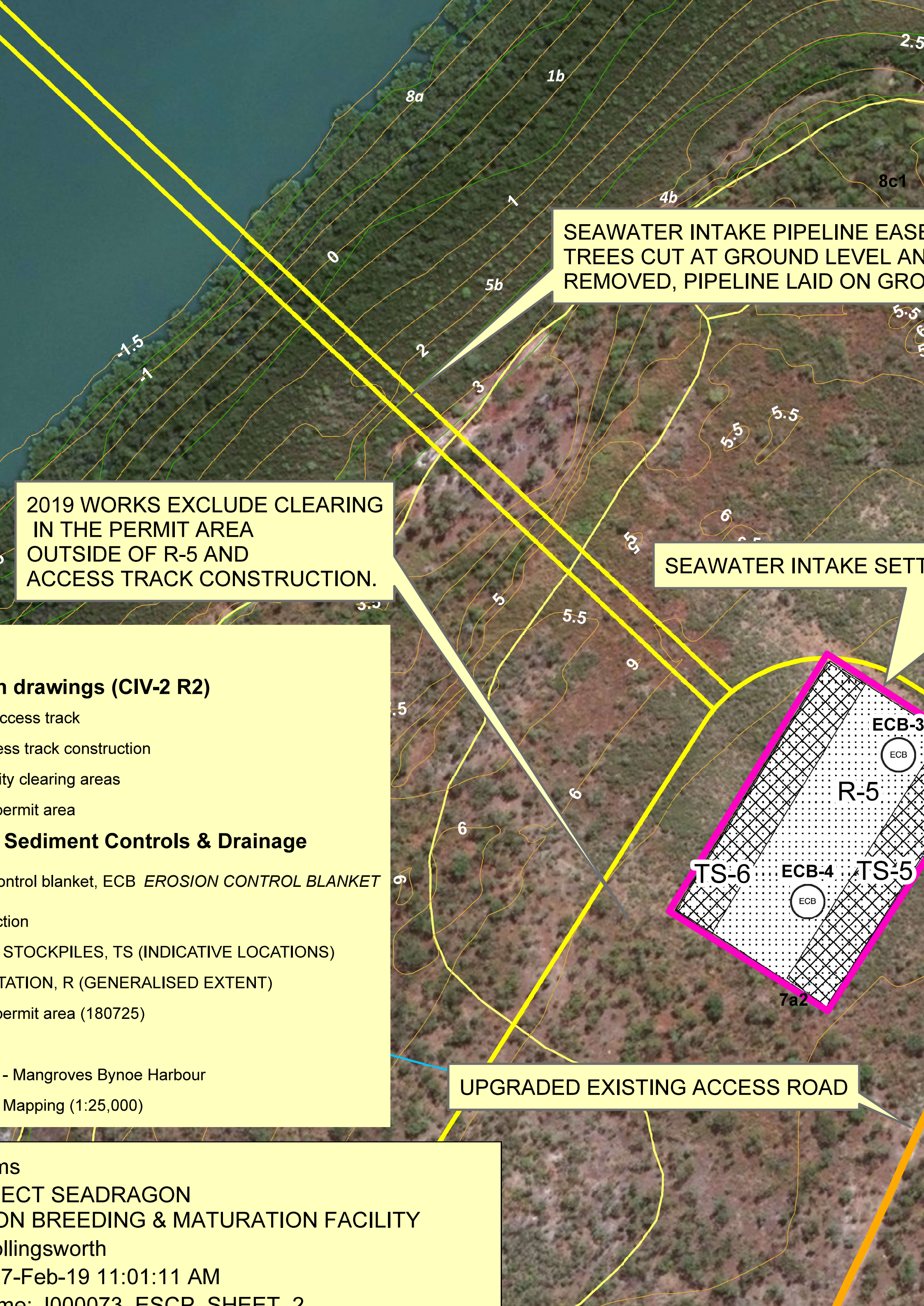
**Table 14 Objectives, targets and indicators for erosion and sediment management**

Objectives	Target	Indicator
Conserve land capability	ESCP is completed and endorsed by CPESCs prior to commencement of work	CPESC endorsed ESCP is approved by Project Sea Dragon prior to commencement of work.
Minimise sediment transport from construction sites to adjacent receiving environment	Implement ESCP prior to commencement of construction where there are risks of erosion and sedimentation, especially prior to the onset of wet season rain	CPESC report confirming that the ESCP is adequately implemented. Inspection and test plan reports
Water quality objectives	No disturbance of waterways No requirement for sediment basins No de-watering releases	Review Project baseline wet and dry season monitoring during construction against interim Project water quality guidelines for Bynoe Harbour and Wheatley Creek.

**Table 15 Inspection, test and ESCP update plan**

Frequency	Responsibility	Inspection activity
Prior to runoff producing rain	Earthworks contractor	Inspect and verify drainage, erosion and sediment control measures are installed and maintained Check temporary flow diversion and drainage works
Following run-off producing rain	Earthworks contractor	Check effectiveness of drainage, sediment control measures Check for excessive sediment deposition and rectify Check for construction material, litter, sediment dispersal across site and rectify Check for excessive erosion, sedimentation, mud around the site office, park up and storage areas and rectify
Daily during rain	Earthworks contractor	Check all drainage, sediment and erosion controls Check for excessive sediment deposition
Weekly	Environment/Project manager ¹ ESCP site inspection checklist =1Non-conformance report	Check condition at site discharge points, Check installation and effectiveness of all drainage, sediment and erosion controls Check for excessive sediment deposition and rectify Check for dispersal of construction materials, litter or sediment dispersal from the site and rectify Area and percentage cover of finished work Remnant and conservation zone vegetation health and integrity of undisturbed areas. Extent of land clearing, earthworks and site stabilisation or revegetation against plan in each work area.
Plan revision	Ian Hollingsworth	Review ESCP performance following weekly inspections by Environment/Project Manager and post-wet season site inspection Review ESCP controls prior to wet season and respond to advised changed scope of work from Construction manager. Respond to non-compliance report from CPESC Auditor
Project start Project end	CPESC Auditor CPESC Auditor	check ESCP compliance with IECA best practice review updated ESCP scope against IECA best practice.

¹ checklist and monitoring report proformas are provide in **Attachment 3**



SEAWATER INTAKE PIPELINE EASE
TREES CUT AT GROUND LEVEL AND
REMOVED, PIPELINE LAID ON GRO

2019 WORKS EXCLUDE CLEARING
IN THE PERMIT AREA
OUTSIDE OF R-5 AND
ACCESS TRACK CONSTRUCTION.

SEAWATER INTAKE SETT

h drawings (CIV-2 R2)

- Access track
- Access track construction
- Quality clearing areas
- Permit area

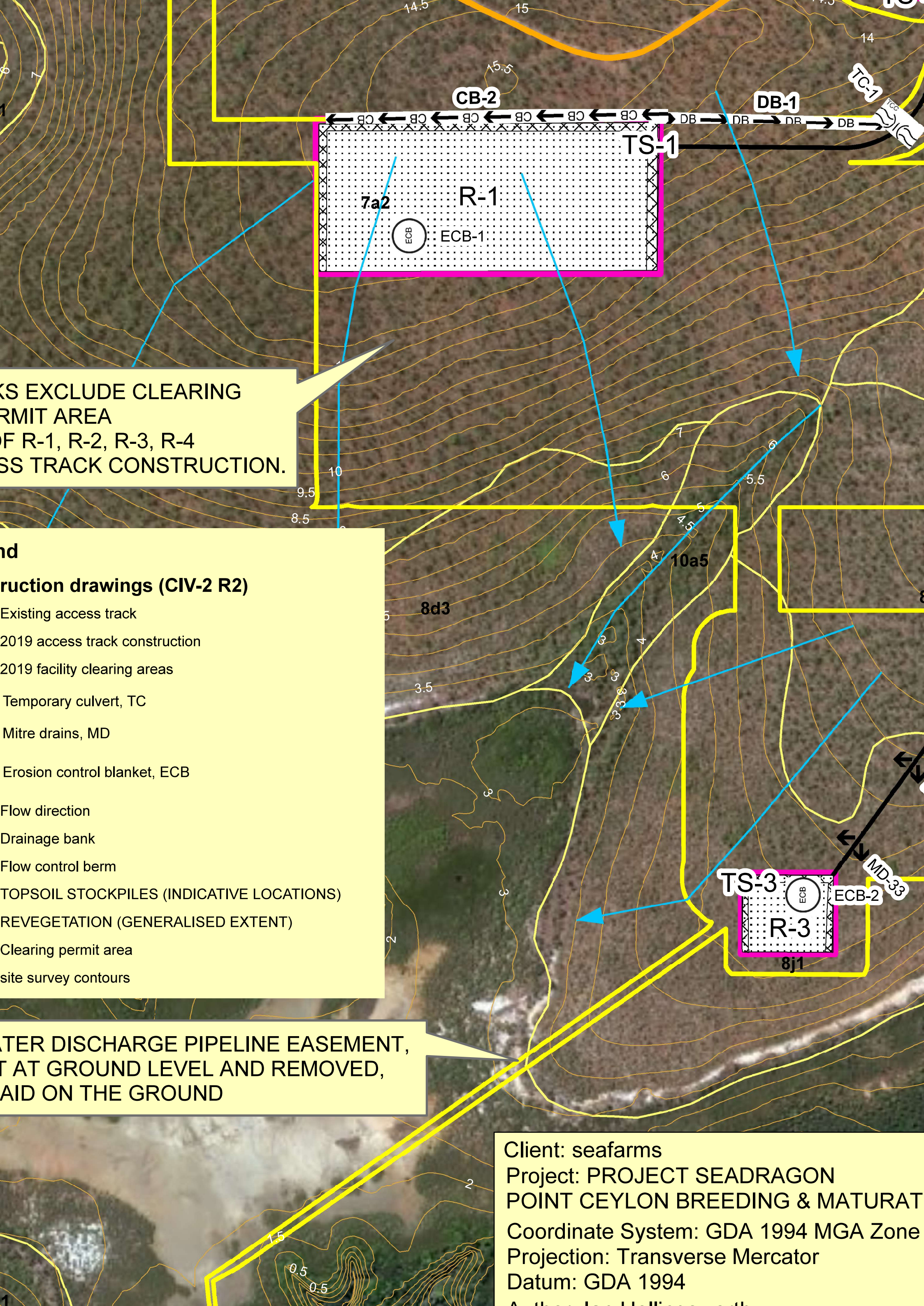
Sediment Controls & Drainage

- Control blanket, ECB *EROSION CONTROL BLANKET*
- Stockpiles, TS (INDICATIVE LOCATIONS)
- Station, R (GENERALISED EXTENT)
- Permit area (180725)

- Mangroves Bynoe Harbour
Mapping (1:25,000)

ns
ECT SEADRAGON
ON BREEDING & MATURATION FACILITY
ollingsworth

7-Feb-19 11:01:11 AM
me: 1000073 ESCP SHEET 2



PERMIT AREA
R-1, R-2, R-3, R-4
SS TRACK CONSTRUCTION.

Legend

Construction drawings (CIV-2 R2)

- Existing access track
- 2019 access track construction
- 2019 facility clearing areas
- Temporary culvert, TC
- Mitre drains, MD
- Erosion control blanket, ECB
- Flow direction
- Drainage bank
- Flow control berm
- TOPSOIL STOCKPILES (INDICATIVE LOCATIONS)
- REVEGETATION (GENERALISED EXTENT)
- Clearing permit area
- Site survey contours

WATER DISCHARGE PIPELINE EASEMENT,
AT GROUND LEVEL AND REMOVED,
PAID ON THE GROUND

Client: seafarms
Project: PROJECT SEADRAGON
POINT CEYLON BREEDING & MATURAT
Coordinate System: GDA 1994 MGA Zone
Projection: Transverse Mercator
Datum: GDA 1994
Author: [illegible]

STOCKPILES, MITRE DRAINS
TEMPORARY CULVERTS
CROSS-FALL DRAINAGE
BRUSH MULCH, EROSION CONTROL

ent in Tender Technical Specifications. Hand clear and remove vegetation in
d discharge pipeline corridors to minimise soil disturbance. Excavation in the
itted.

et out in **TABLE 1**.

erosion and sediment control plan implementation are listed in **TABLE 2**.

s are provided in **ATTACHMENT 3**.

tors for erosion and sediment management are listed in **TABLE 3**.

nt control measures:

curring

not occurring on site

pected rainfall

ainfall event of sufficient intensity and duration to cause runoff on-site.

ant incidents in a field log that is accessible to all relevant regulatory agencies.

ine water quality monitoring sites in Bynoe Harbour and Wheatley Creek against

ater quality guidelines.

en erosion and sediment issues identified from baseline water quality monitoring

romise objectives

le for ensuring that work does not extend outside of designated areas. This will

inspections, with the requirement for amended ESCPs to be determined by a

d amending the ESCP in response to inspection activity and advice on revised
ork is documented in **TABLE 4**.

and check lists to support ESCP implementation are provided in **ATTACHMENT 3**.

roval for changes to this ESCP as per Project Sea Dragon Tender 4 Technical

CPESC to ensure that ESCP implementation is in accordance with IECA Guidelines

ewed and updated and amended as required by a registered CPESC prior to onset
at the end of the 2019 wet season to ensure that ESCP implementation is in
nes (IECA, 2008).

and indicators for erosion and sediment management

Target	Indicator
ESCP is completed and endorsed by CPESCs prior to commencement of work	CPESC endorsed ESCP is approved by Project Sea Dragon prior to commencement of work.
Implement ESCP prior to commencement of construction where there are risks of erosion and sedimentation, especially prior to the onset of wet season rain	CPESC report confirming that the ESCP is adequately implemented. Inspection and test plan reports

d ESCP update plan

nsibility	Inspection activity
orks contractor	Inspect and verify drainage, erosion and sediment control measures are installed and maintained Check temporary flow diversion and drainage works Remove Sediment in rock filter dam, RFD-1 to maintain design capacity Check effectiveness of drainage, sediment control measures
orks contractor	Check for excessive sediment deposition and rectify Check for construction material, litter, sediment dispersal across site and rectify Check for excessive erosion, sedimentation, mud around the site office, park up and storage areas and rectify
orks contractor	Check all drainage, sediment and erosion controls Check for excessive sediment deposition Check condition at site discharge points
ement manager	Check installation and effectiveness of all drainage, sediment and erosion controls
ie inspection checklist	Check for excessive sediment deposition and rectify Check for dispersal of construction materials, litter or sediment dispersal from the site and rectify
onformance report	Area and percentage cover of finished work Remnant and conservation zone vegetation health and integrity of undisturbed areas. Extent of land clearing, earthworks and site stabilisation or revegetation against plan in each work area.
ngsworth CPESC	Review ESCP performance following weekly inspections by Environment/Project Manager and post-wet season site inspection Review ESCP controls prior to wet season and respond

3. ALL DIMENSIONS SHOWN ON THESE PLANS ARE IN METRES UNLESS OTHERWISE NO
4. ALL LINE WORK DENOTING THE LOCATION OF SITE FOOTPRINTS, LIMITS OF CONST
- PROPOSED ROADS, AND CUT AND FILL SLOPES IS APPROXIMATE AND IS BASED ON
- OTHERS. HORIZON ENVIRONMENTAL SOIL SURVEY AND EVALUATION ACCEPTS NO
- INACCURACIES IN DATA PROVIDED BY OTHERS.
5. THESE PLANS HAVE BEEN PREPARED IN ACCORDANCE WITH THE IECA BEST PRACTI
6. THE SUBCONTRACTOR SHALL TAKE ALL NECESSARY MEASURES TO MINIMIZE EROSI
- PREVENT SEDIMENT-LADEN RUNOFF FROM SITE FROM ENTERING WATERWAYS. TH
- ADJUSTMENTS AND MODIFICATIONS TO THESE PLANS IN THE FIELD AS REQUIRED T
- PURPOSE.
7. HORIZON ENVIRONMENTAL SOIL SURVEY & EVALUATION BEARS NO RESPONSIBILI
- PROVIDED BY OTHERS THAT WAS USED IN PREPARING THIS PLAN.

EARTHWORKS

8. THE CONTRACTOR SHALL DO ALL THAT IS PRACTICABLE TO MINIMIZE DISTURBANC
- CONSTRUCTION.
9. THE CONTRACTOR SHALL BE RESPONSIBLE FOR LOCATING ALL EXISTING UTILITIES F
- EARTHWORKS.
10. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE PROTECTION AND REINSTATEN
- EXISTING SERVICES WHICH MAY BE DAMAGED AND/OR DISTURBED DURING CONST
11. HORIZON ENVIRONMENTAL SOIL SURVEY AND EVALUATION ACCEPTS NO RESPON
- UTILITIES DURING CONSTRUCTION.

EROSION & SEDIMENT CONTROL

12. LOCATIONS OF ACTIVE AREAS SHOWN ON THESE PLANS MAY BE SUBJECT TO CHAN
- APPROXIMATE.

EMERGENCY EROSION AND SEDIMENT CONTROL MEASURES

13. PRIOR TO EXPECTED HEAVY RAINFALL AND PRIOR TO INSTALLING TEMPORARY CUL
- ENSURE THAT ROAD DRAINAGE CONTROL MEASURES ARE INSTALLED.

TABLE 1 Installation sequence

Item	Sheet	Installed	F
WORK LIMITS – WITHIN 5M OF WORK	1, 2, 3	Prior to site disturbance according to 2019 Point Ceylon Stage 1 engineering plans, and within the clearing permit area.	Pr
MITRE DRAINS (MD) 60M APART STARTING BELOW THE TOP OF THE SLOPE	1, 2,	Prior to installing culverts	Re
CULVERTS (TC)	1, 2,	After installing mitre drains	Re
DRAINAGE DIVERSION BANK, DB-1	2	Prior to clearing vegetation.	Pr
CLEAR AND GRUB VEGETATION FOLLOWING EMP SPECIFICATION STOCKPILE AND MANAGE TOPSOIL AND CLEARED VEGETATION (TS) FOLLOWING SPECIFICATION IN THE EMP REVEGETATE (R) FOLLOWING SPECIFICATION IN THE EMP	1,2,3	Prior to construction works At site clearing When construction is completed	Pe W co

TABLE 2 Roles and responsibilities

CONTACT	CONTACT DETAILS
CONSTRUCTION MANAGER	WARREN HARRIES PHONE: 0477 774 901 EMAIL: WARREN.HARRIES@SEAFARMS.COM.A NOTE: SITE SPECIFIC MANAGER AND OH&A APPOINTED AS PROJECT DEVELOPS
ENVIRONMENTAL MANAGER KATE MCBEAN	ENVIRONMENTAL MANAGER KATE MCBEAN PHONE: 07 3248 0211 EMAIL: KATE.MCBEAN@CO2AUSTRALIA.COM.. NOTE: SITE SPECIFIC MANAGER AND OH&A APPOINTED AS PROJECT DEVELOPS
SEAFARMS LTD	REFER PROPONENT ABOVE
24-HOUR EMERGENCY CONTACT (WITHIN SEAFARMS)	ROD DYER
ESCP DEVELOPER	IAN HOLLINGSWORTH, HORIZON ENVIRONM EVALUATION; PHONE: 0457 IAN.HOLLINGSWORTH@HORIZONESSE.COM
ESCP AUDITOR	TIM ELDER, ECOZ ENVIRONMENTAL TIM.ELDER@ECOZ.COM.AU

les and responsibilities for erosion and sediment control plan implementation listed in **Table 2**. Sediment controls are adequate to meet IECA best practice guidelines if works continue into the (October – March). However, trafficability in work areas will be greatly reduced once the soils are saturated, after approximately 300 mm of rain. The ESCP would be reviewed with subcontractors for civil works to reassess controls needed to ensure temporary access.

Inspection forms are provided in **ATTACHMENT 3**. Targets and indicators for erosion and sediment management are listed in **Table 3**. Erosion and sediment control measures:

- while work is occurring
- when work is not occurring on site
- within 24 hours of expected rainfall
- within 18 hours of a rainfall event of sufficient intensity and duration to cause runoff on-site.
- document environmentally relevant incidents in a field log that is accessible to all relevant regulatory agencies.
- compare water quality at baseline water quality monitoring sites in Bynoe Harbour and Wheatley Creek against the Bays of Plenty Water Quality Interim water quality guidelines.
- manage unforeseen erosion and sediment issues identified from baseline water quality monitoring
- actions that compromise objectives
- workers are responsible for ensuring that work does not extend outside of designated areas. This will be monitored during weekly inspections, with the requirement for amended ESCPs to be determined by a

Amendments

For updating and amending the ESCP in response to inspection activity and advice on revised plan scope of work is documented in **Table 4**. Inspection forms and check lists to support ESCP implementation are provided in **ATTACHMENT 3**. The ESCP must be approved by the project manager and approved by the project manager. The ESCP must be approved by a registered CPESC to ensure that ESCP implementation is in accordance with IECA

ESCP implementation will be reviewed and updated and amended as required by a registered CPESC prior to the start of the 2019 wet season and at the end of the 2019 wet season to ensure that ESCP implementation is in accordance with IECA Guidelines.

Implementation plan

Application	Description	
At completion of work package	Roughen and decompact worked and disturbed surfaces. Remove grader, or dozer windrows that potentially concentrate overland flow. Re-spread stockpiled topsoil to 50mm minimum depth. Apply recommended revegetation seed mix (below) with brush mulch (BM), or as specified in landscaping plans.	
Treat stockpiles and disturbed areas	Apply recommended cover mix (R)	
	Scientific and common names	Recommended sowing rate
	<i>Chloris gayana</i> (Rhodes grass)	5kg/ha
	<i>Stylosanthes hamata</i> (Verano Stylo - a legume)	10 kg/ha
	Cynodon dactylon (Green Couch)	5kg/ha
	Paspalum notatum (Bahia Grass)	5kg/ha
	NPK fertiliser	200 kg/ha

IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION, EXTENT, OR METHOD OF APPLICATION CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

1. CHECK THE LOCATION OF THE DIVERSION BANKS AFTER FIRST DECIDING SUITABLE LOCATIONS FOR THE OUTLET.

2. CHECK THE LOCATION FOR THE BANK, CLEARING ONLY THE AREA THAT IS NEEDED FOR ACCESS.

3. REMOVE ROOTS, STUMPS AND DISPOSE OF IN DESIGNATED STOCKPILE AREA (S) OR WINDROW UPSLOPE, OR DOWNSLOPE OF THE DIVERSION BANK TO BE USED IN REHABILITATION OF THE DIVERSION BANK AFTER WORKS ARE COMPLETED.

4. PUSH THE BANK FROM THE MATERIAL AS A BACK-PUSH GRASS LINED BANK AS SHOWN ON THE DESIGN DIAGRAMS.

5. MAKE SURE THE SIDES OF EARTH BANKS ARE NOT STEEPER THAN 2:1 H:V AND THE COMPLETED BANK IS AT LEAST 500 mm HIGH.

6. CHECK THE BANK ALIGNMENT TO ENSURE POSITIVE DRAINAGE IN THE DESIRED DIRECTION TO THE LEVEL SPREADERS AT THE OUTLETS.

CE

1. INSPECT DIVERSION BANKS WEEKLY AND AFTER RUNOFF PRODUCING RAINFALL.

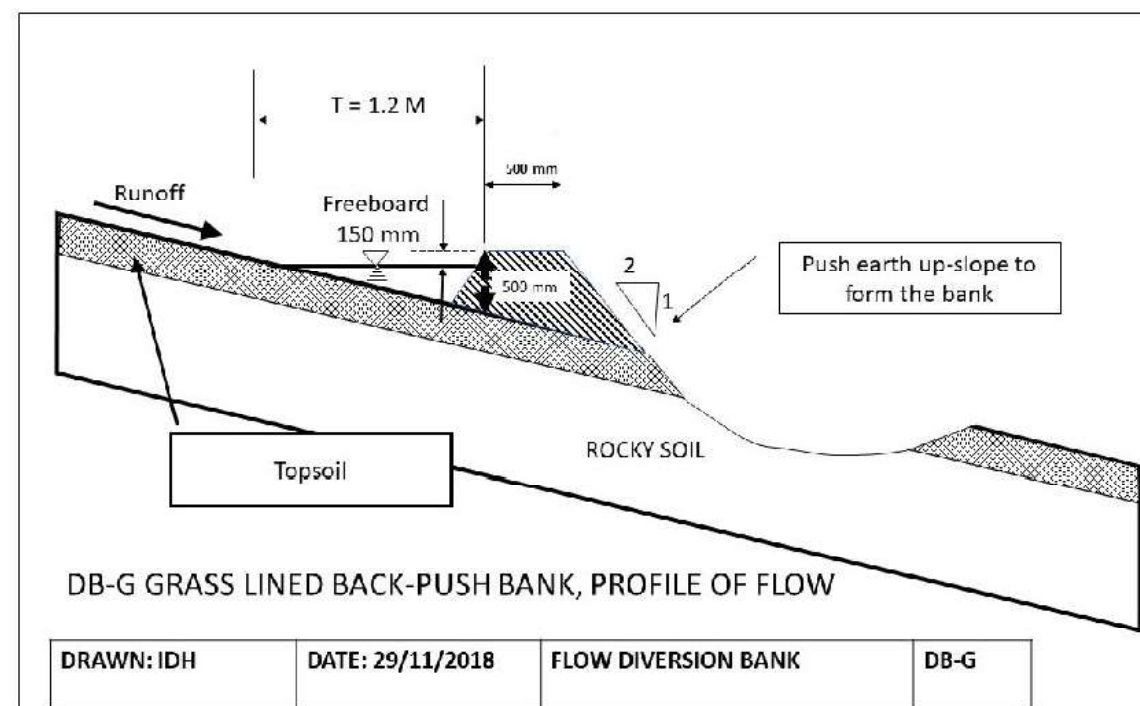
2. CHECK THE BANK FOR SLUMPING, WHEEL TRACK DAMAGE OR LOSS OF FREEBOARD.

3. CHECK THAT FILL MATERIAL OR SEDIMENT HAS NOT BLOCKED THE DRAINAGE PATH UP-SLOPE OF THE EMBANKMENT.

4. REMOVE EXCESS OF COLLECTED SEDIMENT OR FILL SO AS NOT TO CAUSE EROSION OR SEDIMENT POLLUTION.

5. REPAIR WEAK POINTS IN THE BANK THAT MAY FAIL.

1. DECOMMISSION AS ADVISED BY QUARRY SUPERVISOR, WHEN OPERATIONS AND DOWNSLOPE ACTIVITY ARE COMPLETE, AND THE WORK AREA IS STABILISED AND MEETS THE REVEGETATION AND REHABILITATION DESIGN (R-01).
2. REMOVE COLLECTED SEDIMENT AND DISPOSE IN A MANNER THAT DOES NOT CAUSE EROSION AND SEDIMENT POLLUTION.
3. GRADE THE AREA AND SMOOTH IT OUT IN PREPARATION FOR STABILISATION.
4. REMOVE WINDROWS.
5. STABILISE AREA AS SPECIFIED ON APPROVED PLANS TO DESIGN R-01.



Drawn: IDH	Date: DEC-18	Diversion Bank	DB → DB
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ON

1. TALL ABOVE COMBINED TOPSOIL & VEGETATION STOCKPILE IF NEEDED TO MAINTAIN POSITIVE DRAINAGE. REFER TO APPROVED PLANS AND PROCEDURES FOR LOCATION, EXTENT, AND APPLICATION DETAILS. IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION, EXTENT, OR METHOD OF APPLICATION CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

2. CHECK THE LOCATION FOR THE BERM, CLEARING ONLY THE AREA THAT IS NEEDED FOR ACCESS FOR PERSONNEL AND EQUIPMENT.

3. REMOVE ROOTS AND DEBRIS AND DISPOSE OF IN THE DESIGNATED STOCKPILE AREA.

4. BACK PUSH TOPSOIL MATERIAL TO A HEIGHT OF 500 MM TO FORM A BERM IN THE LOCATION SHOWN ON PLANS, OR AS INDICATED.

5. CHECK THE ALIGNMENT OF THE BERM WITH A GRADIENT NOT EXCEEDING 1:2000 TO ENSURE POSITIVE DRAINAGE IN THE DESIRED DIRECTION.

6. MAKE SURE THE BERM DISCHARGES TO A SUITABLE ROCKY OR VEGETATED OUTLET

MAINTENANCE

1. INSPECT FLOW CONTROL BERMS WEEKLY, OR AFTER RUNOFF PRODUCING RAINFALL.
2. INSPECT THE BERM FOR ANY SLUMPS, WHEEL TRACK DAMAGE OR LOSS OF FREEBOARD. MAKE REPAIRS AS REQUIRED.
3. CHECK THAT THE FILL MATERIAL OR SEDIMENT HAS NOT PARTIALLY BLOCKED THE DRAINAGE PATH UP-SLOPE OF THE EMBANKMENT. WHERE NECESSARY, REMOVE ANY DEPOSITED MATERIAL TO ALLOW FREE DRAINAGE.
4. DISPOSE OF ANY COLLECTED SEDIMENT OR FILL IN THE DESIGNATED STOCKPILE AREA, (S).
5. REPAIR THE BERM WHERE THERE IS RISK OF FAILURE.

REMOVAL

1. THE FLOW CONTROL BERM SHOULD BE REMOVED WHEN THE WORK AREA IS NO LONGER ACTIVE AND THE BANK IS NO LONGER ACTIVE AND THE AREA HAS BEEN STABILISED BY REVEGETATION (R) OR SURFACE ROUGHENING (SR-1) TREATMENTS.
2. DISPOSE OF ANY SEDIMENT OR EARTH IN THE DESIGNATED STOCKPILE AREA, AS NOT TO CREATE AN EROSION OR POLLUTION HAZARD BY INFILLING SLOPES OR PLACING IN THE DESIGNATED STOCKPILE AREA, SR.
3. GRADE THE AREA AND SMOOTH IT OUT IN PREPARATION FOR STABILISATION.
4. STABILISE THE AREA BY GRASSING IT AND SPREAD TOPSOIL AND CLEARED VEGETATION WITH MILLETT AS DIRECTED IN THE REVEGETATION TREATMENT PLAN.

FLOW CONTROL BERM DIMENSIONS

Parameter	Earth Bank
Height	500 mm
Top width	500 mm
Base width	2500 mm
Side slope	2:1 (H:V)
Freeboard	300 mm
Gradient	1:2000 (H:V)

SYSTEMS WITH THE LOCATION, EXTENT, METHOD OF APPLICATION CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

TO THE LAND SURFACE TO 100 MM DEPTH IF IT HAS BEEN COMPACTED TO ROUGHEN AND DECOMPACT.

SPREAD STOCKPILED TOPSOIL AND PLANTED VEGETATION ACROSS DISTURBED AREAS THAT NEED TO BE REVEGETATED.

BROADCAST FERTILISER AND SEED AT RECOMMENDED RATES SHOWN IN TEMPORARY REVEGETATION PARAMETERS.

APPLY SEED UNIFORMLY BY HAND OR WITH CYCLONE SEEDER, DROP-TYPE SPREADER, PNEUMATIC SEEDER, HYDROSEEDER, HYDROMULCHER, OR OTHER SUITABLE EQUIPMENT AS SPECIFIED.

WHEN USING BROADCAST-SEEDING METHODS, SUBDIVIDE THE AREA INTO MARKABLE SECTIONS AND APPLY ONE-THIRD OF THE SPECIFIED QUANTITY OF SEED WHILE MOVING BACK AND FORTH ACROSS EACH SECTION, MAKING A UNIFORM PATTERN.

THEN APPLY THE SECOND HALF IN THE SAME WAY, BUT MOVING AT RIGHT ANGLES TO THE FIRST PASS. COVER BROADCAST SEED BY RAKING OR CHAIN DRAGGING; THEN FIRM THE SURFACE WITH A ROLLER TO PROVIDE GOOD SEED CONTACT.

- TO SEEDED EXTERNAL POND EMBANKMENTS AS SPECIFIED IN THE APPROVED PLAN.
9. COVER BROADCAST SEED IN GENERAL REVEGETATION AREAS BY HARROWING OR CHAIN DRAGGING IF IT IS PRACTICAL AND COVER WITH BRUSH MULCH (BM).

WEED CONTROL

1. THE RAPID GROWTH RATE OF SEED MIX USUALLY CONTROLS ANY WEED PROBLEM.

MAINTENANCE

1. WATER THE VEGETATION IN THE FIRST 7 DAYS AFTER SOWING, AND ECB INSTALLATION ON POND WALL EMBANKMENTS, USING LOW-PRESSURE SPRAYS.
2. BEGIN WATERING IMMEDIATELY AFTER SOWING. VARY WATERING ACCORDING TO WEATHER AND SOIL CONDITIONS.
RECOMMENDED WATERING SCHEDULE:
 - I. 25MM TWICE A WEEK FOR THREE WEEKS; AND
 - II. 25MM ONCE A WEEK FOR A FURTHER TWO WEEKS.
3. MONITOR SITE REVEGETATION, PARTICULARLY AFTER RAINFALL, AND APPROPRIATE MAINTENANCE AND/OR AMENDMENT TO ENSURE THAT THE

- THAT EROSION IS CONTROLLED.
5. WHERE PRACTICAL, FILL IN, OR LEVEL ANY RILL EROSION AND CONSIDER OVERSOWING.
 6. RE-SEED AREAS IF THE VEGETATION IS DAMAGED TO ESTABLISH OR IS DAMAGED BY CONSTRUCTION ACTIVITIES.
 7. IF THE TEMPORARY REVEGETATION IS DAMAGED FOR ANY REASON BEFORE ESTABLISHMENT OF PERMANENT COVER, THEN RE-SEED WITH AN APPROPRIATE COVER, SUCH AS JUTE MATTING, CLEARED VEGETATION, OR ROCK MULCH TO PREVENT SOIL EROSION.
 8. WHERE THE COVER DENSITY IS LESS THAN EQUIVALENT COVER IN ADJACENT UNDISTURBED AREAS OR COMBINATION OF COVER AND VEGETATION COVER IS <80% THEN CONSIDERED ADEQUATE FOR EROSION CONTROL, THEN OVER SOW AT RECOMMENDED RATES, OR SPREAD GRAVEL.

Drawn: IDH	Date: Dec-18	Revegetation - General
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cover of dead or living vegetation and gravel as a visual guide. Each quarter of any one quarter has the same percent cover.



Temporary revegetation parameters.

Parameter	Directions
SITE PREPARATION	Decompact and roughen surface. Re-spread topsoil and clear vegetation. Remove windrows that direct runoff.
SEED MIX	Recommended s
<i>Chloris gayana</i> (Rhodes grass)	5kg/ha
<i>Stylosanthes hamata</i> (Verano Stylo - a legume)	10 kg/ha
<i>Cynodon dactylon</i> (Green Couch)	5kg/ha
<i>Paspalum notatum</i> (Bahia Grass)	5kg/ha
NPK fertiliser	300 kg/ha
Lime	2000 kg/ha
Surface treatment	Roughen compacted surfaces by ripping, scarifying, ploughing to 0.3m depth perpendicular to slope.

ATE STOCKPILES AT LEAST 20M AWAY FROM DRAINAGE LINES, OR
 NCENTRATED OVERLAND FLOWS.

CKPILE LOCATIONS NEED TO BE CONFIRMED FROM DETAILED SITE
 NS.

ATE THE COMBINED TOPSOIL AND CLEARED VEGETATION STOCKPILES
 OND THE EDGE OF OUTSIDE EMBANKMENT BATTERS AND INSIDE THE
 ARING PERMIT BOUNDARY INDICATED ON PLANS.

ERT DRAINAGE UPSLOPE OF STOCKPILES WITH AN EARTH FLOW
 NTROL BUND (CB)

IP AND STOCKPILE TOPSOIL IMMEDIATELY AFTER PUSHING CLEARED
 ETATION TO WORK AREA BOUNDARIES.

DID MIXING THE SURFACE 0-100 MM OF MATERIAL WITH
 TENTIALLY ROCKY, SALINE AND SODIC MATERIAL FROM GREATER
 THS.

CKPILES SHOULD BE LESS THAN 2 M HIGH.

NTAIN STOCKPILES IN A FREE-DRAINING CONDITION.

VER EXPOSED SUBSOILS AS SOON AS POSSIBLE.

SPREAD TOPSOIL AND CLEARED VEGETATION STOCKPILES, IN
 MBINATION WITH TEMPORARY REVEGETATION TREATMENT (R) TO
 BILISE WORK AREAS PRIOR TO THE ONSET OF MONSOON RAINFALL.

ABILITATE STOCKPILE AREAS AS SOON AS POSSIBLE AFTER THEY HAVE
 N REMOVED.

- CHECK STABILITY AND SEDIMENT LOAD.
- TREAT ANY OBSERVED EROSION AND SEDIMENT DEPOSITION
RECTIFY PROBLEMS.

Stockpile parameters.

Parameters	
Height	<2 m
Erosion control	Apply temporary revegetation measure R .
Drainage control	20 m distance from flow lines
	Upslope wet season flow control bund, CB .
	Downslope check dam sediment trap or filter fence as directed by site manager.

Drawn: IDH	Date: Sep-18	Topsoil & cleared vegetation stockpiles	TS
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ATION

REFER TO APPROVED PLANS FOR LOCATION, EXTENT, AND APPLICATION
 DETAILS. IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION,
 EXTENT, OR METHOD OF APPLICATION CONTACT THE ENGINEER OR
 RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

CHECK THE LOCATION OF THE MITRE DRAINS AFTER FIRST DECIDING ON
 SUITABLE LOCATIONS FOR THE OUTLETS, ONE THAT IS NOT BLOCKED BY A
 ROCK OR A TREE, SO THAT WATER WILL SPILL ONTO UNDISTURBED
 VEGETATION AND NOT BACK ONTO THE ROAD.

CONSTRUCT THE MITRE DRAIN TO DIVERT RUNOFF FROM THE
 SHOULDERS OF THE TABLE DRAIN, OR WHERE THE ROAD HAS BEEN CUT
 INTO THE SURROUNDING LAND, TO DISPOSAL ON STABLE VEGETATED
 GROUND AWAY FROM THE ROAD ALIGNMENT.

CONSTRUCT MITRE DRAINS WITH A BROAD FLAT BASE AT LEAST A METRE
 WIDE.

PUSH MATERIAL COMMENCING AT THE OUTLET TO PLACE MATERIAL
 DIVERTING FLOW IN THE TABLE DRAIN.

PUSH LOOSENED EARTH COMMENCING AT THE OUTLET AND WORKING
 TOWARDS THE TABLE DRAIN, TO FORM A BANK. SUFFICIENT LOOSE
 EARTH MUST BE USED TO FORM A BANK OF THE REQUIRED DIMENSIONS.

FORM THE BANK WITH A GRADE OF APPROXIMATELY 1:100 TO ENSURE
 THAT WATER DOES NOT POND AND A LEVEL SILL OF APPROXIMATELY 3M
 AT THE OUTLET.

RACK, OR WHEEL ROLL, THE ENTIRE LENGTH OF THE BANK TO ACHIEVE
 MAXIMUM COMPACTION AND AN EVEN FINISH. USE THE BLADE TO
 CLEAR THE CHANNEL OF LOOSE MATERIAL.

LEAVE ANY SMALL EARTH BANK FORMED AT THE OUTLET TO ACT AS A
 SILT TRAP AND LEVEL SPREADER. PUSH THIS FAR ENOUGH TO ENSURE
 THAT THE DRAINAGE CLEARS THE ROAD EFFECTIVELY.

- IF AN ERODED TABLE DRAIN HAS TO BE FILLED TO BUILD A
BANK AT THAT POINT MUST BE WELL COMPACTED WITH EX
TO ALLOW FOR SLUMPING AND TO COPE WITH THE CONCE
RUNOFF IN THE TABLE DRAIN.

MAINTENANCE

- INSPECT MITRE DRAINS ANNUALLY BEFORE THE START OF T
SEASON.
- REVIEW THE LOCATION, SPACING AND SIZE OF CROSS BANK
NOTE OF THE DISTANCE OF WATER RUN ON THE TRACK BEF
EROSION OCCURS.
- CHECK THAT THE MITRE DRAIN OUTLETS PERMIT FREE FLOW
- REPAIR AND REINSTATE AS REQUIRED TO STABILISE THE TRA

REMOVAL

- DECOMMISSION IF REQUIRED BY SUPERVISOR DURING STA
PERMANENT ACCESS ROAD CONSTRUCTION IN 2019.
- REGRADE BANKS AND COLLECTED SEDIMENT AND FORM IN
PERMANENT CROWNED ROAD PROFILE.
- REMOVE WINDROWS.

Drawn: IDH	Date: Oct-2018	Mitre drain	MD
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CONSTRUCTION PLANS

MINIMUM 50 mm NOMINAL ROCK
AGGREGATE: 50-75 MM CLEAN
GATE.

TEXTILE FABRIC: HEAVY-DUTY, NEEDLE-
ED, NON-WOVEN FILTER CLOTH
UM BIDIM A34 OR EQUIVALENT).

TS SHOULD HAVE A FLOW CAPACITY AT
QUAL TO THE NORMAL CHANNEL
TY OF THE WATERCOURSE WHEN THE
LEVEL REACHES THE CREST OF THE
T DECK.

PROTECTION AT CULVERT INLETS AND
S WITH WELL GRADED HARD, EROSION
NT ROCK MINIMUM SIZE (D₅₀) OF
AND MAXIMUM OF 350MM

DUTY GEOTEXTILE UNDERLAY FOR
PROTECTION.

ON

ER TO APPROVED PLANS FOR
ICATION, EXTENT, AND APPLICATION
AILS. IF THERE ARE QUESTIONS OR
BLEMS WITH THE LOCATION, EXTENT,
METHOD OF APPLICATION CONTACT
ENGINEER OR RESPONSIBLE ON-SITE
ICER FOR ASSISTANCE.

CULVERT TO ALLOW ACCESS AND
APPROACHES.

4. CONSTRUCT THE WATERCOURSE CROSSING
PERPENDICULAR TO THE FLOW DIRECTION
IN THE CHANNEL IF POSSIBLE.
5. CONSTRUCT STRAIGHT APPROACHES FOR
AT LEAST 10 M ALIGNED WITH THE
CROSSING IF POSSIBLE.
6. COVER THE CROSSING SURFACE WITH
HEAVY DUTY FILTER CLOTH.
7. COVER THE FILTER CLOTH WITH 150 MM
OF CLEAN 50-75 MM AGGREGATE, OR TO
SPECIFICATION IN THE CONSTRUCTION
PLAN.
8. PLACE THE SPECIFIED SIZE AND NUMBER OF
CULVERT PIPES AND ALIGN THEM WITH
THE DIRECTION OF THE DOWNSTREAM
CHANNEL.
9. ENSURE THE PIPES EXTEND AT LEAST
200 MM BEYOND THE PROPOSED EXTENT
OF THE ROCK FILL
10. INSTALL TEMPORARY OUTLET PROTECTION
EXTENDING IN AN APRON 1 M BEYOND THE
OUTLET AND INLET AND THE FULL WIDTH
OF THE TABLE DRAIN ON A HEAVY DUTY
GEOTEXTILE BASE, KEYED 300MM INTO THE
SOIL AT ITS UPSTREAM AND DOWNSTREAM
ENDS, AND COVERED WITH 500MM WELL

12. COVER PIPES WITH SUFFICIENT ROCK
(MINIMUM 300 MM LAYER) TO SATI
MANUFACTURER'S LOADING
REQUIREMENTS TO AVOID DAMAGE
THE PIPES RESULTING FROM THE EX
TRAFFIC LOAD.
13. SLOPE OF ROCK FACE UPSTREAM AND
DOWNSTREAM OF THE CULVERT NO
STEEPER THAN 3:1 (H:V).
14. FORM THE SHAPE OF THE ROAD SURF
ACCORDING TO THE CONSTRUCTION
PLANS.
15. APPLY A SUITABLE COVER OF AGGRE
OVER THE ROCK FILL TO FORM THE
TRAFFICABLE ROAD SURFACE.
16. FINISH CONSTRUCTION AND STABIL
OF THE APPROACH ROADS INCLUDING
APPROACH RAMPS EACH SIDE OF TH
BRIDGE CROSSING.
17. TAKE ALL REASONABLE MEASURES T
PREVENT EXCESS ROCK, DEBRIS AND
CONSTRUCTION MATERIAL FORM
ENTERING THE WATER COURSE.

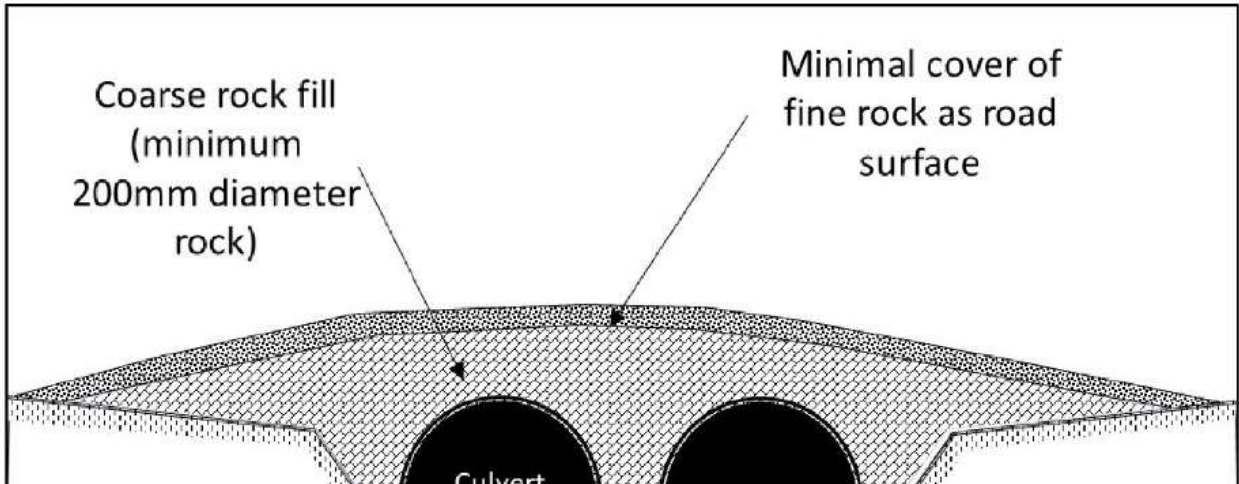
Drawn: IDH	Date: Oct-18	Temporary Culvert	TC TCC ≈ ≈
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MAINTENANCE

INSPECT THE TEMPORARY WATERCOURSE
CROSSING AFTER RUNOFF PRODUCING
RAINFALL.
REMOVE DEBRIS TRAPPED ON THE
UPSTREAM OF THE CROSSING.
REPAIR DAMAGE CAUSED BY
CONSTRUCTION TRAFFIC. IF TRAFFIC HAS
EXPOSED BARE SOIL, REINSTATE ROCK
COVER, OR REVEGETATE AS APPROPRIATE.
MAINTAIN A MINIMUM 200 MM ROCK
COVER OVER THE CULVERTS.
CHECK FOR EROSION OF THE FORMED
EMBANKMENT, CHANNEL SCOUR, OR ROCK
DISPLACEMENT. MAKE ALL NECESSARY
REPAIRS IMMEDIATELY.
CHECK FOR EXCESSIVE EROSION ON
APPROACH ROADS.
CHECK ANY BYPASS FLOODWAY MAKING
SURE THE BANKS ARE STABLE.

REMOVAL

1. REMOVE ALL TEMPORARY CULVERTS AS
SOON AS POSSIBLE AFTER ALTERNATIVE
PERMANENT ACCESS IS ACHIEVED OR THE
CULVERT IS NO LONGER NEEDED.
2. REMOVE ALL SPECIFIED MATERIALS AND
DISPOSE OF IN A SUITABLE MANNER THAT
WILL NOT CAUSE AN EROSION OR
POLLUTION HAZARD.
3. REPLACE THE TEMPORARY CULVERT
CROSSING WITH A PERMANENT CROSSING,
AS SET OUT IN CONSTRUCTION PLANS, OR
RESTORE THE WATERCOURSE CHANNEL TO
ITS ORIGINAL CROSS-SECTION - SMOOTH
AND APPROPRIATELY STABILISE AND
REVEGETATE ALL DISTURBED AREAS IF THE
CROSSING IS NOT REQUIRED.



Drawn: IDH	Date: Sep-18	Temporary Culvert	TC TCC ≈ ≈
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TO APPROVED PLANS FOR
ION, EXTENT, AND APPLICATION
S. IF THERE ARE QUESTIONS OR
EMS WITH THE LOCATION, EXTENT,
THOD OF APPLICATION CONTACT
GINEER OR RESPONSIBLE ON-SITE
R FOR ASSISTANCE.

G MAINTENANCE, GRADE FROM THE
, WITH MAERIAL BEING MOVED
RDS THE CENTGRE OF THE ROAD.
TO ACHIEVE CROSSFALL AND HEIGHT,
D THE MATERIAL AWAY FROM THE
E LINE T THE EDGE.

AIN CROSSFALL BETWEEN 4 AND 5%
TO RE-PROFILE THE TRACK WHERE
D TO MAINTAIN CROSSFALL
AGE, I.E., DRAINAGE DIRECTED AWAY
THE HILLSIDE, ALLOWING
WATER TO DISCHARGE FROM THE
AS SHEET FLOW.

VE ANY WINDROWS THAT DEVELOP
G THE DOWN-SLOPE SIDE OF THE
DURING CONSTRUCTION,
TION AND MAINTENANCE.

MATERIAL SLUMPING FROM CUT
RS IF IT DOES NOT UNDULY RESTRICT
PERATING WIDTH OF THE TRAIL. IF
RIAL NEEDS TO BE REMOVED, TAKE
NOT TO UNDERCUT THE TOE OF THE
R.

CT AT LEAST ANNUALLY BEFORE THE
OF THE WET SEASON.

- 1. REMOVE CROSSFALL DRAINAGE
PERMANENT GRAVEL ROAD
CONSTRUCTION WITH CROWN
DRAINAGE AND MITRE DRAIN

Drawn: IDH	Date: Oct-18	Crossfall Drainage - General	CD
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ED BATTERS WITH BIODEGRADABLE SHORT LIFE-
PAN (APPROXIMATELY 9 MONTHS) MATTING
APPLY THE FOLLOWING MATERIAL SPECIFICATIONS
UNLESS OTHERWISE SPECIFIED.

BRE BLANKET

- i. JUTEMASTER LITE, OR
- ii. JUTE BASED MESH
- iii. MINIMUM WIDTH OF 2M
- iv. 250-300 GRAMS/M² WEIGHT

TAPLES

- i. MINIMUM 11 GAUGE GALVANIZED STEEL WIRE
- ii. "T" OR "U" SHAPE WITH 150MM OR LONGER VERTICAL LEGS AND SHORTER HORIZONTAL MEASUREMENTS (LONGER THAN TWO MESH OPENINGS)

INSTALLATION

1. REFER TO THE MANUFACTURERS, OR DISTRIBUTORS, INSTALLATION PROCEDURES.
2. TRIM AND GRADE EMBANKMENTS PRIOR TO PLACING MINIMUM 50MM TOPSOIL TO PROVIDE A SMOOTH, EVEN, FREE DRAINING SURFACE, FREE FROM UNDULATIONS TO FINAL DESIGN LEVELS UNLESS SPECIFIED OTHERWISE IN THE CONTRACT SPECIFIC REQUIREMENTS.

50MM DIAMETER TO MAINTAIN UNINTERRUPTED CONTACT WITH THE MATTING.

4. APPLY REVEGETATION FOLLOWING DESIGN SPECIFICATION, R, OR AS OTHERWISE DIRECTED IN CONTRACT SPECIFIC REQUIREMENTS.
5. COMMENCE INSTALL FROM THE TOP OF THE EMBANKMENT. BURY THE UPPER EDGE OF THE BLANKET IN A 300MM DEEP TRENCH AND STABLE AT 200 TO 250 MM CENTRES.
6. PLACE BLANKETS LENGTHWISE ALONG THE SLOPE OR DOWN THE SLOPE BUT NOT DIAGONALLY ACROSS THE SLOPE.
7. OVERLAP THE SIDES OF EACH BLANKET BY AT LEAST 100MM.
8. BURY THE EDGE OF THE BLANKET LOCATED ALONG THE OUTER MOST EDGE OF THE TREATED AREA WITHIN A 300MM DEEP TRENCH AND STABLE THE BLANKET WITHIN THE TRENCH AT 200 TO 250MM CENTRES
9. WHERE MORE THAN ONE BLANKET IS USED DOWN THE SLOPE OVERLAP EACH BLANKET BY AT LEAST 300MM WITH THE UPPER BLANKET PLACED OVER THE LOW BLANKET.
10. AVOID STRETCHING THE BLANKETS AND MAINTAIN CONTINUOUS CONTACT WITH THE SOIL

ENSURE THAT THE BLANKET ACHIEVES
RETAINS INTIMATE CONTACT WITH
SOIL

13. REPAIR OR REPLACE DAMAGED F
14. IRRIGATE WEEKLY WITH A WATER
TO HELP ESTABLISH GRASS COVER

MAINTENANCE

1. INSPECT EMBANKMENTS FORTNIGHTLY FOR THE FIRST 3 MONTHS. IDENTIFY WHETHER:
 - a. THERE IS DAMAGE FROM CONSTRUCTION ACTIVITY
 - b. RUNOFF IS UNDERMINING BLANKET
 - c. GOOD CONTACT IS MAINTAINED WITH THE SOIL
 - d. ADEQUATE BLANKET COVER IS MAINTAINED.
2. IF DAMAGED, REPAIR OR REPLACE DAMAGED SECTION. IF WATER IS UNDERMINING THE FABRIC, REPAIR HOLES OR JOINTS OR RE-BURY THE ENDS OF THE DAMAGED SECTION
3. CONTROL GROWTH OF WEEDS.

Drawn: IDH	Date: Sep-18	Erosion Control Blanket	
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MATERIALS

MULCH: REUSE BY RE-SPREADING CLEARED VEGETATION AS A LIGHT MULCH, WHERE IT IS WEED FREE AND WILL AID REINSTATEMENT OF NATURAL GROUND COVER VALUES AND NOT INTERFERE WITH SITE ACCESS AND OPERATIONS.

APPLICATION

1. REFER TO APPROVED PLANS FOR LOCATION, EXTENT AND APPLICATION DETAILS.
2. ENSURE THE SURFACE IS FREE OF FEATURES THAT MAY CONCENTRATE FLOW, SUCH AS WHEEL RUTS AND WINDROWS.
3. SPREAD CLEARED VEGETATION STOCKPILES TO ACHIEVE 80% GROUND COVER (COVER INCLUDES GRAVEL).
4. IF THE AREA WAS SEEDED FOLLOWING REVEGETATION, R, THEN IRRIGATE AS REQUIRED TO ACHIEVE PLANT ESTABLISHMENT.

MAINTENANCE

1. INSPECT MULCHED AREAS FORTNIGHTLY AND AFTER RUNOFF PRODUCING RAINFALL
2. CHECK FOR EROSION AND DISLODGE-
MENT OF MULCH.
3. REPLACE ANY DISPLACED MULCH TO MAINTAIN REQUIRED COVER.
4. INVESTIGATE ADDITIONAL DRAINAGE CONTROLS IF MORE THAN 10% OF THE MULCH IS DISPLACED BY RUNOFF.

5. CONTINUE INSPECTIONS UNTIL VEGETATION IS ESTABLISHED.
6. REPLACE THE MULCH IF IT IS NOT EFFECTIVE IN CONTROLLING SOIL EROSION, OR ADOPT AN ALTERNATIVE PROCEDURE AFTER CONSULTATION WITH THE SITE SUPERVISOR.

Drawn: IDH	Date: Sep-18	BRUSH MULCH	BM
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Point Ceylon Stage 1 Factual Soils Report for Erosion and Sediment Control Planning

Project Sea Dragon Point Ceylon, NT PORTION 03192 BYNOE

Prepared for
seafarms Pty Ltd

Project J000073
Date: Friday, 18 January 2019



Document History

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Summary

Soil information to support IECA best practice erosion and sediment control and acid sulfate risk assessment was collated and collected to address the scope of **seafarms** Project Sea Dragon Stage 1 construction planned for the Point Ceylon Breeding and Maturation Farm in 2019.

The completeness of soil survey characterization of areas in the scope of work from previous studies, including the EIS, has been supplemented with field survey to meet IECA best practice guidelines for erosion and sediment control planning (ESCP) and QASSIT guidelines for acid sulfate risk assessment across the Package 1 construction footprint planned for 2019. Soil investigations for the EIS established that the soil properties warranted a level 2 assessment according to IECA guidelines.

This scope of work addresses the requirements of a level 2 soil assessment. Horizon Environmental Soil Survey and evaluation undertook a field survey in October 2018 and NATA accredited laboratory testing program reported here to support level 2 soil assessment in the ESCP.

Soil erosion risk is low to moderate across the clearing footprint. Soils in sections of the Seawater Intake and Discharge Pipeline where they traverse inter-tidal flats and a mixture of mangrove and salt flat present high to extra high risk levels from potential acid sulfate soil if they are exposed by excavation or drained. Acid sulfate soil risk was not detected in areas of the Seawater Intake, Broodstock Maturation Centre, Discharge Pond and Discharge Pipeline that were below 5 m AHD but above the inter-tidal zone. Acid sulfate soil risk was limited to the inter-tidal zone.

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ATTACHMENTS

ATTACHMENT 1 Point Ceylon Stage 1 Site Development (GHD Drawing no: 43-22784-C001)

Appendices

Appendix A Soil profile descriptions and properties

Appendix B Laboratory reports

Appendix C Laboratory QC Reports

SOIL FACTUAL REPORT**Project Sea Dragon Construction Package 1,
PROJECT SEA DRAGON – POINT CEYLON CORE BREEDING CENTRE AND
BROODSTOCK MATURATION CENTRE****Local Authority: N.T. PORTION 03192 BYNOE**

Proponent: seafarms Pty Ltd

1 Background

1.1 Project Plan

The Development Permit (DP17/0371) for N.T. Portion 03192 BYNOE issued to clear native vegetation on the site contains conditions relating to the development of Erosion and Sediment Control Plans (ESCP), geotechnical investigation for acid sulfate soils (ASS) and development of ASS Management Plan. The scope of our proposal is designed to meet the conditions of Development Permit for the construction works described above and the 2019 engineering footprint (**Figure 1**).

The construction works are being staged. This year 2018 the section of road that links the existing track to the road easement from Fog Bay will be graded.

Construction will start in 2019 on Stage 1 of the Breeding Farm Facility at Point Ceylon, comprising:

- seawater intake and pipeline from the point behind the mangroves to the settlement ponds (note that this pipeline will be laid above ground)
- settlement ponds
- pipeline from the settlement ponds to the broodstock maturation centre (note this pipeline will be laid above ground)
- broodstock maturation centre
- discharge pond and pipeline (note that this will consist of a pipeline laid above ground and quad bike track).

Additionally, the existing access track that runs from Fog Bay to the settlement ponds will be graded and used for construction traffic.

1.2 Previous surveys

Landscape topography, geology, climate, soil and vegetation patterns have been described from detailed air photo interpretation in the land unit mapping of the Lower Finniss (Hill, Fett et al. 2002) and detailed mangrove mapping of Bynoe Harbour. The map resolution is sufficiently detailed to identify environmental variation across the project area. This survey supports the sparse field work in regional land unit mapping to provide accurate interpretation across the project area.

Douglas Partners (Douglas_Partners 2016) and WANNT Geotechnics (WANT_Geotechnics 2017) geotechnical investigations of the site were used for reference and to supplement the work.

1.3 Geology and geomorphology

The project area at the end of a peninsula, Point Ceylon, in Bynoe Harbour is on gently undulating rises (9-30 m relief) formed from deeply weathered Proterozoic gneiss or granite and sandstone. There are extensive areas of ferricrete that outcrop on the residual weathered rock landscape. The residual, weathered landscape has shallow to moderately deep soils supporting tall woodlands dominated by *Corymbia bleeseri*, in areas of shallow soils and ferricrete, and *E miniate*/*E tetradonta* on deep, gravelly soils. A Cretaceous mudstone, the Darwin Member of the Bathurst Island Formation, which occurs elsewhere in the Darwin region and on the Tiwi Islands, onlaps the coastline discontinuously around Point Ceylon and forms relatively level plains of limited extent above the tidal zone. Land gradients are gentle (<3%).

Due to the highly erosive monsoon rainfall the undulating terrain acts as a transport surface for sheet flow of eroded sediment that aggrades the mudstone landscape and any drainage areas with up to 0.5 m of sandy wash. These swamp areas support low *Melaleuca viridiflora* woodlands with *Melaleuca leucadendra* along drainage lines. Quaternary sediments in the intertidal zone of the estuary support diverse mangrove and underlain by Proterozoic gneiss. The rock is deeply weathered into a lateritic profile with extensive areas of ferricrete outcrop and small areas of sandy Cretaceous sediments.

2 Scope of Work

The following work areas shown on **Figure 1** included for erosion and sediment control plans (ESCP) and acid sulfate soil management plans (ASSMP) are:

1. Seawater Intake (350 m)
2. Settlement ponds (17.5 Ha)
3. Broodstock maturation centre (33.5 Ha)
4. Discharge pond (12.5 Ha)
5. Discharge pipeline (850 m)
6. Access road (7900 m).

2.1 Sampling plan

The sampling plan was to assess soil properties across in each project area from observations of approximately 1 site per hectare or 1 site per 100 m on linear structures such as pipelines and roads. Soil profiles were inspected at approximately 20% of the sites and approximately 5% of the sites surveyed were sampled for chemical and physical analysis to assess acid sulfate soil risk in areas below 5 m AHD and to assess erosion risk elsewhere according to acid sulfate soil (Ahern, Ahern et al. 1998) and erosion and sediment control guidelines (IECA 2008).

3 Methods

Soil profile morphology was described at 67 sites in the 50 Ha footprint of Stage 1 works. Survey methods followed Australian soil and land survey guidelines (McDonald, Isbell et al. 2009). Dispersion index (Emmerson 2002), soil pH and electrical conductivity (1:5 soil:water) were tested on selected soil horizon samples. Acid sulfate soil assessment referred to the National assessment guideline (Sullivan, Ward et al. 2018) and the Queensland acid sulfate soil management guideline (Dear, Moore et al. 2014).

Samples from 10 profiles at sites in the acid sulfate soil risk zone below 5 m AHD identified from regional mapping (Hill, Fett et al. 2002) on the Seawater Intake, Discharge Pond and Discharge Pipeline were consigned to ALS Sydney, NATA accredited to assess acid sulfate soil risk using the chromium reducible sulfur suite.

Samples from six profiles above 5 m AHD were consigned to Nutrient Advantage, NATA accredited laboratory to test for soil fertility constraints for erosion and sediment control using standard methods for land resources assessment (Rayment and Higginson 1992).

Dry soil bulk density was measured with 100mm diameter 60mm deep stainless-steel coring rings in soil profiles at two sites and two depths, 0 and 50 cm, in the estuarine sediments on the Seawater Intake and Discharge Pipeline. Dry bulk density is used to convert from gravimetric to volumetric units for calculating the amount of lime required to neutralise potential acidity in acid sulfate soil.

4 Results

Soil descriptions and laboratory results are provided in **Appendix A**. The accompanying laboratory analysis is provided in **Appendix B**. Chain of custody reports for the laboratory analysis is provided in **Appendix C**.

The soil distribution across the project area is shown in **Figure 1 to Figure 4**.

Soil map unit descriptions are provided in the soil legend **Table 2**. Soil chemical and physical properties are summarised in **Table 3**. Soil profiles at sites in the Seawater intake and Discharge Pipeline are saline and sodic and have very high to extra high reduced sulfur contents that predispose them to acid sulfate soil formation when drained or exposed to the atmosphere.

4.1 Seawater Intake

The seawater intake pipeline traverses 150 metres of Quaternary sediments that support mangrove vegetation in the tidal zone. species mapped in the Bynoe Harbour Mangrove Mapping, namely *Avicennia marina*/*Ceriops tagal*, *Bruguiera exaristata* and *Sonneratia alba*. The mangrove soils are classed as Intertidal, Histic-Sulfidic, Hemic Hydrosols; Thick, slightly gravelly, Peaty, Clayey, Very deep.

There is a high risk of acid sulfate soil development in the soil profiles from the surface to 2 m depth if these areas are drained or excavated and exposed to the air. Estimated liming rates to neutralise potential acidity range from very high near the land surface to extra high treatment (10 to 165 kg/tonne) with fine agricultural lime at depth.

Above the mangroves the seawater intake pipeline traverses 75 metres across sandy, gravelly colluvium supporting *Melaleuca viridiflora* woodland (Land Unit 8j1). The soils are Mottled, Supratidal, Hydrosols; Medium, Gravelly, Sandy, Clayey, Moderately deep. The pipeline then traverses 125 m of weathered gneiss (Lower Finniss Mapping Land Unit 7a2) supporting tall open *E tetradonta*, *E miniata* woodland on Ferric, Petroferric, Brown Kandosols; Medium, Gravelly, Loamy, Clay loamy; Moderately deep. Subsoils are generally moderately dispersive and erosion risk is low to moderate.

4.2 Settlement Pond

The Settlement Pond covers 17.5 Ha on gently undulating rises in Land Unit 7a2 with minor inclusion of Land Unit 8j1. The major soil type is Haplic Petroferric Brown Kandosols; Medium, Gravelly, Sandy, Clay loamy, Moderate, which supports tall *E miniata* woodland. There is no acid sulfate soil risk and erosion risk is moderate.

4.3 Broodstock Maturation Centre

The Broodstock Maturation Centre covers 33.5 Ha on gently undulating rises on ferricrete in Land Unit 7a2 with minor inclusion of Land Units 8j1, 10a5 Drainage depressions (Mesotrophic Petroferric Redoxic Hydrosols; Medium, Gravelly, Sandy, Clayey, Deep) and 8a2 Gently undulating plains in ferricrete (Ferric, Petroferric, Brown Kandosols; Medium, Moderately gravelly, Loamy, Clay loamy; Shallow). There is no acid sulfate soil risk and erosion risk is moderate.

4.4 Discharge Pond

The Discharge Pond covers 12.5 ha on gently inclined plains of sandy colluvium in Land Unit 8j1 (Mesotrophic Rudosolic Oxyaquic Hydrosols; Medium, Moderately gravelly, Loamy, Clay Loamy, Shallow) supporting *M viridiflora* woodland and 8a2 Gently undulating plains in ferricrete (Ferric, Petroferric, Brown Kandosols; Medium, Moderately gravelly, Loamy, Clay loamy; Shallow) supporting *E miniata* woodland. There is no acid sulfate soil risk and erosion risk is moderate.

4.5 Discharge Pipeline

Above the inter-tidal zone, the Discharge Pipeline traverses 300 metres across sandy, gravelly colluvium supporting *Melaleuca viridiflora* woodland (Land Unit 8j1). The soils are Mottled, Supratidal, Hydrosols; Medium, Gravelly, Sandy, Clayey, Moderately deep. There is no acid sulfate soil risk and erosion risk is moderate.

The Discharge Pipeline then extends across 550 M of inter-tidal flats on quaternary sediments that support mangrove vegetation. Mixes species low woodland and samphire occur at the tidal flat margin, which changes to a high tidal salt flat with little vegetation before going into low/mid tidal flats with shoreline comprising *Rhizophora stylosa* low closed forest. The mangrove soils vary in texture and depth are classed as Intertidal, Histic-Sulfidic, Hemic Hydrosols; Thick, slightly gravelly, Peaty, Clayey, Very deep.

In the inter-tidal zone there is a high risk of acid sulfate soil development in the soil profiles from the surface to 2 m depth if these areas are drained or excavated and exposed to the air. Estimated liming rates to neutralise potential acidity range from very high near the land surface to extra high treatment (10 to 165 kg/tonne) with fine agricultural lime at depth.

4.6 Access Road

The access road in the clearing permit area covers 7,900 m on gently undulating rises mainly in Land Unit 7a2. The major soil type is Haplic Petroferric Brown Kandosols; Medium, Gravelly, Sandy, Clay loamy, Moderate, which supports tall *E miniata* woodland. There are minor areas of Land Unit 8a3 – gently undulating plains on weathered rock and ferricrete. Soils are dominantly Basic Petroferric Orthic Tenosols; Medium, Very gravelly, Sandy, Sandy, Shallow There is no acid sulfate soil risk and erosion risk is moderate.

5 Conclusions

Soil erosion risks are low to moderate. Based on the project footprint and proximity to relatively undisturbed estuarine environments an erosion and sediment control plan is needed for Stage 1 construction to ensure that drainage is diverted as far as practicable around work areas, erosion is minimised and sediment laden runoff is contained or treated prior to discharge.

More detail is needed, including a review of whether a cut channel is required, or a rock energy dissipater is enough for design of the discharge outlet. The discharge pipeline outlet is shown on current plans as a cut channel lined with rip-rap. Cut at the outlet, if it is in the inter-tidal range, could trigger acid sulfate soil risk management at this point. Otherwise, based on the cut and fill plan (Attachment 1) the requirement for an acid sulfate soil management plan is not required according to the current guidelines (Dear, Moore et al. 2014). If the cut and fill plan for Stage 1 were to change to include excavation of inter-tidal areas, then an acid sulfate soil management plan will be needed.

6 References

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7 Limitations

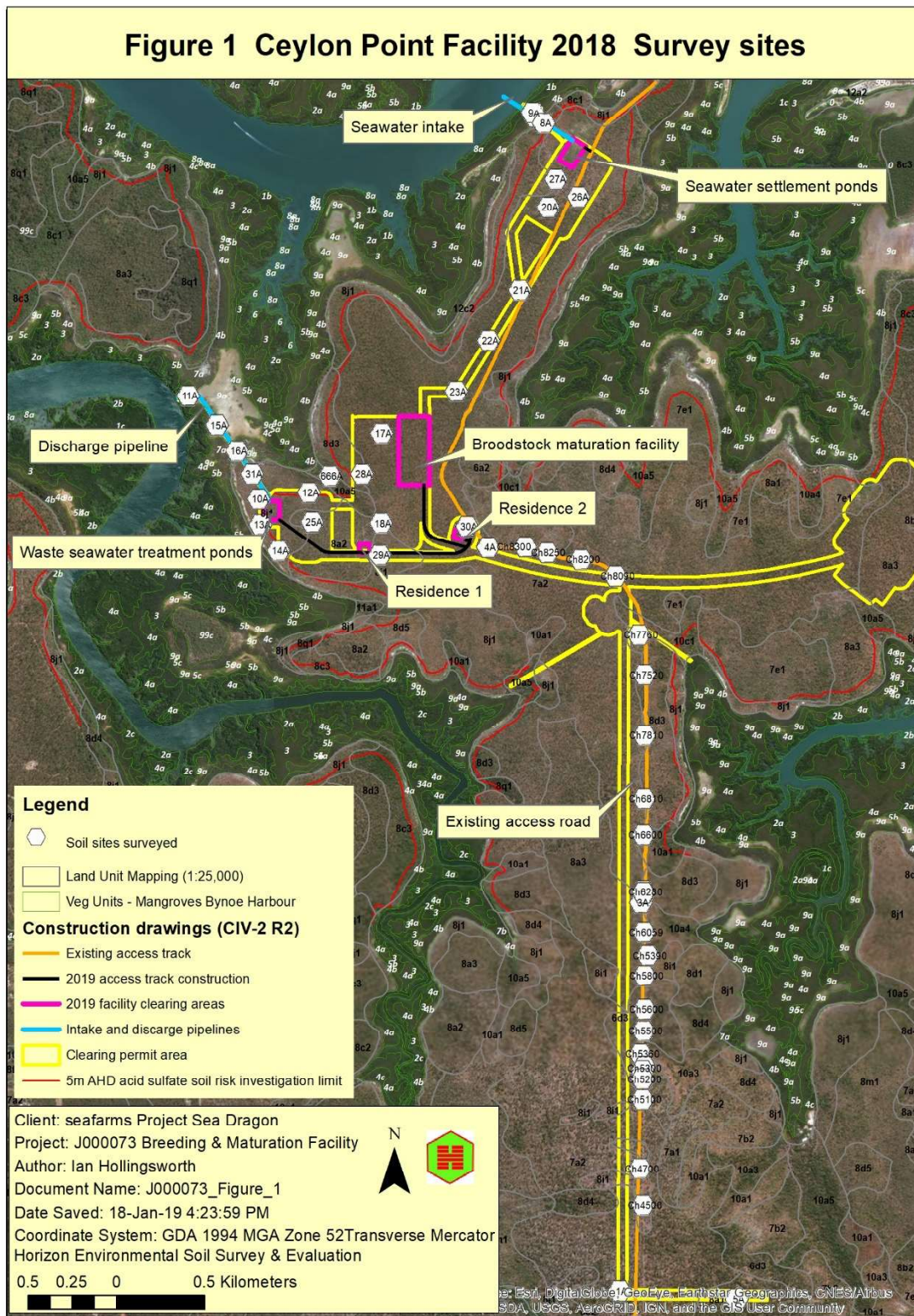
Horizon Environmental Soil Survey and Evaluation (HESSE) has prepared advice on Project Sea Dragon Package 1 erosion and sediment control in accordance with direction from Peter Stubbs, Project Sea Dragon Area Manager, on the 5 July 2018. This conceptual advice is provided for the exclusive use of **seafarms** for this work package only and for the purpose(s) described in the report. It should not be used for other projects. In preparing this report HESSE has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the surface and sub-surface conditions only at the specific sampling or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of anthropogenic influences. Such changes may occur after field testing has been completed.

HESSE's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by HESSE in this report may be limited by undetected variations in ground conditions between sampling locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

This report must be read in conjunction with all of the attached notes and should be kept in its entirety without separation of individual pages or sections. HESSE cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion given in this report.

Figures





Tables

Table 1 Cut fill plan

<i>Work area</i>	<i>Pad design RL</i>	<i>Pond Base RL</i>	<i>Dimensions</i>	<i>Strip</i>	<i>Cut</i>	<i>Fill</i>
Raw seawater storage pond and pad 1- refer to drawing 43-22784-H011	7.2 m	5.2 m	180x90 m	2430 m ³	14332 m ³	2155 m ³
HAC/BMC STAGE 1 – refer to drawing 43-22784-H011	14.38 m		190x150 m	9975 m ³	22626 m ³	18904 m ³
Discharge Ponds and pad	5.51 m	3.51 m	100x130 m	1500 m ³	10987 m ³	1883 m ³

Table 2 Soil map legend

Map unit.	Landform - Vegetation	Soil type (sites)	Slope (%)	Acid sulfate risk	Erosion risk	Seawater Intake	Settlement Pond	Breeding & maturation centre	Discharge Pond	Discharge pipeline	Access road
8a	Low tidal flat, mangroves Sonneratia alba woodland on estuarine sediment	Intertidal Hydrosol, poorly drained	0	VH	L	X					
1b	Low-mid tidal flat, Rhizophora stylosa closed mangrove forest on estuarine sediment	Intertidal Hydrosol, poorly drained	0	VH	L	X					
5b	High tidal flat, Avicennia marina/Ceriops tagal open mangrove forest on estuarine sediment	Intertidal Hydrosol, poorly drained (9A)	0	VH	L	X					
4b	Tidal flat margin, mixed species closed- mangrove forest on estuarine sediment	Extratidal Hydrosol, poorly drained (6A)	0	Nil	L	X					
8j1	Plains, M viridiflora on ferricrete, granite	Gravelly, Sandy, Clay loamy, Hydrosol, poorly drained (8A, 10A 13A, 18A, 29A, 31A)	0<5	Nil	M.	X	X	X	X	X	X
7a2	Gently undulating Low rises, E tetradonta, E miniate on ferricrete, granite, siltstone	Gravelly, Shallow Gravelly, Loamy, Clay loamy, Brown Kandosols, well drained (1A, 4A, 17A, 20A, 21A, 22A, 23A, 26A, 27A, 28A, 30A)	<6	Nil		X	X	X	X		X
8d3	Plains, mixed woodland over ferricrete and granite	Shallow Gravelly, Loamy, Clay loamy, Brown Kandosols, imperfectly drained (CH7766, 7520, 7810, 6280)	<3	Nil	M				X		
8a2	Plains, E tetradonta, E miniate	Shallow, Gravelly Loam, Clay loamy, Brown Kandosols, well drained (25A)	<3	Nil					X		

<i>Map unit.</i>	<i>Landform - Vegetation</i>	<i>Soil type (sites)</i>	<i>Slope (%)</i>	<i>Acid sulfate risk</i>	<i>Erosion risk</i>	<i>Seawater Intake</i>	<i>Settlement Pond</i>	<i>Breeding & maturation centre</i>	<i>Discharge Pond</i>	<i>Discharge pipeline</i>	<i>Access road</i>
10a5	Drainage depressions, Monsoon vine thicket	Deep, Non-gravelly, sandy, clayey Hydrosols on alluvium (666A)	<2	Nil	H				X		
7a	Extra-tidal flat, Mixed low mangrove and samphire	Inter-tidal Hydrosols (16A)	0	H	L					X	
9a	Extra-tidal salt flats, bare	Inter-tidal Hydrosols (11A, 15A)	0	H	L					X	
1c	Low-mid tidal flat Intertidal mangroves, Rhizophora sytlosa, estuarine alluvium	Intertidal Hydrosols	0	VH	L					X	
8a3	Gently undulating plains, C. bleeseri, E tetrodonta woodland	Gravelly, moderately deep, Loamy, clay loamy, Brown Tenosols (CH6059, 6530, 5390, 5800)	<3	Nil	M						X
6d3	Steep scarps with extensive rock outcrop n rises, E tetrodonta woodland	Gravelly, Well drained, shallow Brown loam, clay loam , Rudosols (CH5600, 5500, 5360, 5310, 5300, 5200)	15< 25	Nil	V						X
8i1	Plains sorghum grassland on ferricrete pavement	Gravelly, sandy, very shallow, Brown Rudosols, well drained		N	L						X
8a1	Plains E tetrodonta E miniate woodland on ferricrete and sandstone	Gravelly, loam, clay, moderately deep, well drained, Red Kandosols (5A1)	<3	N	H						X
10a1	Drainage lines, M nervosa, Lophostemon lactifluus low open woodland, colluvium over ferricrete and granite	Gravelly, sandy, clayey, Poorly drained, moderately deep, Hydrosols (CH3600)	<5	N	H						X

Table 3 Soil chemical and physical properties

<i>Area</i>	<i>Elevation range (m AHD)</i>	<i>Depth (m)</i>	<i>Dry bulk density</i>	<i>Emmerson dispersion class</i>	<i>%Sox</i>	<i>pH</i>	<i>EC (dS/m)</i>	<i>ESP (%)</i>
Seawater Intake	-1.5-6	0-0.2	1.1±0.1	5	0.1-2.5	4.3-6.2	1-2	>15
		0.5-0.7	1.3±0.2	5	2-3.5	6.4-7.5	2-5	>15
Settlement Ponds	11-20	0-0.2		3b	<0.02	5.5-6.5	<0.1	2-8
Broodstock Maturation Centre	5-42m	0.5-0.7		3b				
		0-0.2		3b	<0.02	5.5-6.5	0.01-0.1	2-8
Discharge Pond	6.3-6.4	0.5-0.7		3b				
		0-0.2		3b	<0.02	5.5-6.5	0.01-0.1	2-8
Discharge Pipeline	0-6	0.5-0.7		3b				
		0-0.2	1.4±0.2	5	0.1-3.1	4.5-6.5	1-5.7	>15
Access road	10-30	0.5-0.7	1.3±0.2	5	2-3.5	6.4-7.5	2-5	>15
		0-0.2		3b	nil			
		0.5-0.7		3b	nil			

APPENDIX A Soil profiles

Project Code: J000073

Site ID: 1A

Observation ID: 1

Site Information

Desc. By: I. Hollingsworth
 Date Desc.: 03/10/18
 Map Ref.: GPS S.A. Off
 Northing/Long.: 8587805 AMG zone: 52
 Easting/Lat.: 668633 Datum:

Locality: sampled 1 to 20, 2 to 50, 3 to 70cm
 Elevation: 22 metres
 Rainfall: 1500
 Runoff: Rapid
 Drainage: Well drained

Geology

Exposure Type: Auger boring
 Geol. Ref.: Czl

Conf. Sub. is Parent. Mat.: Almost certain or certain
 Substrate Material: Auger boring, 1 m deep, Porous, , Granite

Land Form

Rel/Slope Class: Gently undulating rises 9-30m 1-3%

Pattern Type: Rises

Morph. Type: Crest
 Elem. Type: Summit surface
 Slope: 2 %

Relief: 9 metres
 Slope Category: Very gently sloped
 Aspect: No Data

Surface Soil Condition (dry):

Australian Soil Classification:
 Melacic-Basic Petroferric Red Kandosol Medium Slightly
 gravelly Loamy Clay-loamy Moderately deep

Mapping Unit: 7a2
 Principal Profile Form: N/A

Great Soil Group:

Red earth

Surface Coarse Fragments: ; 20-50%, medium gravelly, 6-20mm, rounded, Ferricrete

Profile Morphology

1A1 0 - 0.2 m Dusky red (2.5YR3/2-Moist); ; Loamy sand; Dry; Slightly plastic; Normal plasticity; Slightly sticky; 20-50%, coarse gravelly, 20-60mm, rounded tabular, dispersed, Ferricrete, coarse fragments; Gradual, Smooth change to -

1A3 0.2 - 0.5 m Reddish brown (2.5YR4/4-Moist); ; Sandy loam; Dry; Slightly plastic; Normal plasticity; Slightly sticky; 2-10%, medium gravelly, 6-20mm, rounded tabular, dispersed, Ferricrete, coarse fragments; Gradual, Smooth change to -

1B2 0.5 - 1 m Red (2.5YR4/6-Moist); ; Sandy clay loam; Dry; Moderately plastic; Normal plasticity; Slightly sticky; 2-10%, medium gravelly, 6-20mm, rounded tabular, dispersed, Ferricrete, coarse fragments; Gradual, Smooth change to -

1B2 1 - 1.5 m Red (2.5YR4/6-Moist); ; Light clay; Dry; Very plastic; Normal plasticity; Slightly sticky; 50-90%, coarse gravelly, 20-60mm, rounded tabular, dispersed, Ferricrete, coarse fragments; Gradual, Smooth change to -

Morphological Notes

1A1 Emmerson Dispersion Index = 3b; pH=5.5
 1A3 Emmerson Dispersion Index = 3b; pH=5.5
 1B2 Emmerson Dispersion Index = 3b; pH=6
 1B2 Emmerson Dispersion Index = 3b; pH=6.5

Laboratory Test Results:

Depth m	pH	1:5 EC dS/m	Ca	Exchangeable Mg	Cations K	Na Cmol (+)/kg	Exchangeabl Acidity	CEC	ECEC	ESP %
0 - 0.2	5.6A 4.6C	0.02A	0.18*	0.19	0.089	0.024	0.56A	1.04*	1.04F	2.31
0.2 - 0.5	5.7A 4.6C	0.01A	0.063*	0.27	0.068	<0.022	0.52A	0.92*	0.92F	
0.5 - 1	5.9A 4.8C	0.01A	0.034*	0.37	0.046	<0.022	<0.27A	0.73*	0.73F	

Depth m	CaCO3 %	Organic C %	Avail. P mg/kg	Total P %	Total N %	Total K %	%
0 - 0.2			8.6J		0.047A	42*	
0.2 - 0.5			7.7J		<0.04A	38*	
0.5 - 1			15J		<0.04A	30*	

Project Code: J000073
Agency Name: HESSE

Site ID: 2A

Observation ID: 1

Site Information

Desc. By: I. Hollingsworth
Date Desc.: 04/10/18
Map Ref.: GPS S.A. Off
Northing/Long.: 8591818 AMG zone: 52
Easting/Lat.: 668657 Datum:

Locality: Gravel lag, swamp
Elevation: 12 metres
Rainfall: 1500
Runoff: Slow
Drainage: Poorly drained

Geology

Exposure Type: Auger boring
Geol. Ref.: Qcl

Conf. Sub. is Parent. Mat.: Almost certain or certain
Substrate Material: Auger boring, 0.5 m deep, Slightly porous, Ferricrete

Land Form

Rel/Slope Class: Gently undulating rises 9-30m 1-3%

Pattern Type: Rises

Morph. Type: Upper-slope
Elem. Type: Swamp
Slope: 4 %

Relief: 9 metres
Slope Category: Very gently sloped
Aspect: No Data

Surface Soil Condition (dry):

Erosion:

Soil Classification

Australian Soil Classification:
 Mesotrophic Rudosolic Oxyaquic Hydrosol Medium Moderately
 gravelly Loamy Clay-loamy Shallow

Mapping Unit: 8J1
Principal Profile Form: N/A

ASC Confidence:
 All necessary analytical data are available.

Great Soil Group:

Site Disturbance:

Vegetation:

Surface Coarse Fragments: 20-50%, medium gravelly, 6-20mm, rounded, Quartz; 20-50%, medium gravelly, 6-20mm, rounded, Ferricrete

Profile Morphology

1A1	0 - 0.2 m	Dark grey (2.5YR4/1-Moist); ; Loamy sand; Dry; Slightly plastic; Normal plasticity; Slightly sticky; 20-50%, coarse gravelly, 20-60mm, subangular, dispersed, Quartz, coarse fragments; Gradual, Smooth change to -
1A3g	0.2 - 0.5 m	Grey (2.5YR5/1-Moist); ; Loamy sand; Dry; Moderately plastic; Normal plasticity; Moderately sticky; 10-20%, coarse gravelly, 20-60mm, subangular, dispersed, Quartz, coarse fragments; Gradual, Smooth change to -
1B1	0.5 - 0.6 m	Grey (10YR4/6-Moist); ; Sandy clay loam; Dry; Moderately plastic; Normal plasticity; Moderately sticky; 10-20%, coarse gravelly, 20-60mm, subangular, dispersed, Quartz, coarse fragments; Gradual, Smooth change to -
1B2m	0.6 - m	Grey (10YR4/6-Moist); ; 10-20%, coarse gravelly, 20-60mm, subangular, dispersed, Quartz, coarse fragments; Smooth change to -

Morphological Notes

1A1	Emmerson Dispersion Index = 5; pH=5.5; EC = 0.1
1A3g	Emmerson Dispersion Index = 5; pH=5.5; EC = 0.1
1B1	Emmerson Dispersion Index = 5; pH=6; EC = 0.1

Project Code: J000073
Agency Name: HESSE

Site ID: 3A

Observation ID: 1

Site Information

Desc. By: I. Hollingsworth
Date Desc.: 05/10/18
Map Ref.: GPS S.A. Off
Northing/Long.: 8590008 AMG zone: 52
Easting/Lat.: 668756 Datum:

Locality: Gravelly, similar to 2A
Elevation: 12 metres
Rainfall: 1500
Runoff: Rapid
Drainage: Moderately well drained

Geology

Exposure Type: Auger boring
Geol. Ref.: Czl

Conf. Sub. is Parent. Mat.: Almost certain or certain
Substrate Material: Auger boring, 0.5 m deep, Porous, , Granite

Land Form

Rel/Slope Class: Gently undulating rises 9-30m 1-3%

Pattern Type: Rises

Morph. Type: Upper-slope

Relief: 9 metres

Elem. Type: Hillslope

Slope Category: Very gently sloped

Slope: 3 %

Aspect: No Data

Surface Soil Condition (dry):

Erosion: Stable, Minor (sheet)

Soil Classification

Australian Soil Classification:

Acidic Petroferric Bleached-Orthic Tenosol Medium Moderately gravelly Sandy Loamy Moderately deep

Mapping Unit: 8a3

Principal Profile Form: N/A

ASC Confidence:

All necessary analytical data are available.

Great Soil Group:

Site Disturbance:

Vegetation:

Surface Coarse Fragments: 20-50%, medium gravelly, 6-20mm, rounded, Ferricrete

Profile Morphology

1A1	0 - 0.2 m	Brown (7.5YR4/4-Moist); ; Sandy loam; Dry; Slightly plastic; Normal plasticity; Slightly sticky; Gradual, Smooth change to -
1B1	0.2 - 0.5 m	Strong brown (7.5YR4/6-Moist); ; Sandy clay loam; Dry; Slightly plastic; Normal plasticity; Slightly sticky; Gradual, Smooth change to -
1B2	0.5 - 1 m	Strong brown (7.5YR4/6-Moist); ; Light clay; Dry; Very plastic; Normal plasticity; Slightly sticky; Gradual, Smooth change to -

Morphological Notes

1A1	Emmerson Dispersion Index = 5; pH=5.9; EC = 0.1
1B1	Emmerson Dispersion Index = 5; pH=6.5; EC = 0.1
1B2	Emmerson Dispersion Index = 5; pH=6.5; EC = 0.1

Laboratory Test Results:

Depth m	pH	1:5 EC dS/m	Ca	Exchangeable Mg	Cations K	Na Cmol (+)/kg	Exchangeabl Acidity	CEC	ECEC	ESP %
0 - 0.2	5.9A 5C	0.13A	1.1*	0.43	0.16	0.45	0.12A	2.28*	2.28F	19.74
0.2 - 0.5	6A 4.9C	0.09A	0.52*	0.27	0.095	0.31	0.18A	1.38*	1.38F	22.46
0.5 - 1	6A 5C	0.09A	0.22*	0.22	0.062	0.33	0.15A	0.97*	0.97F	34.02

Depth m	CaCO3 %	Organic C %	Avail. P mg/kg	Total P %	Total N %	Total K %	Bulk Density Mg/m3	Particle Size Analysis				
								GV	CS	FS %	Silt	Clay
0 - 0.2			7.7J		0.086A	63*						
0.2 - 0.5			5.9J		0.073A	45*						
0.5 - 1			7.2J		<0.04A	40*						

Project Code: J000073

Site ID: 4A

Observation ID: 1

Agency Name: HESSE

Site Information

Desc. By: I. Hollingsworth
Date Desc.: 04/10/18
Map Ref.: GPS S.A. Off
Northing/Long.: 8592022 AMG zone: 52
Easting/Lat.: 667889 Datum:

Locality: Gravel lag, swamp
Elevation: 12 metres
Rainfall: 1500
Runoff: Slow
Drainage: Poorly drained

Geology

Exposure Type: Auger boring
Geol. Ref.: Qcl

Conf. Sub. is Parent. Mat.: Almost certain or certain
Substrate Material: Auger boring, 0.5 m deep, Slightly porous, Ferricrete

Land Form

Rel/Slope Class: Gently undulating rises 9-30m 1-3%
Pattern Type: Rises
Morph. Type: Upper-slope
Relief: 9 metres
Elem. Type: Swamp
Slope Category: Very gently sloped
Slope: 4 %
Aspect: No Data

Surface Soil Condition (dry):

Erosion:

Soil Classification

Australian Soil Classification:
 Mesotrophic Rudosolic Oxyaquic Hydrosol Medium Moderately
 gravelly Loamy Clay-loamy Shallow

Mapping Unit: 8J1
Principal Profile Form: N/A

ASC Confidence:

All necessary analytical data are available.

Great Soil Group:

Surface Coarse Fragments: 20-50%, medium gravelly, 6-20mm, rounded, Quartz; 20-50%, medium gravelly, 6-20mm, rounded, Ferricrete

Profile Morphology

1A1 0 - 0.2 m Dark grey (2.5YR4/1-Moist); ; Loamy sand; Dry; Slightly plastic; Normal plasticity; Slightly sticky; 20-50%, coarse gravelly, 20-60mm, subangular, dispersed, Quartz, coarse fragments; Gradual, Smooth change to -

1A3g 0.2 - 0.5 m Grey (2.5YR5/1-Moist); ; Loamy sand; Dry; Moderately plastic; Normal plasticity; Moderately sticky; 10-20%, coarse gravelly, 20-60mm, subangular, dispersed, Quartz, coarse fragments; Gradual, Smooth change to -

1B1 0.5 - 0.6 m Grey (10YR4/6-Moist); Mottles, 2.5Y51, 2-10% , 15-30mm, Distinct; Sandy clay loam; Dry; Moderately plastic; Normal plasticity; Moderately sticky; 10-20%, coarse gravelly, 20-60mm, subangular, dispersed, Quartz, coarse fragments; Gradual, Smooth change to -

1B2m 0.6 - m Grey (10YR4/6-Moist); ; 10-20%, coarse gravelly, 20-60mm, subangular, dispersed, Quartz, coarse fragments; Smooth change to -

Morphological Notes

1A1 Emmerson Dispersion Index = 5; pH=5.5; EC = 0.1
 1A3g Emmerson Dispersion Index = 5; pH=5.5; EC = 0.1
 1B1 Emmerson Dispersion Index = 5; pH=6; EC = 0.1

Project Name:

Laboratory Test Results:

Depth m	pH	1:5 EC dS/m	Ca	Exchangeable Mg	Cations K	Na Cmol (+)/kg	Exchangeabl Acidity	CEC	ECEC	ESP %
0 - 0.2	4.8C 5.5A	0.26A	0.55*	0.63	0.16	0.67	0.25A	2.26*	2.26F	29.65

Depth m	CaCO3 %	Organic C %	Avail. P mg/kg	Total P %	Total N %	Total K %	Bulk Density Mg/m3	Particle GV	Size CS	Analysis FS %	Silt %	Clay %
0 - 0.2			13J		0.078A	90*						

Project Code: J000073 **Site ID:** 5A **Observation ID:** 1

Site Information

Desc. By: I. Hollingsworth
 Date Desc.: 03/10/18
 Map Ref.: GPS S.A. Off
 Northing/Long.: 8587759 AMG zone: 52
 Easting/Lat.: 669297 Datum:

Locality: Sample 4, 5, 6 at 20, 50, 100
 Elevation: 26 metres
 Rainfall: 1500
 Runoff: Rapid
 Drainage: Moderately well drained

Geology

Exposure Type: Auger boring
 Geol. Ref.: Pwt

Conf. Sub. is Parent. Mat.: Almost certain or certain
 Substrate Material: Auger boring, 1 m deep, Porous, , Granite

Land Form

Rel/Slope Class: Gently undulating rises 9-30m 1-3%
 Pattern Type: Rises
 Morph. Type: Crest
 Elem. Type: Summit surface
 Slope: 0.5 %
 Relief: 9 metres
 Slope Category: Level
 Aspect: No Data

Erosion: Stable, Minor (sheet)

Soil Classification

Australian Soil Classification:
 Melacic-Basic Petroferric Red Kandosol Medium Slightly
 gravelly Loamy Clay-loamy Moderately deep

Mapping Unit: 8a1
 Principal Profile Form: N/A

Great Soil Group: Red earth

Surface Coarse Fragments: ; 20-50%, medium gravelly, 6-20mm, rounded, Ferricrete

Profile Morphology

1A1 0 - 0.2 m Dark reddish brown (5YR3/2-Moist); ; Sandy loam; Dry; Non-plastic; Normal plasticity; Moderately sticky; 20-50%, coarse gravelly, 20-60mm, rounded tabular, dispersed, Ferricrete, coarse fragments; Clear, Smooth change to -
 1A3 0.2 - 0.5 m Dark reddish grey (5YR4/2-Moist); ; Sandy loam; Dry; Non-plastic; Normal plasticity; Moderately sticky; 2-10%, medium gravelly, 6-20mm, rounded tabular, dispersed, Ferricrete, coarse fragments; Clear, Smooth change to -
 1B2 0.5 - 1 m Yellowish red (5YR4/6-Moist); ; Light clay; Dry; Non-plastic; Normal plasticity; Moderately sticky; 2-10%, medium gravelly, 6-20mm, rounded tabular, dispersed, Ferricrete, coarse fragments; Clear, Smooth change to -
 1B3 1 - 1.5 m Yellowish red (5YR4/6-Moist); ; Sandy clay loam; Dry; Moderately plastic; Normal plasticity; Moderately sticky; 50-90%, coarse gravelly, 20-60mm, rounded tabular, dispersed, Ferricrete, coarse fragments; Gradual, Smooth change to -

Morphological Notes

1A1 Sample 4; 1:5 pH 6 EC 0.1 Emmerson Dispersion Index = 3b
 1A3 Sample 5; 1:5 pH 6 EC 0.1 Emmerson Dispersion Index = 3b
 1B2 1:5 pH 6 EC 0.1 Emmerson Dispersion Index = 3b

Laboratory Test Results:

Depth m	pH	1:5 EC dS/m	Ca	Exchangeable Mg	Cations K	Na Cmol (+)/kg	Exchangeabl Acidity	CEC	ECEC	ESP %
0 - 0.2	6.5A 5.4C	0.03A	1.4*	0.74	0.19	<0.022	0.24A	2.59*	2.59F	
0.2 - 0.5	6.6A 5.5C	0.02A	1.4*	0.59	0.19	<0.022	0.16A	2.3*	2.3F	
0.5 - 1	6.5A 5.5C	0.01A	0.74*	0.77	0.1	<0.022	<0.1A	1.62*	1.62F	
Depth m	CaCO3 %	Organic C %	Avail. P mg/kg	Total P %	Total N %	Total K %	Bulk Density Mg/m3	Particle Size Analysis GV CS FS %	Silt %	Clay %
0 - 0.2			6.1J		0.076A	82*				
0.2 - 0.5			6.6J		0.055A	83*				
0.5 - 1			13J		<0.04A	56*				

Project Code: J000073
Agency Name: HESSE

Site ID: 6A

Observation ID: 1

Site Information

Desc. By: I. Hollingsworth
Date Desc.: 03/10/18
Map Ref.: GPS S.A. Off
Northing/Long.: 8594457 AMG zone: 52
Easting/Lat.: 668162 Datum:

Locality: mangrove, tidal flat margin
Elevation: 2 metres
Rainfall: 1500
Runoff: Very slow
Drainage: Very poorly drained

Geology

Exposure Type: Auger boring
Geol. Ref.: Qca

Conf. Sub. is Parent. Mat.: Almost certain or certain
Substrate Material: Auger boring, 1 m deep, Porous, ,
Unconsolidated material (unidentified)

Land Form

Rel/Slope Class: Level plain <9m <1%
Morph. Type: Flat
Elem. Type: Estuary
Slope: 0 %

Pattern Type: Tidal flat
Relief: 1 metres
Slope Category: Level
Aspect: No Data

Surface Soil Condition (dry):

Erosion: Active, Moderate (wind);

Soil Classification

Australian Soil Classification:
Sapric Sulphidic Intertidal Hydrosol Medium Gravelly Sandy
Clay-loamy Moderately deep

Mapping Unit: 4b
Principal Profile Form: N/A

Profile Morphology

			Morphology	pH	pH _{fox}	reaction	%S equiv.	Liming rate excl. ANC (kg CaCO ₃ /t)	Lab sample
0.2	1O2		Dark humus						EB1824560
0.5	1A11g		Very dark grey (5Y3/1-Moist); ; Silty loam; Wet; Moderately plastic; Normal plasticity; Very sticky; Gradual, Smooth change to	5.5	3.05	H	0.017	2	11
1	1A12g		very dark greenish grey (10Y3/1-Moist); ; Silty loam; Wet; Moderately plastic; Normal plasticity; Very sticky; Gradual, Smooth change to -	4.7	1.73	L	0.705	35	12
1.5	1B1g		Brown (7.5YR4/4-Moist); Silty clay loam; Wet; Very plastic; Normal plasticity; Very sticky; Gradual, Smooth change to	4.3	2.93	M	2.53	125	13
2	1B3g		Dark yellowish brown (10YR4/4-Moist); ; Light clay; Wet; Very plastic; Normal plasticity; Very sticky	4.3	3.81	H	3.37	164	14

MATERIAL REACTION – peroxide

- L Low reaction
- M Medium reaction
- H High reaction
- X Extreme reaction
- V Volcanic reaction

Project Code: J000073

Site ID: 8A

Observation ID: 1

Agency Name: HESSE

Site Information

Desc. By: I. Hollingsworth

Locality: Coastal Melaleuca swamp, samples 7 8 9 10 for ASS testing

Date Desc.: 03/10/18

Elevation: 4 metres

Map Ref.: GPS S.A. Off

Rainfall: 1500

Northing/Long.: 8594429 AMG zone: 52

Runoff: Very slow

Easting/Lat.: 668205 Datum:

Drainage: Very poorly drained

Geology

Exposure Type: Auger boring

Conf. Sub. is Parent. Mat.: Almost certain or certain

Geol. Ref.: Qca

Substrate Material: Auger boring, 1 m deep, Slightly porous, Unconsolidated material (unidentified)

Land Form

Rel/Slope Class: Level plain <9m <1%

Pattern Type: Rises

Morph. Type: Flat

Relief: 1 metres

Elem. Type: Drainage depression

Slope Category: Level

Slope: 0 %

Aspect: No Data

Surface Soil Condition (dry):

Erosion: Active, Moderate (wind); Active, Minor scalding (scald)

Soil Classification

Australian Soil Classification:

Mapping Unit: 8j1

Sodosolic Subplastic Hydrosol Medium Gravelly Loamy Clayey Deep

Principal Profile Form: N/A

Profile Morphology

				pH	pH _{fox}	reaction	%S equiv.	Liming rate excl. ANC (kg CaCO ₃ /t)	Lab sample
0.2	102		Dark humus						EB1824560
0.5	1A11g		Very dark grey (5Y3/1-Moist); ; Silty loam; Wet; Moderately plastic; Normal plasticity; Very sticky; Gradual, Smooth change to	6.75	4.62	L	0.013	3	7
1	1A12g		very dark greenish grey (10Y3/1-Moist); ; Silty loam; Wet; Moderately plastic; Normal plasticity; Very sticky; Gradual, Smooth change to -	6.4	4.17	L	0.008	3	8
1.5	1B1g		Brown (7.5YR4/4-Moist); Silty clay loam; Wet; Very plastic; Normal plasticity; Very sticky; Gradual, Smooth change to	5.88	3.47	L	0.010	2	9
2	1B3g		Dark yellowish brown (10YR4/4-Moist); ; Light clay; Wet; Very plastic; Normal plasticity; Very sticky	5.88	2.45	H	0.008	2	10

MATERIAL REACTION – peroxide

- L Low reaction
- M Medium reaction
- H High reaction
- X Extreme reaction
- V Volcanic reaction

Project Code: J000073
Agency Name: HESSE

Site ID: 9A

Observation ID: 1

Site Information

Desc. By: I. Hollingsworth
Date Desc.: 03/10/18
Map Ref.: GPS S.A. Off
Northing/Long.: 8594488 AMG zone: 52
Easting/Lat.: 668140 Datum:

Locality: Mangrove tidal, strong monosulfide smell
Elevation: 2 metres
Rainfall: 1500
Runoff: Very slow
Drainage: Very poorly drained

Geology

Exposure Type: Auger boring
Geol. Ref.: Qca

Conf. Sub. is Parent. Mat.: Almost certain or certain
Substrate Material: Auger boring, 1 m deep, Slightly porous, ,
Unconsolidated material (unidentified)

Land Form

Rel/Slope Class: Level plain <9m <1%
Morph. Type: Flat
Elem. Type: Estuary
Slope: 0 %

Pattern Type: Tidal flat
Relief: 1 metres
Slope Category: Level
Aspect: No Data

Surface Soil Condition (dry):

Soil Classification

Australian Soil Classification:
Sapric Sulphidic Intertidal Hydrosol Medium Gravelly Sandy
Clay-loamy Deep

Mapping Unit: 5b
Principal Profile Form: N/A

Profile Morphology

				pH	pH _{tox}	reaction	%S equiv.	Liming rate excl. ANC (kg CaCO ₃ /t	Lab sample
0.2	1O2		Dark humus						
0.5	1A11g		Olive grey (5Y5/2-Moist); ; Silty loam; Wet; Moderately plastic; Normal plasticity; Very sticky; Gradual, Smooth change to -	5.9	2.42	X	1.35	64	15
1	1A12g		Dark grey (5Y4/1-Moist); ; Silty clay loam; Wet; Moderately plastic; Normal plasticity; Very sticky; Gradual, Smooth change to -	6	2.33	X	1.54	73	16
1.5	1B1g		(N3/0-Moist); ; Silty light clay; Wet; Moderately plastic; Normal plasticity; Very sticky; Gradual, Smooth change to -	4.8	1.52	V	2.08	100	17
2	1B3g		(5GY3/1-Moist); Light clay; Wet; Moderately plastic; Normal plasticity; Very sticky;	5.3	1.66	X	1.27	62	18

MATERIAL REACTION – peroxide

L Low reaction
M Medium reaction
H High reaction
X Extreme reaction
V Volcanic reaction

Project Code: J000073
Agency Name: HESSE

Site ID: 10A

Observation ID: 1

Site Information

Desc. By: I. Hollingsworth

Locality: M viridiflora swamp, same as 4A, samples 22, 23 at 20 and 50,,sl gravellyquaetz and iromstone

Date Desc.: 04/10/18

Elevation: 5 metres

Map Ref.: GPS S.A. Off

Rainfall: 1500

Northing/Long.: 8592296 AMG zone: 52

Runoff: Slow

Easting/Lat.: 666588 Datum:

Drainage: No Data

Geology

ExposureType: Auger boring

Conf. Sub. is Parent. Mat.: Almost certain or certain

Geol. Ref.: Czs

Substrate Material: Auger boring, 0.5 m deep,, Unconsolidated material (unidentified)

Land Form

Rel/Slope Class: Gently undulating rises 9-30m 1-3% Pattern Type: Rises

Morph. Type: Flat

Relief: 9 metres

Elem. Type: Swamp

Slope Category: Level

Slope: 1 %

Aspect: No Data

Surface Soil Condition (dry): Surface crust**Erosion:****Soil Classification****Australian Soil Classification:**

Mapping Unit: 8j1

Mesotrophic Rudosolic Oxyaquic Hydrosol Medium Moderately

Principal Profile Form: N/A

gravelly Loamy Clay-loamy Moderately deep

Analytical data are incomplete but reasonable confidence.

Site Disturbance: No effective disturbance. Natural**Vegetation:**

Tall Strata - Tree, 1.01-3m, Sparse. *Species includes - Melaleuca viridiflora

Surface Coarse Fragments: 20-50%, medium gravelly, 6-20mm, angular, Quartz; 10-20%, medium gravelly, 6-20mm, angular tabular, Ferricrete**Profile Morphology**

			pH	pH _{iox}	reaction	%S equiv.	Limiting rate excl. ANC (kg CaCO ₃ /t	Dispersion	Samp.No.
0.25	1A11g	Dark greyish brown (10YR4/2-Moist); , 0-0% ; Sand; Single grain grade of structure; Dry; Slightly plastic; Normal plasticity; Very sticky; 20-50%, medium gravelly, 6-20mm, angular tabular, dispersed, Quartz, coarse fragments; Clear, Smooth change to -	6.1	3.28		2.63	129	3b	19
.5	1A12g	Greyish brown (10YR5/2-Moist); , 0-0% ; Sandy loam; Massive grade of structure; Dry; Moderately plastic; Normal plasticity; Very sticky; 2-10%, medium gravelly, 6-20mm, angular, dispersed, Quartz, coarse fragments; Field pH 6 (pH meter); Clear, Smooth change to - -	9.3	3.84		1.86	93	3b	20
0.75	1B1g	Grey (10YR5/1-Moist); Mottles, 5YR5/6, 10-20% , 5-15mm, Distinct; Sandy clay loam; Massive grade of structure; Dry; Very plastic; Normal plasticity; Very sticky; 2-10%, coarse gravelly, 20-60mm, angular, dispersed, Quartz,	9	4.73		2.03	101	3b	21

		9.3coarse fragments; Many (20 - 50 %), Ferruginous, Medium (2 -6 mm), Nodules; Soil matrix is Slightly calcareous; Field pH 6 (pH meter); Clear, Smooth change to -							
1	1B3g	Brown (10YR5/3-Moist); Mottles, 7.5YR5/6, 20-50% , 5-15mm, Distinct; Sandy loam; Massive grade of structure; Dry; Very plastic; Normal plasticity; Very sticky; 20-50%, coarse gravelly, 20-60mm, angular, dispersed, Quartz, coarse fragments; Few (2 - 10 %), Ferruginous, Medium (2 -6 mm), Nodules; Soil matrix is Slightly calcareous; Field pH 6 (pH meter); Clear, Smooth change to -	9	4.67		3.10	151	3b	22
1.5		Dark yellowish brown (10YR4/4-Moist); Substrate influence, 5YR4/6, 10-20% , 15-30mm, Distinct; Sandy loam; Massive grade of structure; Dry; Moderately plastic; Normal plasticity; Very sticky; 10-20%, coarse gravelly, 20-60mm, angular, dispersed, Quartz, coarse fragments; Few (2 - 10 %), Ferruginous, Coarse (6 - 20 mm), Nodules; Soil matrix is Slightly calcareous; Field pH 9 (pH meter); Clear, Smooth change to -	9.2			2.86	136	3b	
2		Mottles, 10R25, 2-10% , 5-15mm, Distinct; Sandy loam; Massive grade of structure; Dry; Moderately plastic; Normal plasticity; Very sticky; Few (2 - 10 %), Ferruginous, Coarse (6 - 20 mm), Nodules; Soil matrix is Slightly calcareous; Field pH 9 (pH meter);	9.5			0.519	25	3b	

MATERIAL REACTION – peroxide

- L Low reaction
- M Medium reaction
- H High reaction
- X Extreme reaction
- V Volcanic reaction

Project Code: J000073
Agency Name: HESSE

Site ID: 11A

Observation ID: 1

Site Information

Desc. By: I. Hollingsworth
Date Desc.: 04/10/18
Map Ref.: GPS S.A. Off
Northing/Long.: 8592881 AMG zone: 52
Easting/Lat.: 666189 Datum:

Locality: Same as 16A
Elevation: 2 metres
Rainfall: 1500
Runoff: Very slow
Drainage: Very poorly drained

Geology

Exposure Type: Auger boring
Geol. Ref.: Qca

Conf. Sub. is Parent. Mat.: Almost certain or certain
Substrate Material: Auger boring, 1 m deep, Slightly porous, ,
 Unconsolidated material (unidentified)

Land Form

Rel/Slope Class: Level plain <9m <1%
Morph. Type: Open depression (vale)
Elem. Type: Estuary
Slope: 0 %

Pattern Type: Tidal flat
Relief: 1 metres
Slope Category: Level
Aspect: No Data

Surface Soil Condition (dry): Surface crust

Erosion: Active, Moderate (wind);

Soil Classification

Australian Soil Classification:
 Fibric Sulphidic Hydrosol Medium Gravelly Loamy Clayey Deep

Mapping Unit: 9a
Principal Profile Form: N/A

ASC Confidence:
 Analytical data are incomplete but reasonable confidence.

Great Soil Group:

Site Disturbance: No effective disturbance. Natural

Vegetation:

Tall Strata - Tussock grass, <0.25m, Isolated plants. *Species includes - None Recorded

Surface Coarse Fragments: No surface coarse fragments

Profile Morphology

				pH	pH _{lox}	Reaction	%S equiv.	Liming rate excl. ANC (kg CaCO ₃ /t	Dispersion	Samp.No.
0.25	1A11g		Reddish brown (2.5YR5/3-Moist); Mottles, 5YR44, 20-50% , 15-30mm, Prominent; Silty clay loam; Massive grade of structure; Earthy fabric; Fine, (0 - 5) mm crack; Few (<1 per 100mm ²) macropores, Moderately moist; Weak consistence; Slightly plastic; Slightly sticky; Field pH 4.2 (pH meter); Few coarse fragments; Clear, Smooth change to - -	6.5	2.5	X	2.63	129	5	36
.5	1A12g		Dark greenish grey (5G4/1-Moist); Mottles, N50, 10-20% , 15-30mm, Distinct; Sapric peat; Massive grade of structure; Earthy fabric; Few (<1 per 100mm ²) macropores, Wet; Weak consistence; Moderately plastic; Normal plasticity; Slightly sticky; Field pH 4.3 (pH meter); Few coarse fragments, Gradual, Smooth change to -	6.3	2.1	X	1.86	93	5	37

0.75	1A3g		Greyish green (5G5/2-Moist); , 0-0% ; Sapric peat; Massive grade of structure; Earthy fabric; Few (<1 per 100mm2) macropores, Wet; Weak consistence; Moderately plastic; Normal plasticity; Very sticky; Field pH 4.1 (pH meter); Few coarse fragments; Gradual, Smooth change to -	6.5	2.0	X	2.03	101	5	38
1	1B1g		Greyish green (5G5/2-Moist); , 0-0% ; Sapric peat; Massive grade of structure; Earthy fabric; Few (<1 per 100mm2) macropores, Wet; Weak consistence; Moderately plastic; Normal plasticity; Very sticky; Field pH 4.1 (pH meter); Few coarse fragments; Gradual, Smooth change to -	6.5	1.9	X	3.10	151	5	39
1.5	D1		Grey (N5/0-Moist); Mottles, 10YR4/6, 10-20% , 15-30mm, Distinct; Sapric peat; Massive grade of structure; Earthy fabric; Few (<1 per 100mm2) macropores, Wet; Firm consistence; Very plastic; Normal plasticity; Very sticky; 2-10%, coarse gravelly, 20-60mm, subangular, dispersed, Quartz, coarse fragments; Field pH 4.2 (pH meter); Gradual, Smooth change to	6.6	2.2	X	2.86	136	5	40
2	D2		Grey (N5/0-Moist); ; Silty medium heavy clay; Massive grade of structure; Earthy fabric; Few (<1 per 100mm2) macropores, Wet; Firm consistence; Very plastic; Normal plasticity; Very sticky; Field pH 4.8 (pH meter); Gradual, Smooth change to -	6.6	2.0	X	0.51 9	25	3b	41

MATERIAL REACTION – peroxide

- L Low reaction
- M Medium reaction
- H High reaction
- X Extreme reaction
- V Volcanic reaction

Project Code: J000073
Agency Name: HESSE

Site ID: 12A

Observation ID: 1

Site Information

Desc. By: I. Hollingsworth
Date Desc.: 05/10/18
Map Ref.: GPS S.A. Off
Northing/Long.: 8592333 AMG zone: 52
Easting/Lat.: 666873 Datum:

Locality: Pale grey sandy, 10% sandstone gravel
Elevation: No Data
Rainfall: 1500
Runoff: Very slow
Drainage: Very poorly drained

Geology

Exposure Type: Auger boring
Geol. Ref.: Czs

Conf. Sub. is Parent. Mat.: Almost certain or certain
Substrate Material: Auger boring, 1 m deep, Slightly porous, , Unconsolidated material (unidentified)

Land Form

Rel/Slope Class: Gently undulating rises 9-30m 1-3%
Pattern Type: Rises
Morph. Type: Open depression (vale)
Elem. Type: Drainage depression
Slope: 2 %
Relief: 9 metres
Slope Category: Very gently sloped
Aspect: No Data

Surface Soil Condition (dry): Firm

Erosion:

Soil Classification

Australian Soil Classification:
 Mesotrophic Rudosolic Oxyaquic Hydrosol Medium Moderately
 gravelly Loamy Clay-loamy Shallow

Mapping Unit: 8j1
Principal Profile Form: N/A

Site Disturbance: No effective disturbance. Natural

Vegetation:

Tall Strata - Tree, 1.01-3m, Mid-dense. *Species includes - Melaleuca viridiflora

Surface Coarse Fragments: 10-20%, medium gravelly, 6-20mm, rounded, Ferricrete

Profile Morphology

				pH	pH _{fox}	Reaction	Dispersion	%S equiv.	Samp.No.
0.2	1A11		Dark greyish brown (10YR4/2-Moist); , 0-0% ; Loamy sand; Earthy fabric; Dry; Slightly plastic; Normal plasticity; Moderately sticky; Clear, Smooth change to -	6.4	3.14	L	3b	0.006	EB182637 1
.4	1A12		Grey (10YR5/1-Moist); , 0-0% ; Sandy loam; Massive grade of structure; Earthy fabric; Dry; Moderately plastic; Normal plasticity; Very sticky; 2-10%, medium gravelly, 6-20mm, rounded, stratified, Ferricrete, coarse fragments; Clear, Smooth change to -	5.9	4.19	L	3b	0.015	EB182637 2
0.6	1B2c		Yellowish brown (10YR5/6-Moist); Mottles, 10YR56, 2-10% , 5-15mm, Distinct; Sandy clay loam; Massive grade of structure; Earthy fabric; Dry; Moderately plastic; Normal plasticity; Very sticky; 50-90%, medium	5.2	4.57	L	3b	0.016	EB182637 3

			gravelly, 6-20mm, rounded, stratified, Ferricrete, coarse fragments; Many (20 - 50 %), Ferruginous, Coarse (6 - 20 mm), Nodules; Clear, Smooth change to -						
1	1B3		Yellowish brown (10YR5/4-Moist); , 0-0% ; Sandy loam; Earthy fabric; Dry; Very plastic; Normal plasticity; Very sticky; 10-20%, coarse gravelly, 20-60mm, subangular, dispersed, Quartzite, coarse fragments; Clear, Smooth change to -	5.6	4.57	L	3b	0.006	EB182637 4
1.5	D1		Grey (10YR5/1-Moist); Mottles, 7.5R25, 2-10% , 15-30mm, Distinct; Sandy loam; Earthy fabric; Dry; Very plastic; Normal plasticity; Very sticky; 50-90%, coarse gravelly, 20-60mm, angular tabular, dispersed, Quartz, coarse fragments; Clear, Smooth change to -	5.1	4.61	L	3b	0.012	EB182637 5
2	D2		Grey (10YR5/1-Moist); Mottles, 10R26, 10-20% , 5-15mm, Distinct; Sandy loam; Earthy fabric; Dry; Very plastic; Normal plasticity; Very sticky; 20-50%, medium gravelly, 6-20mm, subangular, dispersed, Quartz, coarse fragments; Clear, Smooth change to -	5.0	4.41	L	3b	0.010	EB182637 6

MATERIAL REACTION – peroxide

- L Low reaction
- M Medium reaction
- H High reaction
- X Extreme reaction
- V Volcanic reaction

Project Code: J000073
Agency Name: HESSE

Site ID: 13A

Observation ID: 1

Site Information

Desc. By: I. Hollingsworth
Date Desc.: 04/10/18
Map Ref.: GPS S.A. Off
Northing/Long.: 8592152 AMG zone: 52
Easting/Lat.: 666598 Datum:

Locality: M viridiflora swamp, check site same as 4A
Elevation: 4 metres
Rainfall: 1500
Runoff: Slow
Drainage: Very poorly drained

Geology

ExposureType: Auger boring
Geol. Ref.: Czs

Conf. Sub. is Parent. Mat.: Almost certain or certain
Substrate Material: Auger boring, 0.5 m deep, Slightly porous, , Granite

Land Form

Rel/Slope Class: Gently undulating rises 9-30m 1-3%
Pattern Type: Rises
Morph. Type: Lower-slope
Elem. Type: Swamp
Slope: 2 %
Relief: 9 metres
Slope Category: Very gently sloped
Aspect: No Data

Surface Soil Condition (dry):

Erosion:

Soil Classification

Australian Soil Classification:
 Mesotrophic Rudosolic Oxyaquic Hydrosol Medium Moderately
 gravelly Loamy Clay-loamy Shallow

Mapping Unit: 8j1
Principal Profile Form: N/A

ASC Confidence:
 All necessary analytical data are available.

Great Soil Group:

Site Disturbance: No effective disturbance. Natural

Vegetation:

Surface Coarse Fragments: 20-50%, medium gravelly, 6-20mm, rounded, Quartz

Profile Morphology

				pH	pH _{fox}	Reaction	Dispersion	%S equiv.	Samp.No. EB182637
0.2	1A11		Dark greyish brown (10YR4/2-Moist); , 0-0% ; Loamy sand; Earthy fabric; Dry; Slightly plastic; Normal plasticity; Moderately sticky; Clear, Smooth change to -	5.6	4.62	L	3b	0.006	7
.4	1A12		Grey (10YR5/1-Moist); , 0-0% ; Sandy loam; Massive grade of structure; Earthy fabric; Dry; Moderately plastic; Normal plasticity; Very sticky; 2-10%, medium gravelly, 6-20mm, rounded, stratified; Clear, Smooth change to -	5.9	5.1	M	3b	0.018	EB1 826 37 8
0.6	1B2c		Yellowish brown (10YR5/6-Moist); Mottles, 10YR5/6, 2-10% , 5-15mm, Distinct; Sandy clay loam; Massive grade of structure; Earthy fabric; Dry; Moderately plastic; Normal plasticity; Very sticky; 50-90%, medium gravelly, 6-20mm, rounded, stratified, Ferricrete, coarse fragments; Many (20 - 50 %), Ferruginous, Coarse (6 - 20 mm), Nodules; Clear, Smooth change to -	5.2	4.47	M	3b	0.006	EB1 826 37 9
1	1B3		Yellowish brown (10YR5/4-Moist); , 0-0% ; Sandy loam; Earthy fabric; Dry; Very plastic; Normal plasticity; Very sticky; 10-20%, coarse gravelly, 20-60mm, subangular, dispersed, Quartzite, coarse	5.2	4.6	H	3b	0.016	EB1 826 37

			fragments; Clear, Smooth change to -						10
1.5	D1		Grey (10YR5/1-Moist); Mottles, 7.5R25, 2-10% , 15-30mm, Distinct; Sandy loam; Earthy fabric; Dry; Very plastic; Normal plasticity; Very sticky; 50-90%, coarse gravelly, 20-60mm, angular tabular, dispersed, Quartz, coarse fragments; Clear, Smooth change to -	5.1	4.5	L	3b	0.009	EB1 826 37 11
2	D2		Grey (10YR5/1-Moist); Dark red Mottles, 10R26, 10-20% , 5-15mm, Distinct; Sandy loam; Earthy fabric; Dry; Very plastic; Normal plasticity; Very sticky; 20-50%, medium gravelly, 6-20mm, subangular, dispersed, Quartz, coarse fragments; Clear, Smooth change to -	4.9	3.95	H	3b	0.006	EB1 826 37 12

MATERIAL REACTION – peroxide

- L Low reaction
- M Medium reaction
- H High reaction
- X Extreme reaction
- V Volcanic reaction

Project Code: J000073
Agency Name: HESSE

Site ID: 14A

Observation ID: 1

Site Information

Desc. By: I. Hollingsworth
Date Desc.: 04/10/18
Map Ref.: GPS S.A. Off
Northing/Long.: 8592004 AMG zone: 52
Easting/Lat.: 666700 Datum:

Locality: M viridiflora swamp, check site same as 4A
Elevation: 4 metres
Rainfall: 1500
Runoff: Slow
Drainage: Very poorly drained

Geology

ExposureType: Auger boring
Geol. Ref.: Czs

Conf. Sub. is Parent. Mat.: Almost certain or certain
Substrate Material: Auger boring, 0.5 m deep, Slightly porous, , Granite

Land Form

Rel/Slope Class: Gently undulating rises 9-30m 1-3%
Pattern Type: Rises
Morph. Type: Lower-slope
Elem. Type: Swamp
Slope: 2 %
Relief: 9 metres
Slope Category: Very gently sloped
Aspect: No Data

Surface Soil Condition (dry):

Erosion:

Soil Classification

Australian Soil Classification:
 Mesotrophic Rudosolic Oxyaquic Hydrosol Medium Moderately
 gravelly Loamy Clay-loamy Shallow

Mapping Unit: 8j1
Principal Profile Form: N/A

ASC Confidence:
 All necessary analytical data are available.

Great Soil Group:

Site Disturbance:

Vegetation:

Tall Strata - Tree, 3.01-6m, Sparse. *Species includes - Melaleuca viridiflora

Surface Coarse Fragments: 20-50%, medium gravelly, 6-20mm, rounded, Quartz

Profile Morphology

				pH	pH _{fox}	Reaction	Dispersion	%S equiv.	Samp.No. EB182637
0.2	1A11		Dark grey (2.5YR4/1-Moist); , 0-0% ; Loamy sand; Single grain grade of structure; Earthy fabric; Dry; Non-plastic; Normal plasticity; Slightly sticky; 0-2%, medium gravelly, 6-20mm, rounded, dispersed, Ferricrete, coarse fragments; Field pH 5 (Raupach); Clear, Smooth change to -	6.1	5.5	L	3b	0.006	13
.4	1A12		Grey (2.5YR5/1-Moist); , 0-0% ; Sandy loam; Massive grade of structure; Earthy fabric; Dry; Non-plastic; Normal plasticity; Slightly sticky; 0-2%, medium gravelly, 6-20mm, rounded, dispersed, Ferricrete, coarse fragments; Field pH 6 (pH meter); Clear, Smooth change to -	9.3	8.5	M	3b	0.018	14
0.6	1B2c		Yellowish brown (10YR5/4-Moist); Mottles, 10YR71, 2-10% , 5-15mm, Distinct; Sandy clay loam; Massive grade of structure; Earthy fabric; Dry; Moderately plastic; Normal plasticity; Moderately sticky; 50-90%, medium gravelly, 6-20mm, rounded, stratified, Ferricrete, coarse fragments; Many (20 - 50 %), Ferruginous, Medium (2 -6 mm), Nodules; Clear,	9.0	8.3	M	3b	0.006	15

			Smooth change to -						
1	1B3		Grey (10YR6/1-Moist); Mottles, 10R35, 2-10% , 5-15mm, Distinct; Sandy loam; Massive grade of structure; Earthy fabric; Dry; Slightly plastic; Normal plasticity; Slightly sticky; 0-2%, rounded, dispersed, Shale, coarse fragments; Few (2 - 10 %), Ferruginous, Medium (2 -6 mm), Nodules;	9.0	8.6	H	3b	0.016	16
1.5	D1		Light yellowish brown (10YR6/4-Moist); Mottles, 10YR71, 10-20% , 5-15mm, Distinct; Sandy loam; Massive grade of structure; Earthy fabric; Dry; Slightly plastic; Normal plasticity; Slightly sticky; 2-10%, medium gravelly, 6-20mm, angular tabular, dispersed, Shale, coarse fragments; Very few (0 - 2 %), Ferruginous, Medium (2 -6 mm), Nodules; Clear, Smooth change to -	9.2	8.6	L	3b	0.009	17
2	D2		Dark red (10R3/5-Moist); Mottles, 10YR71, 10-20% , 5-15mm, Distinct; Sandy loam; Massive grade of structure; Earthy fabric; Dry; Slightly plastic; Normal plasticity; Very sticky; 20-50%, coarse gravelly, 20-60mm, angular tabular, dispersed, Shale, coarse fragments; Common (10 - 20 %), Earthy, Coarse (6 - 20 mm), Nodules; Field pH 9 (pH meter);	9.5	8.8	H	3b	0.006	18

MATERIAL REACTION – peroxide

- L Low reaction
- M Medium reaction
- H High reaction
- X Extreme reaction
- V Volcanic reaction

Project Code: J000073
Agency Name: HESSE

Site ID: 15A

Observation ID: 1

Site Information

Desc. By: I. Hollingsworth

Locality: Mangrove and saline flats, same as 16A, shallow to water at 50cm

Date Desc.: 04/10/18

Elevation: 2 metres

Map Ref.: GPS S.A. Off

Rainfall: 1500

Northing/Long.: 8592714 AMG zone: 52

Runoff: Slow

Easting/Lat.: 666351 Datum:

Drainage: Very poorly drained

Geology

ExposureType: Auger boring

Conf. Sub. is Parent. Mat.: Almost certain or certain

Geol. Ref.: Qca

Substrate Material: Auger boring, 1 m deep, Slightly porous, Unconsolidated material (unidentified)

Land Form

Rel/Slope Class: Level plain <9m <1%

Pattern Type: Tidal flat

Morph. Type: Flat

Relief: 1 metres

Elem. Type: Intertidal flat

Slope Category: Level

Slope: 0 %

Aspect: No Data

Surface Soil Condition (dry): Surface crust

Erosion: Active, Moderate (wind);

Soil Classification

Australian Soil Classification:

Mapping Unit: 9a

Fibric Sulphidic Hydrosol Medium Gravelly Loamy Clayey Deep

Principal Profile Form: N/A

ASC Confidence:

All necessary analytical data are available.

Great Soil Group:

Site Disturbance: No effective disturbance. Natural

Vegetation:

Tall Strata - Tree, 1.01-3m, Isolated clumps. *Species includes - None Recorded

Surface Coarse Fragments: 0-2%, medium gravelly, 6-20mm, subrounded, Quartz

Profile Morphology

				pH	pH _{fox}	Reaction	%S equiv.	Liming rate excl. ANC (kg CaCO ₃ /t)	Dispersion	Samp.No. EB1824560
0.25	1A11g		Reddish brown (2.5YR5/3-Moist); Mottles, 5YR44, 20-50% , 15-30mm, Prominent; Silty clay loam; Massive grade of structure; Earthy fabric; Fine, (0 - 5) mm crack; Few (<1 per 100mm ²) macropores, Moderately moist; Weak consistence; Slightly plastic; Slightly sticky; Field pH 4.2 (pH meter); Few coarse fragments; Clear, Smooth change to - -	6.4	2.25	L	0.016	<1	3b	30
.5	1A12g		Dark greenish grey (5G4/1-Moist); Mottles, N50, 10-20% , 15-30mm, Distinct; Sapric peat; Massive grade of structure; Earthy fabric; Few (<1 per 100mm ²) macropores, Wet; Weak consistence; Moderately plastic; Normal plasticity; Slightly sticky; Field pH 4.3 (pH meter); Few coarse fragments, Gradual, Smooth change to -	5.9	4.18	H	0.013	<1	3b	31
0.75	1A3g		Greyish green (5G5/2-Moist); , 0-0% ; Sapric peat; Massive grade of structure; Earthy fabric; Few (<1 per 100mm ²)	6.4	2.6	X	0.644	33	3b	32

			macropores, Wet; Weak consistence; Moderately plastic; Normal plasticity; Very sticky; Field pH 4.1 (pH meter); Few coarse fragments; Gradual, Smooth change to -							
1	1B1g		Greyish green (5G5/2-Moist); , 0-0% ; Sapric peat; Massive grade of structure; Earthy fabric; Few (<1 per 100mm2) macropores, Wet; Weak consistence; Moderately plastic; Normal plasticity; Very sticky; Field pH 4.1 (pH meter); Few coarse fragments; Gradual, Smooth change to -	6.5	2.22.2	X	1.44	70	3b	33
1.5	D1		Grey (N5/0-Moist); Mottles, 10YR46, 10-20% , 15-30mm, Distinct; Sapric peat; Massive grade of structure; Earthy fabric; Few (<1 per 100mm2) macropores, Wet; Firm consistence; Very plastic; Normal plasticity; Very sticky; 2-10%, coarse gravelly, 20-60mm, subangular, dispersed, Quartz, coarse fragments; Field pH 4.2 (pH meter); Gradual, Smooth change to	6.5	2.5	X	0.718	34	3b	34
2	D2		Grey (N5/0-Moist); ; Silty medium heavy clay; Massive grade of structure; Earthy fabric; Few (<1 per 100mm2) macropores, Wet; Firm consistence; Very plastic; Normal plasticity; Very sticky; Field pH 4.8 (pH meter); Gradual, Smooth change to -	6.6	2.4	X	0.167	8	3b	35

MATERIAL REACTION – peroxide

- L Low reaction
- M Medium reaction
- H High reaction
- X Extreme reaction
- V Volcanic reaction

Project Code: J000073
Agency Name: HESSE

Site ID: 16A

Observation ID: 1

Site Information

Desc. By: I. Hollingsworth
Date Desc.: 04/10/18
Map Ref.: GPS S.A. Off
Northing/Long.: 8592567 AMG zone: 52
Easting/Lat.: 666467 Datum:

Locality: Mangrove and saline flats, shallow to water at 50cm
Elevation: 3 metres
Rainfall: 1500
Runoff: Slow
Drainage: Very poorly drained

Geology

Exposure Type: Auger boring
Geol. Ref.: Qca

Conf. Sub. is Parent. Mat.: Almost certain or certain
Substrate Material: Auger boring, 1 m deep, Slightly porous, Unconsolidated material (unidentified)

Land Form

Rel/Slope Class: Level plain <9m <1%
Morph. Type: Flat
Elem. Type: Intertidal flat
Slope: 0 %

Pattern Type: Tidal flat
Relief: 1 metres
Slope Category: Level
Aspect: No Data

Surface Soil Condition (dry): Firm

Erosion: Active, Moderate (wind);

Soil Classification

Australian Soil Classification:

Fibric Sulphidic Hydrosol Medium Gravelly Loamy Clayey Deep

Mapping Unit: 7a

Principal Profile Form: N/A

Site Disturbance: No effective disturbance. Natural

Vegetation:

Tall Strata - Tree, 1.01-3m, Mid-dense. *Species includes - Melaleuca viridiflora

Surface Coarse Fragments: 10-20%, medium gravelly, 6-20mm, rounded, Ferricrete

Profile Morphology

			MORPHOLOGY	pH	pH _{fox}	Reaction	%S equiv.	Liming rate excl. ANC (kg CaCO ₃ /t)	Dispersion	Samp.No. EB1824560
0.25	1A11g		Reddish brown (2.5YR5/4-Moist); Mottles, 5YR46, 10-20% , 5-15mm, Distinct; Medium heavy clay; Massive grade of structure; Earthy fabric; Firm consistence; Very plastic; Normal plasticity; Very sticky; 10-20%, medium gravelly, 6-20mm, rounded, dispersed, Ferricrete, coarse fragments; Field pH 6 (pH meter); FewClear, Smooth change to -	6.3	4.75	L	0.017		3b	24
.5	1A12g		Reddish brown (2.5YR5/4-Moist); Mottles, 5YR46, 10-20% , 5-15mm, Distinct; Medium heavy clay; Massive grade of structure; Earthy fabric; Firm consistence; Very plastic; Normal plasticity; Very sticky; 10-20%, medium gravelly, 6-20mm, rounded, dispersed, Ferricrete, coarse fragments; Field pH 6 (pH meter); FewClear, Smooth change to -	6.1	3.42	L	0.014		3b	25
0.75	1A3g		Reddish brown (2.5YR5/4-Moist); Mottles, 5YR46, 2-10%, 5-15mm, Distinct; Medium heavy clay; Massive grade of structure; Earthy fabric; Weak consistence; Very plastic; Normal plasticity; Very sticky; 0-2%, medium gravelly, 6-20mm, rounded, dispersed, Ferricrete, coarse fragments; Field pH 6 (pH meter); FewClear, Smooth change to -	6.3	2.25	H	0.010		3b	26
1	1B1g		Dark grey (N4/1-Moist); , 0-0% ; Silty medium clay; Massive grade of structure; Earthy fabric; Weak consistence; Slightly plastic; Normal plasticity; Very	6.5	3.1	M	0.009		3b	27

			sticky; Field pH 6 (pH meter); Clear, LS smooth change to -							
1.5	D1		Grey (N4/0-Moist); Mottles, 5YR4/6, 20-50% , 15-30mm, Distinct; Silty medium clay; Massive grade of structure; Earthy fabric; Weak consistence; Moderately plastic; Normal plasticity; Slightly sticky; 2-10%, medium gravelly, 6-20mm, rounded tabular, dispersed, Quartz, coarse fragments; Field pH 6 (pH meter); Clear, Smooth change to -	6.2	3.42	L	0.009		3b	28
2	D2		Yellowish brown (10YR5/6-Moist); ; Light clay; Massive grade of structure; Earthy fabric; Firm consistence; Field pH 6.2 (pH meter)	6.4	2.25	H	0.036	2	3b	29

MATERIAL REACTION – peroxide

- L Low reaction
- M Medium reaction
- H High reaction
- X Extreme reaction
- V Volcanic reaction

Project Code: J000073
Agency Name: HESSE

Site ID: 17A

Observation ID: 1

Site Information

Desc. By: I. Hollingsworth
Date Desc.: 05/10/18
Map Ref.: GPS S.A. Off
Northing/Long.: 8592667 AMG zone: 52
Easting/Lat.: 667284 Datum:

Locality: Gravelly, shallow, similar to 2A
Elevation: 13 metres
Rainfall: 1500
Runoff: Rapid
Drainage: Moderately well drained

Geology

Exposure Type: Auger boring
Geol. Ref.: Czl

Conf. Sub. is Parent. Mat.: Almost certain or certain
Substrate Material: Auger boring, 0.5 m deep, Slightly porous, , Granite

Land Form

Rel/Slope Class: Gently undulating rises 9-30m 1-3%

Pattern Type: Rises

Morph. Type: Upper-slope
Elem. Type: Hillslope
Slope: 2 %

Relief: 9 metres
Slope Category: Very gently sloped
Aspect: No Data

Surface Soil Condition (dry):

Erosion:

Soil Classification

Australian Soil Classification:
 Ferric Mesotrophic Brown Kandosol Medium Moderately gravelly Sandy Loamy Moderately deep

Mapping Unit: 7a2
Principal Profile Form: N/A

Surface Coarse Fragments: 20-50%, medium gravelly, 6-20mm, rounded, Quartz; 20-50%, medium gravelly, 6-20mm, rounded, Ferricrete

Profile Morphology

1A1	0 - 0.2 m	Brown (7.5YR4/4-Moist); ; Sandy loam; Dry; Slightly plastic; Normal plasticity; Slightly sticky; Gradual, Smooth change to -
1B1	0.2 - 0.5 m	Strong brown (7.5YR4/6-Moist); ; Sandy clay loam; Dry; Slightly plastic; Normal plasticity; Slightly sticky; Gradual, Smooth change to -
1B2	0.5 - 1 m	Strong brown (7.5YR4/6-Moist); ; Light clay; Dry; Very plastic; Normal plasticity; Slightly sticky; Gradual, Smooth change to -

Morphological Notes

1A1	Emmerson Dispersion Index = 5; pH=5.9; EC = 0.1
1B1	Emmerson Dispersion Index = 5; pH=6.5; EC = 0.1
1B2	Emmerson Dispersion Index = 5; pH=6.5; EC = 0.1

Project Code: J000073
Agency Name: HESSE

Site ID: 18A

Observation ID: 1

Site Information

Desc. By: I. Hollingsworth
Date Desc.: 04/10/18
Map Ref.: GPS S.A. Off
Northing/Long.: 8592160 AMG zone: 52
Easting/Lat.: 667283 Datum:

Locality: Swamp, check site, same as 4A
Elevation: 8 metres
Rainfall: 1500
Runoff: Slow
Drainage: Very poorly drained

Geology

ExposureType: Auger boring
Geol. Ref.: Qcl

Conf. Sub. is Parent. Mat.: Almost certain or certain
Substrate Material: Auger boring, 1 m deep, Slightly porous, , Unconsolidated material (unidentified)

Land Form

Rel/Slope Class: Gently undulating rises 9-30m 1-3%
Pattern Type: Rises
Morph. Type: Flat
Relief: 4 metres
Elem. Type: Swamp
Slope Category: Very gently sloped
Slope: 0.5 %
Aspect: No Data

Surface Soil Condition (dry):

Erosion:

Soil Classification

Australian Soil Classification: Mesotrophic Rudosolic Oxyaquic Hydrosol Medium Moderately gravelly Loamy Clay-loamy Shallow
Mapping Unit: 8j1
Principal Profile Form: N/A

Surface Coarse Fragments: 20-50%, medium gravelly, 6-20mm, rounded, Quartz

Profile Morphology

1A1 0 - 0.2 m Dark grey (2.5YR4/1-Moist); ; Loamy sand; Dry; Slightly plastic; Normal plasticity; Slightly sticky; Gradual, Smooth change to -
 1A3g 0.2 - 0.5 m Grey (2.5YR5/1-Moist); ; Loamy sand; Dry; Moderately plastic; Normal plasticity; Moderately sticky; Gradual, Smooth change to -
 1B1 0.5 - 0.6 m Grey (10YR4/6-Moist); Mottles, 2.5Y51, 2-10% , 15-30mm, Distinct; Sandy clay loam; Dry; Moderately plastic; Normal plasticity; Moderately sticky; Gradual, Smooth change to -
 1B2m 0.6 - m Grey (10YR4/6-Moist); ; Smooth change to -

Morphological Notes

1A1 Emmerson Dispersion Index = 5; pH=5.5; EC = 0.5
 1A3g Emmerson Dispersion Index = 5; pH=5.5; EC = 0.5
 1B1 Emmerson Dispersion Index = 5; pH=6; EC = 0.5

Observation

melaleuca swamp woodland

Site Notes

M viridiflora woodland

Project Code: J000073
Agency Name: HESSE

Site ID: 19A

Observation ID: 1

Site Information

Desc. By: I. Hollingsworth

Locality: Similar to 2A, 30% qz gravel, 2 % ferricrete out crop moderately deep

Date Desc.: 04/10/18

Elevation: 7 metres

Map Ref.: GPS S.A. Off

Rainfall: 1500

Northing/Long.: 8594228 AMG zone: 52

Runoff: Slow

Easting/Lat.: 668400 Datum:

Drainage: Imperfectly drained

Geology

ExposureType: Auger boring

Conf. Sub. is Parent. Mat.: Almost certain or certain

Geol. Ref.: Czl

Substrate Material: Auger boring, 0.5 m deep, Slightly porous, Ferricrete

Land Form

Rel/Slope Class: Gently undulating rises 9-30m 1-3%

Pattern Type: Rises

Morph. Type: Flat

Relief: 4 metres

Elem. Type: Plain

Slope Category: Level

Slope: 0.5 %

Aspect: No Data

Surface Soil Condition (dry):

Erosion:

Soil Classification

Australian Soil Classification:

Ferric Mesotrophic Brown Kandosol Medium Moderately gravelly Sandy Loamy Shallow

Mapping Unit: 8j1

Principal Profile Form: N/A

ASC Confidence:

Analytical data are incomplete but reasonable confidence.

Great Soil Group: Red earth

Surface Coarse Fragments: 50-90%, medium gravelly, 6-20mm, rounded, Ferricrete

Profile Morphology

1A3	0.2 - 0.5 m	Reddish brown (2.5YR4/4-Moist); ; Sandy loam; Dry; Slightly plastic; Normal plasticity; Slightly sticky; 2-10%, medium gravelly, 6-20mm, rounded tabular, dispersed, Ferricrete, coarse fragments; Gradual, Smooth change to -
1A1	0 - 0.2 m	Dusky red (2.5YR3/2-Moist); ; Loamy sand; Dry; Slightly plastic; Normal plasticity; Slightly sticky; 20-50%, medium gravelly, 6-20mm, rounded tabular, dispersed, Ferricrete, coarse fragments; Gradual, Smooth change to -
1B2	0.5 - 1 m	Red (2.5YR4/6-Moist); ; Sandy clay loam; Dry; Moderately plastic; Normal plasticity; Slightly sticky; 2-10%, medium gravelly, 6-20mm, rounded tabular, dispersed, Ferricrete, coarse fragments; Gradual, Smooth change to -
1B2m	1 - m	Red (2.5YR4/6-Moist); ; 50-90%, medium gravelly, 6-20mm, rounded tabular, dispersed, Ferricrete, coarse fragments;

Morphological Notes

1A3 Emmerson Dispersion Index = 5; pH=5.5

1A1 Emmerson Dispersion Index = 5; pH=5.5

1B2 Emmerson Dispersion Index = 5; pH=6

Observation

C bleeseri woodland

Site Notes

C bleeseri woodland

Project Code: J000073
Agency Name: HESSE

Site ID: 20A

Observation ID: 1

Site Information

Desc. By: I. Hollingsworth

Locality: Similar to 2A, 30% qz gravel, 2 % ferricrete out crop moderately deep

Date Desc.: 05/10/18

Elevation: 7 metres

Map Ref.: GPS S.A. Off

Rainfall: 1500

Northing/Long.: 8593949 AMG zone: 52

Runoff: Slow

Easting/Lat.: 668229 Datum:

Drainage: Imperfectly drained

Geology

Exposure Type: Auger boring

Conf. Sub. is Parent. Mat.: Almost certain or certain

Geol. Ref.: Czl

Substrate Material: Auger boring, 0.5 m deep, Porous, ,

Ferricrete

Land Form

Rel/Slope Class: Gently undulating rises 9-30m 1-3%

Pattern Type: Rises

Morph. Type: Flat

Relief: 4 metres

Elem. Type: Plain

Slope Category: Level

Slope: 0.5 %

Aspect: No Data

Surface Soil Condition (dry):

Erosion:

Soil Classification

Australian Soil Classification:

Mapping Unit: 7a2

Ferric Mesotrophic Brown Kandosol Medium Moderately gravelly Sandy Loamy Moderately deep

Principal Profile Form: N/A

ASC Confidence:

Great Soil Group: Red earth

Surface Coarse Fragments: 50-90%, medium gravelly, 6-20mm, rounded, Ferricrete

Profile Morphology

- | | | |
|------|-------------|--|
| 1A1 | 0 - 0.2 m | Dusky red (2.5YR3/2-Moist); ; Loamy sand; Dry; Slightly plastic; Normal plasticity; Slightly sticky; 20-50%, medium gravelly, 6-20mm, rounded tabular, dispersed, Ferricrete, coarse fragments; Gradual, Smooth change to - |
| 1A3 | 0.2 - 0.5 m | Reddish brown (2.5YR4/4-Moist); ; Sandy loam; Dry; Slightly plastic; Normal plasticity; Slightly sticky; 2-10%, medium gravelly, 6-20mm, rounded tabular, dispersed, Ferricrete, coarse fragments; Gradual, Smooth change to - |
| 1B2 | 0.5 - 1 m | Red (2.5YR4/6-Moist); ; Sandy clay loam; Dry; Moderately plastic; Normal plasticity; Slightly sticky; 2-10%, medium gravelly, 6-20mm, rounded tabular, dispersed, Ferricrete, coarse fragments; Gradual, Smooth change to - |
| 1B2m | 1 - m | Red (2.5YR4/6-Moist); ; 50-90%, medium gravelly, 6-20mm, rounded tabular, dispersed, Ferricrete, coarse fragments; |

Morphological Notes

1A1 Emmerson Dispersion Index = 5; pH=5.5; EC=0.1

1A3 Emmerson Dispersion Index = 5; pH=5.5; EC=0.1

1B2 Emmerson Dispersion Index = 5; pH=6; EC=0.1

Observation

C bleeseri woodland

Site Notes

C bleeseri woodland

Project Code: J000073
Agency Name: HESSE

Site ID: 21A

Observation ID: 1

Site Information

Desc. By: I. Hollingsworth

Locality: Similar to 2A, 30% qz gravel, 2 % ferricrete out crop
 Moderately deep

Date Desc.: 05/10/18

Elevation: 7 metres

Map Ref.: GPS S.A. Off

Rainfall: 1500

Northing/Long.: 8593483 AMG zone: 52

Runoff: Slow

Easting/Lat.: 668067 Datum:

Drainage: Imperfectly drained

Geology

ExposureType: Auger boring

Conf. Sub. is Parent. Mat.: Almost certain or certain

Geol. Ref.: Czl

Substrate Material: Auger boring, 0.5 m deep, Porous, Ferricrete

Land Form

Rel/Slope Class: Gently undulating rises 9-30m 1-3%

Pattern Type: Rises

Morph. Type: Flat

Relief: 4 metres

Elem. Type: Plain

Slope Category: Level

Slope: 0.5 %

Aspect: No Data

Surface Soil Condition (dry):

Erosion:

Soil Classification

Australian Soil Classification:

Mapping Unit: 7a2

Ferric Mesotrophic Brown Kandosol Medium Moderately
 gravelly Sandy Loamy Moderately deep

Principal Profile Form: N/A

Great Soil Group:

Red earth

Vegetation: E miniate, C bleeseri woodland

Surface Coarse Fragments:

Profile Morphology

1A1	0 - 0.2 m	Dark grey (2.5YR4/1-Moist); ; Loamy sand; Dry; Slightly plastic; Normal plasticity; Slightly sticky; 20-50%, coarse gravelly, 20-60mm, subangular, dispersed, Quartz, coarse fragments; Gradual, Smooth change to -
1A3g	0.2 - 0.5 m	Grey (2.5YR5/1-Moist); ; Loamy sand; Dry; Moderately plastic; Normal plasticity; Moderately sticky; 10-20%, coarse gravelly, 20-60mm, subangular, dispersed, Quartz, coarse fragments; Gradual, Smooth change to -
1B1	0.5 - 0.6 m	Grey (10YR4/6-Moist); ; Sandy clay loam; Dry; Moderately plastic; Normal plasticity; Moderately sticky; 10-20%, coarse gravelly, 20-60mm, subangular, dispersed, Quartz, coarse fragments; Gradual, Smooth change to -
1B2m	0.6 - m	; 10-20%, coarse gravelly, 20-60mm, subangular, dispersed, Quartz, coarse fragments; Smooth change to -

Morphological Notes

1A1	Emmerson Dispersion Index = 5; pH=5.5; EC = 0.1
1A3g	Emmerson Dispersion Index = 5; pH=5.5; EC = 0.1
1B1	Emmerson Dispersion Index = 5; pH=6; EC = 0.1

Project Code: J000073
Agency Name: HESSE

Site ID: 22A

Observation ID: 1

Site Information

Desc. By: I. Hollingsworth

Locality: Similar to 2A, 30% qz gravel, 2 % ferricrete out crop moderately deep

Date Desc.: 05/10/18

Elevation: 7 metres

Map Ref.: GPS S.A. Off

Rainfall: 1500

Northing/Long.: 8593197 AMG zone: 52

Runoff: Slow

Easting/Lat.: 667890 Datum:

Drainage: Imperfectly drained

Geology

Exposure Type: Auger boring

Conf. Sub. is Parent. Mat.: Almost certain or certain

Geol. Ref.: Czl

Substrate Material: Auger boring, 0.5 m deep, Porous, ,

Ferricrete

Land Form

Rel/Slope Class: Gently undulating rises 9-30m 1-3%

Pattern Type: Rises

Morph. Type: Flat

Relief: 4 metres

Elem. Type: Plain

Slope Category: Level

Slope: 0.5 %

Aspect: No Data

Surface Soil Condition (dry):

Erosion:

Soil Classification

Australian Soil Classification:

Mapping Unit: 7a2

Ferric Mesotrophic Brown Kandosol Medium Moderately gravelly Sandy Loamy Moderately deep

Principal Profile Form: N/A

Great Soil Group:

Red earth

Vegetation: C bleeseri woodland,

Surface Coarse Fragments: 20-50%, medium gravelly, 6-20mm, rounded, Quartz; 20-50%, medium gravelly, 6-20mm, rounded, Ferricrete

Profile Morphology

1A1	0 - 0.2 m	Dark grey (2.5YR4/1-Moist); ; Loamy sand; Dry; Slightly plastic; Normal plasticity; Slightly sticky; 20-50%, coarse gravelly, 20-60mm, subangular, dispersed, Quartz, coarse fragments; Gradual, Smooth change to -
1A3g	0.2 - 0.5 m	Grey (2.5YR5/1-Moist); ; Loamy sand; Dry; Moderately plastic; Normal plasticity; Moderately sticky; 10-20%, coarse gravelly, 20-60mm, subangular, dispersed, Quartz, coarse fragments; Gradual, Smooth change to -
1B1	0.5 - 0.6 m	Grey (10YR4/6-Moist); ; Sandy clay loam; Dry; Moderately plastic; Normal plasticity; Moderately sticky; 10-20%, coarse gravelly, 20-60mm, subangular, dispersed, Quartz, coarse fragments; Gradual, Smooth change to -
1B2m	0.6 - m	Grey (10YR4/6-Moist); ; 10-20%, coarse gravelly, 20-60mm, subangular, dispersed, Quartz, coarse fragments; Smooth change to -

Morphological Notes

1A1	Emmerson Dispersion Index = 5; pH=5.5; EC = 0.1
1A3g	Emmerson Dispersion Index = 5; pH=5.5; EC = 0.1
1B1	Emmerson Dispersion Index = 5; pH=6; EC = 0.1

Observation

Project Code: J000073
Agency Name: HESSE

Site ID: 23A

Observation ID: 1

Site Information

Desc. By: I. Hollingsworth

Locality: Similar to 2A, 30% qz gravel, 2 % ferricrete out crop moderately deep

Date Desc.: 05/10/18

Elevation: 7 metres

Map Ref.: GPS S.A. Off

Rainfall: 1500

Northing/Long.: 8592905 AMG zone: 52

Runoff: Slow

Easting/Lat.: 667709 Datum:

Drainage: Imperfectly drained

Geology

ExposureType: Auger boring

Conf. Sub. is Parent. Mat.: Almost certain or certain

Geol. Ref.: Czl

Substrate Material: Auger boring, 0.5 m deep, Porous, ,

Ferricrete

Land Form

Rel/Slope Class: Gently undulating rises 9-30m 1-3%

Pattern Type: Rises

Morph. Type: Flat

Relief: 4 metres

Elem. Type: Plain

Slope Category: Level

Slope: 0.5 %

Aspect: No Data

Surface Soil Condition (dry):

Erosion: Stable, Minor (sheet)

Soil Classification

Australian Soil Classification:

Mapping Unit: 7a2

Ferric Mesotrophic Brown Kandosol Medium Moderately gravelly Sandy Loamy Moderately deep

Principal Profile Form: N/A

Great Soil Group:

Red earth

Vegetation: C bleeseri woodland

Surface Coarse Fragments: 20-50%, medium gravelly, 6-20mm, rounded, Quartz; 20-50%, medium gravelly, 6-20mm, rounded, Ferricrete

Profile Morphology

1A1 0 - 0.2 m Dark grey (2.5YR4/1-Moist); ; Loamy sand; Dry; Slightly plastic; Normal plasticity; Slightly sticky; Gradual, Smooth change to -

1A3g 0.2 - 0.5 m Grey (2.5YR5/1-Moist); ; Loamy sand; Dry; Moderately plastic; Normal plasticity; Moderately sticky; Gradual, Smooth change to -

1B1 0.5 - 0.6 m Grey (10YR4/6-Moist); ; Sandy clay loam; Dry; Moderately plastic; Normal plasticity; Moderately sticky; Gradual, Smooth change to -

1B2m 0.6 - m Grey (10YR4/6-Moist); ; Smooth change to -

Morphological Notes

1A1 Sample 19; Emmerson Dispersion Index = 5; pH=5.5; EC = 0.1

1A3g Emmerson Dispersion Index = 5; pH=5.5; EC = 0.1

1B1 Emmerson Dispersion Index = 5; pH=6; EC = 0.1

Project Code: J000073 Site ID: 24A Observation ID: 1
Agency Name: HESSE

Site Information

Desc. By:	I. Hollingsworth	Locality:	Similar to 2A, 30% qz gravel, 2 % ferricrete out crop moderately deep
Date Desc.:	04/10/18	Elevation:	12 metres
Map Ref.:	GPS S.A. Off	Rainfall:	1500
Northing/Long.:	8592414 AMG zone: 52	Runoff:	Rapid
Easting/Lat.:	667459 Datum:	Drainage:	Well drained

Geology

Exposure Type:	Auger boring	Conf. Sub. is Parent. Mat.:	Almost certain or certain
Geol. Ref.:	Czl	Substrate Material:	Auger boring, 0.5 m deep, Porous, , Granite

Land Form

Rel/Slope Class:	Gently undulating rises 9-30m 1-3%	Pattern Type:	Rises
Morph. Type:	Upper-slope	Relief:	9 metres
Elem. Type:	Summit surface	Slope Category:	Very gently sloped
Slope:	2 %	Aspect:	No Data

Surface Soil Condition (dry):**Erosion:** Stable, Minor (sheet)**Soil Classification**

Australian Soil Classification:	Mapping Unit:	7a2
Ferric Mesotrophic Brown Kandosol Medium Moderately gravelly Sandy Loamy Moderately deep	Principal Profile Form:	N/A
Great Soil Group:	Red earth	

Vegetation: E miniata woodland**Surface Coarse Fragments:** 20-50%, medium gravelly, 6-20mm, rounded, Quartz; 20-50%, medium gravelly, 6-20mm, rounded, Ferricrete**Profile Morphology**

1A1	0 - 0.2 m	Brown (7.5YR4/4-Moist); ; Sandy loam; Dry; Slightly plastic; Normal plasticity; Slightly sticky; 20-50%, coarse gravelly, 20-60mm, rounded tabular, dispersed, Ferricrete, coarse fragments; Gradual, Smooth change to -
1B1	0.2 - 0.5 m	Strong brown (7.5YR4/6-Moist); ; Sandy clay loam; Dry; Slightly plastic; Normal plasticity; Slightly sticky; 2-10%, medium gravelly, 6-20mm, rounded tabular, dispersed, Ferricrete, coarse fragments; Gradual, Smooth change to -
1B2	0.5 - 1 m	Strong brown (7.5YR4/6-Moist); ; Light clay; Dry; Very plastic; Normal plasticity; Slightly sticky; 2-10%, medium gravelly, 6-20mm, rounded tabular, dispersed, Ferricrete, coarse fragments; Gradual, Smooth change to -
1B2	1 - 1.5 m	; Light clay; Dry; Very plastic; Normal plasticity; Slightly sticky; 2-10%, medium gravelly, 6-20mm, rounded tabular, dispersed, Ferricrete, coarse fragments; Gradual, Smooth change to -

Morphological Notes

1A1	Emmerson Dispersion Index = 5; pH=5.9; EC = 0.1
1B1	Emmerson Dispersion Index = 5; pH=6.5; EC = 0.1
1B2	Emmerson Dispersion Index = 5; pH=6.5; EC = 0.1
1B2	Emmerson Dispersion Index = 3b; pH=6.5

Project Code: J000073 **Site ID:** 25A **Observation ID:** 1
Agency Name: HESSE

Site Information

Desc. By:	I. Hollingsworth	Locality:	check site, v gravelly iron stone, vg sloping rise; same as 30a
Date Desc.:	04/10/18	Elevation:	7 metres
Map Ref.:	GPS S.A. Off	Rainfall:	1500
Northing/Long.:	8592168 AMG zone: 52	Runoff:	Rapid
Eastng/Lat.:	666893 Datum:	Drainage:	Moderately well drained

Geology

ExposureType:	Auger boring	Conf. Sub. is Parent. Mat.:	Almost certain or certain
Geol. Ref.:	Czl	Substrate Material:	Auger boring, 0.5 m deep, Porous, Ferricrete

Land Form

Rel/Slope Class:	Gently undulating rises 9-30m 1-3%	Pattern Type:	Rises
Morph. Type:	Lower-slope	Relief:	9 metres
Elem. Type:	Plain	Slope Category:	Very gently sloped
Slope:	0.5 %	Aspect:	No Data

Surface Soil Condition (dry):

Erosion: Stable, Minor (sheet)

Soil Classification

Australian Soil Classification:	Ferric Mesotrophic Brown Kandosol Medium Moderately gravelly Sandy Loamy Moderately deep	Mapping Unit:	8a2
		Principal Profile Form:	N/A
Great Soil Group:			Red earth

Vegetation: E miniata woodland

Surface Coarse Fragments: ; 20-50%, medium gravelly, 6-20mm, rounded, Ferricrete

Profile Morphology

1A1	0 - 0.2 m	Dark reddish brown (5YR3/2-Moist); ; Loamy sand; Dry; Slightly plastic; Normal plasticity; Slightly sticky; 20-50%, coarse gravelly, 20-60mm, rounded tabular, dispersed, Ferricrete, coarse fragments; Gradual, Smooth change to -
1A3	0.2 - 0.5 m	Dark reddish grey (5YR4/2-Moist); ; Sandy loam; Dry; Slightly plastic; Normal plasticity; Slightly sticky; 2-10%, medium gravelly, 6-20mm, rounded tabular, dispersed, Ferricrete, coarse fragments; Gradual, Smooth change to -
1B2	0.5 - 1 m	Yellowish red (5YR4/6-Moist); ; Light clay; Dry; Non-plastic; Normal plasticity; Moderately sticky; 2-10%, medium gravelly, 6-20mm, rounded tabular, dispersed, Ferricrete, coarse fragments; Clear, Smooth change to -
1B3	1 - 1.5 m	Yellowish red (5YR4/6-Moist); ; Sandy clay loam; Dry; Moderately plastic; Normal plasticity; Moderately sticky; 50-90%, coarse gravelly, 20-60mm, rounded tabular, dispersed, Ferricrete, coarse fragments; Gradual, Smooth change to -

Morphological Notes

1A1	Emmerson Dispersion Index = 5; pH=5.5; EC = 0.1
1A3	Emmerson Dispersion Index = 5; pH=5.5; EC = 0.1
1B2	1:5 pH 6 EC 0.1 Emmerson Dispersion Index = 3b

Project Code: J000073
Agency Name: HESSE

Site ID: 26A

Observation ID: 1

Site Information

Desc. By: I. Hollingsworth

Locality: Similar to 2A, 30% qz geavel, 2 % ferricrete out crop
moderateli deep

Date Desc.: 05/10/18

Elevation: 7 metres

Map Ref.: GPS S.A. Off

Rainfall: 1500

Northing/Long.: 8594009 AMG zone: 52

Runoff: Slow

Easting/Lat.: 668402 Datum:

Drainage: Imperfectly drained

Geology

ExposureType: Auger boring

Conf. Sub. is Parent. Mat.: Almost certain or certain

Geol. Ref.: Czl

Substrate Material: Auger boring, 0.5 m deep,Porous, ,

Ferricrete

Land Form

Rel/Slope Class: Gently undulating rises 9-30m 1-3%

Pattern Type: Rises

Morph. Type: Flat

Relief: 4 metres

Elem. Type: Plain

Slope Category: Level

Slope: 0 %

Aspect: No Data

Surface Soil Condition (dry):

Erosion: Stable, Minor (sheet)

Soil Classification

Australian Soil Classification:

Mapping Unit: 7a2

Ferric Mesotrophic Brown Kandosol Medium Moderately
gravelly Sandy Loamy Moderately deep

Principal Profile Form: N/A

Great Soil Group:

Red earth

All necessary analytical data are available.

Vegetation: C bleaseri woodland

Surface Coarse Fragments: 50-90%, medium gravelly, 6-20mm, rounded, Ferricrete

Profile Morphology

1A3 0.2 - 0.5 m Reddish brown (2.5YR4/4-Moist); ; Sandy loam; Dry; Slightly plastic; Normal plasticity; Slightly sticky; 2-10%, medium gravelly, 6-20mm, rounded tabular, dispersed, Ferricrete, coarse fragments; Gradual, Smooth change to -

1B2 0.5 - 1 m Red (2.5YR4/6-Moist); ; Sandy clay loam; Dry; Moderately plastic; Normal plasticity; Slightly sticky; 2-10%, medium gravelly, 6-20mm, rounded tabular, dispersed, Ferricrete, coarse fragments; Gradual, Smooth change to -

1A1 0 - 0.2 m Dusky red (2.5YR3/2-Moist); ; Loamy sand; Dry; Slightly plastic; Normal plasticity; Slightly sticky; 20-50%, medium gravelly, 6-20mm, rounded tabular, dispersed, Ferricrete, coarse fragments; Gradual, Smooth change to -

1B2m 1 - m Red (2.5YR4/6-Moist); ; 50-90%, medium gravelly, 6-20mm, rounded tabular, dispersed, Ferricrete, coarse fragments;

Morphological Notes

1A3 Emmerson Dispersion Index = 3b; pH=5.5

1B2 Emmerson Dispersion Index = 3b; pH=6

1A1 Emmerson Dispersion Index = 3b; pH=5.5

Project Code: J000073 Site ID: 27A Observation ID: 1
Agency Name: HESSE

Site Information

Desc. By: I. Hollingsworth

Locality: Similar to 2A, 50% gravel lag, sandstone quartz, ferricrete, 50m from boundary with mevir swamp

Date Desc.: 05/10/18

Elevation: 6 metres

Map Ref.: GPS S.A. Off

Rainfall: 1500

Northing/Long.: 8594108 AMG zone: 52

Runoff: Slow

Easting/Lat.: 668272 Datum:

Drainage: Imperfectly drained

Geology

ExposureType: Auger boring

Conf. Sub. is Parent. Mat.: Almost certain or certain

Geol. Ref.: Czl

Substrate Material: Auger boring, 0.5 m deep, Porous, ,

Ferricrete

Land Form

Rel/Slope Class: Gently undulating rises 9-30m 1-3%

Pattern Type: Rises

Morph. Type: Flat

Relief: 4 metres

Elem. Type: Plain

Slope Category: Level

Slope: 0 %

Aspect: No Data

Surface Soil Condition (dry):

Erosion: Stable, Minor (sheet)

Soil Classification

Australian Soil Classification:

Mapping Unit: 7a2

Ferric Mesotrophic Brown Kandosol Medium Moderately gravelly Sandy Loamy Moderately deep

Principal Profile Form: N/A

Great Soil Group:

Red earth

Vegetation: C bleeseri woodland

Surface Coarse Fragments: ; 20-50%, medium gravelly, 6-20mm, rounded, Ferricrete

Profile Morphology

1B2m 0.6 - m Red (2.5YR4/6-Moist); ; 50-90%, medium gravelly, 6-20mm, rounded tabular, dispersed, Ferricrete, coarse fragments; Smooth change to -

1B1 0.5 - 0.6 m Red (2.5YR4/6-Moist); ; Sandy clay loam; Dry; Moderately plastic; Normal plasticity; Moderately sticky; 2-10%, medium gravelly, 6-20mm, rounded tabular, dispersed, Ferricrete, coarse fragments; Gradual, Smooth change to -

1A3g 0.2 - 0.5 m Reddish brown (2.5YR4/4-Moist); ; Loamy sand; Dry; Moderately plastic; Normal plasticity; Moderately sticky; 2-10%, medium gravelly, 6-20mm, rounded tabular, dispersed, Ferricrete, coarse fragments; Gradual, Smooth change to -

1A1 0 - 0.2 m Dusky red (2.5YR3/2-Moist); ; Loamy sand; Dry; Slightly plastic; Normal plasticity; Slightly sticky; 20-50%, coarse gravelly, 20-60mm, subangular, dispersed, Quartz, coarse fragments; Gradual, Smooth change to -

Morphological Notes

1B1 Emmerson Dispersion Index = 5; pH=6; EC = 0.1

1A3g Emmerson Dispersion Index = 5; pH=5.5; EC = 0.1

1A1 Emmerson Dispersion Index = 5; pH=5.5; EC = 0.1

Project Code: J000073
Agency Name: HESSE

Site ID: 28A

Observation ID: 1

Site Information

Desc. By: I. Hollingsworth
Date Desc.: 04/10/18
Map Ref.: GPS S.A. Off
Northing/Long.: 8592437 AMG zone: 52
Easting/Lat.: 667174 Datum:

Locality: Check site, same as 30A
Elevation: 8 metres
Rainfall: 1500
Runoff: Rapid
Drainage: Well drained

Geology

ExposureType: Auger boring
Geol. Ref.: Czi

Conf. Sub. is Parent. Mat.: Almost certain or certain
Substrate Material: Auger boring, 0.5 m deep,, , Ferricrete

Land Form

Rel/Slope Class: Gently undulating rises 9-30m 1-3%

Pattern Type: Rises

Morph. Type: Simple-slope

Relief: 9 metres

Elem. Type: Hillslope

Slope Category: Very gently sloped

Slope: 3 %

Aspect: No Data

Surface Soil Condition (dry):

Erosion: Stable, Minor (sheet)

Soil Classification

Australian Soil Classification:
 Ferric Mesotrophic Brown Kandosol Medium Moderately
 gravelly Sandy Loamy Moderately deep

Mapping Unit: 7a2
Principal Profile Form: N/A

Great Soil Group:

Red earth

Vegetation: E miniata woodland

Surface Coarse Fragments: ; 20-50%, medium gravelly, 6-20mm, rounded, Ferricrete

Profile Morphology

1A1 0 - 0.2 m Dark reddish brown (5YR3/2-Moist); ; Loamy sand; Dry; Slightly plastic; Normal plasticity; Slightly sticky; 20-50%, coarse gravelly, 20-60mm, rounded tabular, dispersed, Ferricrete, coarse fragments; Gradual, Smooth change to -

1A3 0.2 - 0.5 m Dark reddish grey (5YR4/2-Moist); ; Sandy loam; Dry; Slightly plastic; Normal plasticity; Slightly sticky; 2-10%, medium gravelly, 6-20mm, rounded tabular, dispersed, Ferricrete, coarse fragments; Gradual, Smooth change to -

1B2m 0.5 - m ; Smooth change to -

Morphological Notes

1A1 Emmerson Dispersion Index = 5; pH=5.5; EC = 0.1
 1A3 Emmerson Dispersion Index = 5; pH=5.5; EC = 0.1

Observation

check site same as 30A

Project Code: J000073
Agency Name: HESSE

Site ID: 29A

Observation ID: 1

Site Information

Desc. By: I. Hollingsworth
Date Desc.: 04/10/18
Map Ref.: GPS S.A. Off
Northing/Long.: 8591978 AMG zone: 52
Easting/Lat.: 667275 Datum:

Locality: M viridiflora swamp, check site same as 4A
Elevation: 8 metres
Rainfall: 1500
Runoff: Slow
Drainage: Poorly drained

Geology

ExposureType: Auger boring
Geol. Ref.: Czs
 Ferricrete

Conf. Sub. is Parent. Mat.: Almost certain or certain
Substrate Material: Auger boring, 0.5 m deep, Porous, ,

Land Form

Rel/Slope Class: Gently undulating rises 9-30m 1-3%

Pattern Type: Rises

Morph. Type: Lower-slope
Elem. Type: Swamp
Slope: 0.5 %

Relief: 9 metres
Slope Category: Very gently sloped
Aspect: No Data

Surface Soil Condition (dry):

Erosion:

Soil Classification

Australian Soil Classification:
 Mesotrophic Rudosolic Oxyaquic Hydrosol Medium Moderately
 gravelly Loamy Clay-loamy Shallow

Mapping Unit: 8j1
Principal Profile Form: N/A

Vegetation: M viridiflora woodland

Surface Coarse Fragments: ; 20-50%, medium gravelly, 6-20mm, rounded, Ferricrete

Profile Morphology

1A1	0 - 0.2 m	Dark grey (2.5YR4/1-Moist); ; Loamy sand; Dry; Slightly plastic; Normal plasticity; Slightly sticky; 20-50%, coarse gravelly, 20-60mm, subangular, dispersed, Quartz, coarse fragments; Gradual, Smooth change to -
1A3g	0.2 - 0.5 m	Grey (2.5YR5/1-Moist); ; Loamy sand; Dry; Moderately plastic; Normal plasticity; Moderately sticky; 10-20%, coarse gravelly, 20-60mm, subangular, dispersed, Quartz, coarse fragments; Gradual, Smooth change to -
1B1	0.5 - 0.6 m	Grey (10YR4/6-Moist); ; Sandy clay loam; Dry; Moderately plastic; Normal plasticity; Moderately sticky; 10-20%, coarse gravelly, 20-60mm, subangular, dispersed, Quartz, coarse fragments; Gradual, Smooth change to -
1B2m	0.6 - m	Grey (10YR4/6-Moist); ; 10-20%, coarse gravelly, 20-60mm, subangular, dispersed, Quartz, coarse fragments; Smooth change to -

Morphological Notes

1A1 Emmerson Dispersion Index = 5; pH=5.5; EC = 0.1
 1A3g Emmerson Dispersion Index = 5; pH=5.5; EC = 0.1
 1B1 Emmerson Dispersion Index = 5; pH=6; EC = 0.1

Observation

Swamp , check site, same as 4A

Project Code: J000073 Site ID: 30A Observation ID: 1
Agency Name: HESSE

Site Information

Desc. By: I. Hollingsworth
Date Desc.: 04/10/18
Map Ref.: GPS S.A. Off
Northing/Long.: 8592143 AMG zone: 52
Easting/Lat.: 667769 Datum:
Locality: Gravelly ironstone, v g slope, termite mounds
Elevation: 14 metres
Rainfall: 1500
Runoff: Rapid
Drainage: Well drained

Geology

Exposure Type: Auger boring
Geol. Ref.: Czl
Conf. Sub. is Parent. Mat.: Almost certain or certain
Substrate Material: Auger boring, 0.5 m deep, Porous, , Granite

Land Form

Rel/Slope Class: Gently undulating rises 9-30m 1-3%
Morph. Type: Upper-slope
Elem. Type: Hillslope
Slope: 1 %
Pattern Type: Rises
Relief: 9 metres
Slope Category: Very gently sloped
Aspect: No Data

Surface Soil Condition (dry):**Erosion:****Soil Classification**

Australian Soil Classification:
Ferric Mesotrophic Brown Kandosol Medium Moderately
gravelly Sandy Loamy Moderately deep
Vegetation: E miniata woodland
All necessary analytical data are available.
Mapping Unit: 7a2
Principal Profile Form: N/A
Great Soil Group: Red earth

Profile Morphology

1A1 0 - 0.2 m Dusky red (2.5YR3/2-Moist); ; Loamy sand; Dry; Slightly plastic; Normal plasticity; Slightly sticky; 20-50%, medium gravelly, 6-20mm, rounded tabular, dispersed, Ferricrete, coarse fragments; Gradual, Smooth change to -
1A3 0.2 - 0.5 m Reddish brown (2.5YR4/4-Moist); ; Sandy loam; Dry; Slightly plastic; Normal plasticity; Slightly sticky; 2-10%, medium gravelly, 6-20mm, rounded tabular, dispersed, Ferricrete, coarse fragments; Gradual, Smooth change to -
1B1 0.2 - 0.6 m Red (2.5YR4/6-Moist); ; Sandy clay loam; Dry; Slightly plastic; Normal plasticity; Slightly sticky; 2-10%, medium gravelly, 6-20mm, rounded tabular, dispersed, Ferricrete, coarse fragments; Gradual, Smooth change to -
1B2m 0.6 - m Red (2.5YR4/6-Moist); ; 90-100%, medium gravelly, 6-20mm, rounded tabular, dispersed, Ferricrete, coarse fragments; Smooth change to -

Morphological Notes

1A1 Emmerson Dispersion Index = 5; pH=5.5; EC = 0.1
1A3 Emmerson Dispersion Index = 5; pH=5.5; EC = 0.1
1B1 Emmerson Dispersion Index = 5; pH=5.5; EC = 0.1

Laboratory Test Results:

Depth m	pH	1:5 EC dS/m	Ca	Exchangeable Mg	Cations K	Na Cmol (+)/kg	Exchangeabl Acidity	CEC	ECEC	ESP %
0 - 0.2	6.6A 5.8C	0.06A	1.8*	0.66	0.14		<0.1A	2.64*	2.64F	
0.2 - 0.5	6.1A 5C	0.04A	0.51*	0.38	0.049	0.1	0.16A	1.21*	1.21F	8.26
Depth m	CaCO3 %	Organic C %	Avail. P mg/kg	Total P %	Total N %	Total K %				
0 - 0.2			8.9E		0.048A	64*				
0.2 - 0.5			6.1E		<0.04A	66*				

Project Code: J000073
Agency Name: HESSE

Site ID: 31A

Observation ID: 1

Site Information

Desc. By: I. Hollingsworth
Date Desc.: 04/10/18
Map Ref.: GPS S.A. Off
Northing/Long.: 8592439 AMG zone: 52
Easting/Lat.: 666551 Datum:

Locality: Same as 10A, check site
Elevation: 4 metres
Rainfall: 1500
Runoff: Slow
Drainage: Poorly drained

Geology

Exposure Type: Auger boring
Geol. Ref.: Czs
 Ferricrete

Conf. Sub. is Parent. Mat.: Almost certain or certain
Substrate Material: Auger boring, 0.5 m deep, Porous, ,

Land Form

Rel/Slope Class: Gently undulating rises 9-30m 1-3%

Pattern Type: Rises

Morph. Type: Lower-slope
Elem. Type: Swamp
Slope: 0.5 %

Relief: 9 metres
Slope Category: Very gently sloped
Aspect: No Data

Surface Soil Condition (dry):

Erosion:

Soil Classification

Australian Soil Classification:
 Mesotrophic Rudosolic Oxyaquic Hydrosol Medium Moderately
 gravelly Loamy Clay-loamy Shallow

Mapping Unit: 8j1
Principal Profile Form: N/A

Vegetation: M viridiflora woodland

Surface Coarse Fragments:

Profile Morphology

1A11	0 - 0.25 m	, 0-0% ; Sand; Dry; Slightly plastic; Normal plasticity; Very sticky; 20-50%, medium gravelly, 6-20mm, angular tabular, dispersed, Quartz, coarse fragments; Clear, Smooth change to -
1A11	0.25 - 0.5 m	, 0-0% ; Sandy clay loam; Dry; Moderately plastic; Normal plasticity; Very sticky; 2-10%, medium gravelly, 6-20mm, angular, dispersed, Quartz, coarse fragments; Clear, Smooth change to -
1B11	0.5 - 0.75 m	Mottles, 5YR56, 10-20% , 5-15mm, Distinct; Light clay; Dry; Very plastic; Normal plasticity; Very sticky; 2-10%, coarse gravelly, 20-60mm, angular, dispersed, Quartz, coarse fragments; Soil matrix is Slightly calcareous; Clear, Smooth change to -
1B3	0.75 - 1 m	Mottles, 7.5YR56, 20-50% , 5-15mm, Distinct; Light clay; Dry; Very plastic; Normal plasticity; Very sticky; Soil matrix is Slightly calcareous; Clear, Smooth change to -

Morphological Notes

1A11	Emmerson Dispersion Index = 3b; pH=6.1;
1A11	Emmerson Dispersion Index = 3b; pH=9.3;
1B11	Emmerson Dispersion Index = 3b; pH=9.0;
1B3	Emmerson Dispersion Index = 3b; pH=9.0;

Project Code: J000073 Site ID: CH000 Observation ID: 1
 Agency Name: HESSE

Site Information

Desc. By: I. Hollingsworth
 Date Desc.: 07/10/18
 Map Ref.: GPS S.A. Off
 Northing/Long.: 8594488 AMG zone: 52
 Easting/Lat.: 668140 Datum:

Locality: Table drain
 Elevation: No Data
 Rainfall: 1500
 Runoff: No Data
 Drainage: No Data

Geology

ExposureType: Auger boring
 Geol. Ref.: Czl

Conf. Sub. is Parent. Mat.: No Data
 Substrate Material: No Data

Land Form

Rel/Slope Class: No Data
 Morph. Type: No Data
 Elem. Type: No Data
 Slope: %

Pattern Type: No Data
 Relief: No Data
 Slope Category: No Data
 Aspect: No Data

Surface Soil Condition (dry):**Soil Classification**

Australian Soil Classification:
 Ferric Mesotrophic Brown Kandosol Medium Moderately
 gravelly Sandy Loamy Moderately deep
 Great Soil Group:

Mapping Unit: 811
 Principal Profile Form: N/A
 Brown Earth

Project Code: J000073 Site ID: CH200 Observation ID: 1
 Agency Name: HESSE

Site Information

Desc. By: I. Hollingsworth
 Date Desc.: 04/10/18
 Map Ref.: GPS S.A. Off
 Northing/Long.: 8584011 AMG zone: 52
 Easting/Lat.: 668833 Datum:

Locality: BANK
 Elevation: No Data
 Rainfall: 1500
 Runoff: No Data
 Drainage: No Data

Geology

ExposureType: Auger boring
 Geol. Ref.: Czl

Conf. Sub. is Parent. Mat.: No Data
 Substrate Material: No Data

Land Form

Rel/Slope Class: No Data
 Morph. Type: No Data
 Elem. Type: No Data
 Slope: %

Pattern Type: No Data
 Relief: No Data
 Slope Category: No Data
 Aspect: No Data

Surface Soil Condition (dry):**Erosion:****Soil Classification**

Australian Soil Classification:
 Ferric Mesotrophic Brown Kandosol Medium Moderately
 gravelly Sandy Loamy Moderately deep

Mapping Unit: 8e2

Project Code: J000073 Site ID: CH1000 Observation ID: 1
 Agency Name: HESSE

Site Information

Desc. By: I. Hollingsworth Locality: Spoon drains
 Date Desc.: 04/10/18 Elevation: No Data
 Map Ref.: GPS S.A. Off Rainfall: 1500
 Northing/Long.: 8584809 AMG zone: 52 Runoff: No Data
 Easting/Lat.: 668740 Datum: Drainage: No Data

Geology

ExposureType: ExposureType: Auger boring Auger boring Conf. Sub. is Parent. Mat.:
 Conf. Sub. is Parent. Mat.: No Data No Data
 Geol. Ref.: Geol. Ref.: Czl Czl Substrate Material:
 Substrate Material: No Data No Data

Surface Soil Condition (dry):**Soil Classification**

Australian Soil Classification: Mapping Unit: 10a4
 Ferric Mesotrophic Brown Kandosol Medium Moderately

Project Code: J000073 Site ID: CH1303 Observation ID: 1
 Agency Name: HESSE

Site Information

Desc. By: I. Hollingsworth Locality: Causeway
 Date Desc.: 04/10/18 Elevation: No Data
 Map Ref.: GPS S.A. Off Rainfall: 1500
 Northing/Long.: 8586835 AMG zone: 52 Runoff: No Data
 Easting/Lat.: 668781 Datum: Drainage: No Data

Geology

ExposureType: Auger boring Conf. Sub. is Parent. Mat.: No Data
 Geol. Ref.: Czl Substrate Material: No Data

Soil Classification

Australian Soil Classification: Mapping Unit: 8a2
 Ferric Mesotrophic Brown Kandosol Medium Moderately
 gravelly Sandy Loamy Moderately deep

Project Code: J000073 Site ID: CH1500 Observation ID: 1
 Agency Name: HESSE

Site Information

Desc. By: I. Hollingsworth Locality: Bank top of slope
 Date Desc.: 04/10/18 Elevation: No Data
 Map Ref.: GPS S.A. Off Rainfall: 1500
 Northing/Long.: 8585325 AMG zone: 52 Runoff: No Data
 Easting/Lat.: 668738 Datum: Drainage: No Data

Geology

ExposureType: Auger boring Conf. Sub. is Parent. Mat.: No Data
 Geol. Ref.: Czl Substrate Material: No Data

Project Name:
 Project Code: J000073 Site ID: CH1900 Observation ID: 1
 Agency Name: HESSE

Site Information

Desc. By: I. Hollingsworth Locality: Causeway
 Date Desc.: 04/10/18 Elevation: No Data
 Map Ref.: GPS S.A. Off Rainfall: 1500
 Northing/Long.: 8585700 AMG zone: 52 Runoff: No Data
 Easting/Lat.: 668744 Datum: Drainage: No Data

Geology

ExposureType: Auger boring Conf. Sub. is Parent. Mat.: No Data

Geol. Ref.: Czl Substrate Material: No Data

Project Code: J000073 Site ID: CH2180 Observation ID: 1
Agency Name: HESSE

Site Information

Desc. By: I. Hollingsworth
Date Desc.: 04/10/18
Map Ref.: GPS S.A. Off
Northing/Long.: 8585956 AMG zone: 52
Easting/Lat.: 668755 Datum:

Locality: Causeway
Elevation: No Data
Rainfall: 1500
Runoff: No Data
Drainage: No Data

Geology

ExposureType: Auger boring
Geol. Ref.: Czl

Conf. Sub. is Parent. Mat.: No Data
Substrate Material: No Data

Australian Soil Classification:

Mapping Unit: 10a1

Project Code: J000073 Site ID: CH2600 Observation ID: 1
Agency Name: HESSE

Site Information

Desc. By: I. Hollingsworth
Date Desc.: 04/10/18
Map Ref.: GPS S.A. Off
Northing/Long.: 8586408 AMG zone: 52
Easting/Lat.: 668751 Datum:

Locality: Bank at top of slope, table drain and spoon drains to causeway
Elevation: No Data
Rainfall: 1500
Runoff: No Data
Drainage: No Data

Geology

ExposureType: Auger boring
Geol. Ref.: Czl

Conf. Sub. is Parent. Mat.: No Data
Substrate Material: No Data

Australian Soil Classification:

Mapping Unit: 7e1

Project Name:
Project Code: J000073 Site ID: CH3080 Observation ID: 1
Agency Name: HESSE

Site Information

Desc. By: I. Hollingsworth
Date Desc.: 04/10/18
Map Ref.: GPS S.A. Off
Northing/Long.: 8586886 AMG zone: 52
Easting/Lat.: 668769 Datum:

Locality: Banks, spoon drains to top of slope
Elevation: No Data
Rainfall: 1500
Runoff: No Data
Drainage: No Data

Geology

ExposureType: Auger boring
Geol. Ref.: Czl

Conf. Sub. is Parent. Mat.: No Data
Substrate Material: No Data

Australian Soil Classification:

Mapping Unit: 10e1

Hydrosols, very poorly drained

Project Code: J000073 Site ID: CH3450 Observation ID: 1
Agency Name: HESSE

Site Information

Desc. By: I. Hollingsworth
Date Desc.: 04/10/18
Map Ref.: GPS S.A. Off
Northing/Long.: 8587248 AMG zone: 52
Easting/Lat.: 668754 Datum:

Locality: Top of slope
Elevation: No Data
Rainfall: 1500
Runoff: No Data
Drainage: No Data

Geology

ExposureType: Auger boring
Geol. Ref.: Czl

Conf. Sub. is Parent. Mat.: No Data
Substrate Material: No Data

Australian Soil Classification:
Gravelly Brown Kandosol

Mapping Unit: 8c2

Project Code: J000073 **Site ID:** CH3600 **Observation ID:** 1
Agency Name: HESSE

Site Information

Desc. By: I. Hollingsworth	Locality: Bottom of slope banks spoon drains
Date Desc.: 04/10/18	Elevation: No Data
Map Ref.: GPS S.A. Off	Rainfall: 1500
Northing/Long.: 8587402 AMG zone: 52	Runoff: No Data
Easting/Lat.: 668728 Datum:	Drainage: No Data

Geology

ExposureType: Auger boring	Conf. Sub. is Parent. Mat.: No Data
Geol. Ref.: Czl	Substrate Material: No Data

Soil Classification

Australian Soil Classification: **Mapping Unit:** 10a1
Hydrosols, poorly drained

Project Code: J000073 **Site ID:** CH3750 **Observation ID:** 1
Agency Name: HESSE

Site Information

Desc. By: I. Hollingsworth	Locality: Top of slope
Date Desc.: 04/10/18	Elevation: No Data
Map Ref.: GPS S.A. Off	Rainfall: 1500
Northing/Long.: 8587570 AMG zone: 52	Runoff: No Data
Easting/Lat.: 668757 Datum:	Drainage: No Data

Geology

ExposureType: Auger boring	Conf. Sub. is Parent. Mat.: No Data
Geol. Ref.: Czs	Substrate Material: No Data

Australian Soil Classification: **Mapping Unit:** 7a2
Ferric Mesotrophic Brown Kandosol Medium Moderately
gravelly Sandy Loamy Moderately deep **Principal Profile Form:** N/A

Project Code: J000073 **Site ID:** CH4500 **Observation ID:** 1
Agency Name: HESSE

Site Information

Desc. By: I. Hollingsworth	Locality: Plateau gravel
Date Desc.: 04/10/18	Elevation: No Data
Map Ref.: GPS S.A. Off	Rainfall: 1500
Northing/Long.: 8588291 AMG zone: 52	Runoff: No Data
Easting/Lat.: 668767 Datum:	Drainage: No Data

Geology

ExposureType: Auger boring	Conf. Sub. is Parent. Mat.: No Data
Geol. Ref.: Czs	Substrate Material: No Data

Australian Soil Classification: **Mapping Unit:** 8i1
Acidic Petroferric Orthic Tenosol Medium Very gravelly Sandy
Sandy Shallow

Project Code: J000073 **Site ID:** CH4700 **Observation ID:** 1
Agency Name: HESSE

Site Information

Desc. By: I. Hollingsworth	Locality: Long gentle slope, mitre drains, sandy gravel
Date Desc.: 04/10/18	Elevation: No Data
Map Ref.: GPS S.A. Off	Rainfall: 1500
Northing/Long.: 8588497 AMG zone: 52	Runoff: No Data
Easting/Lat.: 668750 Datum:	Drainage: No Data

Geology

ExposureType: Auger boring	Conf. Sub. is Parent. Mat.: No Data
Geol. Ref.: Czs	Substrate Material: No Data

Australian Soil Classification:

Acidic Petroferric Orthic Tenosol Medium Moderately gravelly
Sandy Sandy Moderately deep

Mapping Unit:

8i1

Principal Profile Form:

N/A

Project Code: J000073**Site ID:** CH5100**Observation ID:** 1**Agency Name:** HESSE**Site Information****Desc. By:** I. Hollingsworth**Date Desc.:** 04/10/18**Map Ref.:** GPS S.A. Off**Northing/Long.:** 8588892 AMG zone: 52**Easting/Lat.:** 668763 Datum:**Locality:** Top of steep slope, bank, road drainage**Elevation:** No Data**Rainfall:** 1500**Runoff:** No Data**Drainage:** No Data**Geology****ExposureType:** Auger boring**Geol. Ref.:** Czs**Conf. Sub. is Parent. Mat.:** No Data**Substrate Material:** No Data**Australian Soil Classification:**

Ferric Mesotrophic Brown Kandosol Moderately
gravelly Sandy Loamy Moderately deep

Mapping Unit:

7a2

Project Code: J000073**Site ID:** CH5200**Observation ID:** 1**Agency Name:** HESSE**Site Information****Desc. By:** I. Hollingsworth**Date Desc.:** 04/10/18**Map Ref.:** GPS S.A. Off**Northing/Long.:** 8589007 AMG zone: 52**Easting/Lat.:** 668762 Datum:**Locality:** Causeway**Elevation:** No Data**Rainfall:** 1500**Runoff:** No Data**Drainage:** No Data**Geology****ExposureType:** Auger boring**Geol. Ref.:** Czs**Conf. Sub. is Parent. Mat.:** No Data**Substrate Material:** No Data**Australian Soil Classification:**

Mesotrophic Rudosolic Oxyaquic Hydrosol Medium Moderately
gravelly Loamy Shallow Moderately gravelly

Mapping Unit:

10a3

Principal Profile Form:

N/A

Project Code: J000073**Site ID:** CH5310**Observation ID:** 1**Agency Name:** HESSE**Site Information****Desc. By:** I. Hollingsworth**Date Desc.:** 04/10/18**Map Ref.:** GPS S.A. Off**Northing/Long.:** 8589078 AMG zone: 52**Easting/Lat.:** 668775 Datum:**Locality:** Bank top of slope**Elevation:** No Data**Rainfall:** 1500**Runoff:** No Data**Drainage:** No Data**Geology****ExposureType:** Auger boring**Geol. Ref.:** Czl**Conf. Sub. is Parent. Mat.:** No Data**Substrate Material:** No Data**Project Code:** J000073**Site ID:** CH6280**Observation ID:** 1**Agency Name:** HESSE**Site Information****Desc. By:** I. Hollingsworth**Date Desc.:** 04/10/18**Map Ref.:** GPS S.A. Off**Northing/Long.:** 8590062 AMG zone: 52**Easting/Lat.:** 668769 Datum:**Locality:** Bank at top of slope**Elevation:** No Data**Rainfall:** 1500**Runoff:** No Data**Drainage:** No Data**Geology****ExposureType:** Auger boring**Geol. Ref.:** Czs**Conf. Sub. is Parent. Mat.:** No Data**Substrate Material:** No Data**Australian Soil Classification:****Mapping Unit:**

8d3

Ferric Mesotrophic Brown Kandosol Medium Moderately
gravelly Sandy Loamy Moderately deep

Principal Profile Form: N/A

APPENDIX B Laboratory reports

CERTIFICATE OF ANALYSIS

Work Order : **EB1824560**
Client : **HORIZON ENVIRONMENTAL, SOIL SURVEY & EVALUATION**
Contact : DR IAN HOLLINGSWORTH
Address : 38 WITHERDEN STREET
 NAKARA NT 0810
Telephone : ----
Project : J000072 SEA FARMS PROJECT SEA DRAGON STAGE 1
Order number :
C-O-C number : ----
Sampler : ----
Site : ----
Quote number : SY-198-18
No. of samples received : 30
No. of samples analysed : 30

Page : 1 of 8
Laboratory : Environmental Division Brisbane
Contact : Customer Services EB
Address : 2 Byth Street Stafford QLD Australia 4053
Telephone : +61-7-3243 7222
Date Samples Received : 11-Oct-2018 09:30
Date Analysis Commenced : 16-Oct-2018
Issue Date : 18-Oct-2018 11:19



This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	Position	Accreditation Category
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD

CERTIFICATE OF ANALYSIS

Work Order	: EB1826387	Page	: 1 of 7
Client	: HORIZON ENVIRONMENTAL, SOIL SURVEY & EVALUATION	Laboratory	: Environmental Division Brisbane
Contact	: DR IAN HOLLINGSWORTH	Contact	: Customer Services EB
Address	: 38 WITHERDEN STREET NAKARA NT 0810	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61-7-3243 7222
Project	: J000073 SEA FARMS PROJECT SEA DRAGON POINT CEYLON	Date Samples Received	: 01-Nov-2018 08:50
Order number	: ----	Date Analysis Commenced	: 06-Nov-2018
C-O-C number	: ----	Issue Date	: 08-Nov-2018 13:19
Sampler	: IAN HOLLINGSWORTH		
Site	: ----		
Quote number	: SY-198-18		
No. of samples received	: 24		
No. of samples analysed	: 24		



This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
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<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD



General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.

LOR = Limit of reporting

^ = This result is computed from individual analyte detections at or above the level of reporting

ø = ALS is not NATA accredited for these tests.

~ = Indicates an estimated value.

- ASS: EA033 (CRS Suite): Retained Acidity not required because pH KCl greater than or equal to 4.5
- ASS: EA033 (CRS Suite): Liming rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime (CaCO₃) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor reactivity of lime. For conversion of Liming Rate from 'kg/t dry weight' to 'kg/m³ in-situ soil', multiply 'reported results' x 'wet bulk density of soil in t/m³'.



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	23-10-18 12:30	23-10-18 12:30	23-10-18 12:30	23-10-18 12:30	23-10-18 12:30
Client sampling date / time					01-Nov-2018 00:00	01-Nov-2018 00:00	01-Nov-2018 00:00	01-Nov-2018 00:00	01-Nov-2018 00:00
Compound	CAS Number	LOR	Unit		EB1826387-001	EB1826387-002	EB1826387-003	EB1826387-004	EB1826387-005
					Result	Result	Result	Result	Result
EA033-A: Actual Acidity									
pH KCl (23A)	----	0.1	pH Unit		6.4	5.9	5.2	5.6	5.1
Titratable Actual Acidity (23F)	----	2	mole H+ / t		<2	4	12	9	16
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S		<0.02	<0.02	<0.02	<0.02	0.03
EA033-B: Potential Acidity									
Chromium Reducible Sulfur (22B)	----	0.005	% S		0.006	0.015	0.016	0.006	0.012
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t		<10	<10	<10	<10	<10
EA033-E: Acid Base Accounting									
ANC Fineness Factor	----	0.5	-		1.5	1.5	1.5	1.5	1.5
Net Acidity (sulfur units)	----	0.02	% S		<0.02	0.02	0.04	0.02	0.04
Net Acidity (acidity units)	----	10	mole H+ / t		<10	13	22	13	24
Liming Rate	----	1	kg CaCO3/t		<1	<1	2	<1	2
Net Acidity excluding ANC (sulfur units)	----	0.02	% S		<0.02	0.02	0.04	0.02	0.04
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t		<10	13	22	13	24
Liming Rate excluding ANC	----	1	kg CaCO3/t		<1	<1	2	<1	2



Analytical Results

Sub-Matrix: SOIL
 (Matrix: SOIL)

Client sample ID

				23-10-18 12:30	23-10-18 13:00 PM	23-10-18 13:00 PM	23-10-18 13:00 PM	23-10-18 13:00 PM
Client sampling date / time				01-Nov-2018 00:00	01-Nov-2018 00:00	01-Nov-2018 00:00	01-Nov-2018 00:00	01-Nov-2018 00:00
Compound	CAS Number	LOR	Unit	EB1826387-006	EB1826387-007	EB1826387-008	EB1826387-009	EB1826387-010
				Result	Result	Result	Result	Result
EA033-A: Actual Acidity								
pH KCl (23A)	----	0.1	pH Unit	5.0	5.6	5.9	5.2	5.2
Titratable Actual Acidity (23F)	----	2	mole H+ / t	19	5	3	14	12
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	0.03	<0.02	<0.02	0.02	0.02
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)	----	0.005	% S	0.010	0.006	0.018	0.006	0.016
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	<10	11	<10	<10
EA033-E: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	1.5	1.5	1.5	1.5	1.5
Net Acidity (sulfur units)	----	0.02	% S	0.04	<0.02	0.02	0.03	0.04
Net Acidity (acidity units)	----	10	mole H+ / t	25	<10	14	17	22
Liming Rate	----	1	kg CaCO3/t	2	<1	1	1	2
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	0.04	<0.02	0.02	0.03	0.04
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	25	<10	14	17	22
Liming Rate excluding ANC	----	1	kg CaCO3/t	2	<1	1	1	2



Analytical Results

Sub-Matrix: SOIL
(Matrix: SOIL)

Client sample ID

				23-10-18 13:00 PM	23-10-18 13:00 PM	23-10-18 13:30 PM	23-10-18 13:30 PM	23-10-18 13:30 PM
Client sampling date / time				01-Nov-2018 00:00	01-Nov-2018 00:00	01-Nov-2018 00:00	01-Nov-2018 00:00	01-Nov-2018 00:00
Compound	CAS Number	LOR	Unit	EB1826387-011	EB1826387-012	EB1826387-013	EB1826387-014	EB1826387-015
				Result	Result	Result	Result	Result
EA033-A: Actual Acidity								
pH KCl (23A)	----	0.1	pH Unit	5.1	4.9	6.1	9.3	9.0
Titratable Actual Acidity (23F)	----	2	mole H+ / t	15	18	7	<2	<2
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	0.02	0.03	<0.02	<0.02	<0.02
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)	----	0.005	% S	0.009	0.006	0.011	0.006	0.006
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	<10	<10	<10	<10
EA033-C: Acid Neutralising Capacity								
Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	----	----	----	27.0	7.34
acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	----	----	----	5390	1470
sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	----	----	----	8.64	2.35
EA033-E: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	1.5	1.5	1.5	1.5	1.5
Net Acidity (sulfur units)	----	0.02	% S	0.03	0.03	0.02	<0.02	<0.02
Net Acidity (acidity units)	----	10	mole H+ / t	21	22	14	<10	<10
Liming Rate	----	1	kg CaCO3/t	2	2	1	<1	<1
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	0.03	0.03	0.02	<0.02	<0.02
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	21	22	14	<10	<10
Liming Rate excluding ANC	----	1	kg CaCO3/t	2	2	1	<1	<1



Analytical Results

Sub-Matrix: SOIL
(Matrix: SOIL)

Client sample ID

				23-10-18 13:30 PM	23-10-18 13:30 PM	23-10-18 13:30 PM	23-10-18 14:00 PM	23-10-18 14:00 PM
Client sampling date / time				01-Nov-2018 00:00	01-Nov-2018 00:00	01-Nov-2018 00:00	01-Nov-2018 00:00	01-Nov-2018 00:00
Compound	CAS Number	LOR	Unit	EB1826387-016	EB1826387-017	EB1826387-018	EB1826387-019	EB1826387-020
				Result	Result	Result	Result	Result
EA033-A: Actual Acidity								
pH KCl (23A)	----	0.1	pH Unit	9.0	9.2	9.5	7.2	9.1
Titrateable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	<2	<2	<2
sulfidic - Titrateable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	<0.02	<0.02	<0.02
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)	----	0.005	% S	0.006	0.007	0.006	0.012	0.006
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	<10	<10	<10	<10
EA033-C: Acid Neutralising Capacity								
Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	17.7	20.6	19.3	1.57	10.0
acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	3540	4110	3860	315	2010
sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	5.68	6.58	6.19	0.50	3.22
EA033-E: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	1.5	1.5	1.5	1.5	1.5
Net Acidity (sulfur units)	----	0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
Net Acidity (acidity units)	----	10	mole H+ / t	<10	<10	<10	<10	<10
Liming Rate	----	1	kg CaCO3/t	<1	<1	<1	<1	<1
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	<10	<10	<10	<10	<10
Liming Rate excluding ANC	----	1	kg CaCO3/t	<1	<1	<1	<1	<1

CERTIFICATE OF ANALYSIS

Work Order	: EB1826387	Page	: 1 of 7
Amendment	: 1		
Client	: HORIZON ENVIRONMENTAL, SOIL SURVEY & EVALUATION	Laboratory	: Environmental Division Brisbane
Contact	: DR IAN HOLLINGSWORTH	Contact	: Customer Services EB
Address	: 38 WITHERDEN STREET NAKARA NT 0810	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61-7-3243 7222
Project	: J000073 SEA FARMS PROJECT SEA DRAGON POINT CEYLON	Date Samples Received	: 01-Nov-2018 08:50
Order number	: ----	Date Analysis Commenced	: 06-Nov-2018
C-O-C number	: ----	Issue Date	: 11-Dec-2018 06:32
Sampler	: IAN HOLLINGSWORTH		
Site	: ----		
Quote number	: SY-198-18		
No. of samples received	: 24		
No. of samples analysed	: 24		



Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

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- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD



General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.

LOR = Limit of reporting

^ = This result is computed from individual analyte detections at or above the level of reporting

ø = ALS is not NATA accredited for these tests.

~ = Indicates an estimated value.

- ASS: EA033 (CRS Suite): Retained Acidity not required because pH KCl greater than or equal to 4.5
- This report has been amended following the correction of sample ID's, dates & times.
- ASS: EA033 (CRS Suite): Liming rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime (CaCO₃) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor reactivity of lime. For conversion of Liming Rate from 'kg/t dry weight' to 'kg/m³ in-situ soil', multiply 'reported results' x 'wet bulk density of soil in t/m³'.



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID				
Client sampling date / time				1	2	3	4	5
Compound				23-Oct-2018 12:30	23-Oct-2018 12:30	23-Oct-2018 12:30	23-Oct-2018 12:30	23-Oct-2018 12:30
CAS Number	LOR	Unit		EB1826387-001	EB1826387-002	EB1826387-003	EB1826387-004	EB1826387-005
				Result	Result	Result	Result	Result
EA033-A: Actual Acidity								
pH KCl (23A)	----	0.1	pH Unit	6.4	5.9	5.2	5.6	5.1
Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	4	12	9	16
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	<0.02	<0.02	0.03
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)	----	0.005	% S	0.006	0.015	0.016	0.006	0.012
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	<10	<10	<10	<10
EA033-E: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	1.5	1.5	1.5	1.5	1.5
Net Acidity (sulfur units)	----	0.02	% S	<0.02	0.02	0.04	0.02	0.04
Net Acidity (acidity units)	----	10	mole H+ / t	<10	13	22	13	24
Liming Rate	----	1	kg CaCO3/t	<1	<1	2	<1	2
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	<0.02	0.02	0.04	0.02	0.04
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	<10	13	22	13	24
Liming Rate excluding ANC	----	1	kg CaCO3/t	<1	<1	2	<1	2



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID				
				6	7	8	9	10
Client sampling date / time				23-Oct-2018 12:30	23-Oct-2018 13:00	23-Oct-2018 13:00	23-Oct-2018 13:00	23-Oct-2018 13:00
Compound	CAS Number	LOR	Unit	EB1826387-006	EB1826387-007	EB1826387-008	EB1826387-009	EB1826387-010
				Result	Result	Result	Result	Result
EA033-A: Actual Acidity								
pH KCl (23A)	----	0.1	pH Unit	5.0	5.6	5.9	5.2	5.2
Titratable Actual Acidity (23F)	----	2	mole H+ / t	19	5	3	14	12
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	0.03	<0.02	<0.02	0.02	0.02
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)	----	0.005	% S	0.010	0.006	0.018	0.006	0.016
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	<10	11	<10	<10
EA033-E: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	1.5	1.5	1.5	1.5	1.5
Net Acidity (sulfur units)	----	0.02	% S	0.04	<0.02	0.02	0.03	0.04
Net Acidity (acidity units)	----	10	mole H+ / t	25	<10	14	17	22
Liming Rate	----	1	kg CaCO3/t	2	<1	1	1	2
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	0.04	<0.02	0.02	0.03	0.04
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	25	<10	14	17	22
Liming Rate excluding ANC	----	1	kg CaCO3/t	2	<1	1	1	2



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	11	12	13	14	15
Client sampling date / time					23-Oct-2018 13:00	23-Oct-2018 13:00	23-Oct-2018 13:30	23-Oct-2018 13:30	23-Oct-2018 13:30
Compound	CAS Number	LOR	Unit		EB1826387-011	EB1826387-012	EB1826387-013	EB1826387-014	EB1826387-015
					Result	Result	Result	Result	Result
EA033-A: Actual Acidity									
pH KCl (23A)	----	0.1	pH Unit		5.1	4.9	6.1	9.3	9.0
Titratable Actual Acidity (23F)	----	2	mole H+ / t		15	18	7	<2	<2
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S		0.02	0.03	<0.02	<0.02	<0.02
EA033-B: Potential Acidity									
Chromium Reducible Sulfur (22B)	----	0.005	% S		0.009	0.006	0.011	0.006	0.006
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t		<10	<10	<10	<10	<10
EA033-C: Acid Neutralising Capacity									
Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3		----	----	----	27.0	7.34
acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t		----	----	----	5390	1470
sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S		----	----	----	8.64	2.35
EA033-E: Acid Base Accounting									
ANC Fineness Factor	----	0.5	-		1.5	1.5	1.5	1.5	1.5
Net Acidity (sulfur units)	----	0.02	% S		0.03	0.03	0.02	<0.02	<0.02
Net Acidity (acidity units)	----	10	mole H+ / t		21	22	14	<10	<10
Liming Rate	----	1	kg CaCO3/t		2	2	1	<1	<1
Net Acidity excluding ANC (sulfur units)	----	0.02	% S		0.03	0.03	0.02	<0.02	<0.02
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t		21	22	14	<10	<10
Liming Rate excluding ANC	----	1	kg CaCO3/t		2	2	1	<1	<1



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	16	17	18	19	20
Client sampling date / time					23-Oct-2018 13:30	23-Oct-2018 13:30	23-Oct-2018 13:30	23-Oct-2018 14:00	23-Oct-2018 14:00
Compound	CAS Number	LOR	Unit		EB1826387-016	EB1826387-017	EB1826387-018	EB1826387-019	EB1826387-020
					Result	Result	Result	Result	Result
EA033-A: Actual Acidity									
pH KCl (23A)	----	0.1	pH Unit		9.0	9.2	9.5	7.2	9.1
Titratable Actual Acidity (23F)	----	2	mole H+ / t		<2	<2	<2	<2	<2
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S		<0.02	<0.02	<0.02	<0.02	<0.02
EA033-B: Potential Acidity									
Chromium Reducible Sulfur (22B)	----	0.005	% S		0.006	0.007	0.006	0.012	0.006
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t		<10	<10	<10	<10	<10
EA033-C: Acid Neutralising Capacity									
Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3		17.7	20.6	19.3	1.57	10.0
acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t		3540	4110	3860	315	2010
sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S		5.68	6.58	6.19	0.50	3.22
EA033-E: Acid Base Accounting									
ANC Fineness Factor	----	0.5	-		1.5	1.5	1.5	1.5	1.5
Net Acidity (sulfur units)	----	0.02	% S		<0.02	<0.02	<0.02	<0.02	<0.02
Net Acidity (acidity units)	----	10	mole H+ / t		<10	<10	<10	<10	<10
Liming Rate	----	1	kg CaCO3/t		<1	<1	<1	<1	<1
Net Acidity excluding ANC (sulfur units)	----	0.02	% S		<0.02	<0.02	<0.02	<0.02	<0.02
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t		<10	<10	<10	<10	<10
Liming Rate excluding ANC	----	1	kg CaCO3/t		<1	<1	<1	<1	<1



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	21	22	23	24	----
Client sampling date / time					23-Oct-2018 14:00	23-Oct-2018 14:00	23-Oct-2018 14:00	23-Oct-2018 14:00	----
Compound	CAS Number	LOR	Unit		EB1826387-021	EB1826387-022	EB1826387-023	EB1826387-024	-----
					Result	Result	Result	Result	----
EA033-A: Actual Acidity									
pH KCl (23A)	----	0.1	pH Unit		9.0	9.0	9.2	9.4	----
Titratable Actual Acidity (23F)	----	2	mole H+ / t		<2	<2	<2	<2	----
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S		<0.02	<0.02	<0.02	<0.02	----
EA033-B: Potential Acidity									
Chromium Reducible Sulfur (22B)	----	0.005	% S		<0.005	0.008	0.009	0.009	----
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t		<10	<10	<10	<10	----
EA033-C: Acid Neutralising Capacity									
Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3		8.06	18.2	18.5	21.6	----
acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t		1610	3640	3700	4310	----
sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S		2.58	5.84	5.92	6.91	----
EA033-E: Acid Base Accounting									
ANC Fineness Factor	----	0.5	-		1.5	1.5	1.5	1.5	----
Net Acidity (sulfur units)	----	0.02	% S		<0.02	<0.02	<0.02	<0.02	----
Net Acidity (acidity units)	----	10	mole H+ / t		<10	<10	<10	<10	----
Liming Rate	----	1	kg CaCO3/t		<1	<1	<1	<1	----
Net Acidity excluding ANC (sulfur units)	----	0.02	% S		<0.02	<0.02	<0.02	<0.02	----
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t		<10	<10	<10	<10	----
Liming Rate excluding ANC	----	1	kg CaCO3/t		<1	<1	<1	<1	----

SOIL ANALYSIS REPORT

Report Number: 564288

HORIZON ENVIRONMENTAL SOIL
 36 WITHERDEW ST
 NAKARA
 NT 0810



Report Authorised
 Paul Kennelly
 Laboratory Manager
 NATA Accredited Laboratory
 Number: 11958

Sample Number:	021551676	Paddock Name:	1	Date Sampled:	4-Oct-2018
Test Code:	2018-110	Sample Name:	HESSE J00073 1A	Date Received:	25-Oct-2018
Purchase Order No:	J00073 POINT CEYLON	Sample Depth:	0 to 20 cm	Date of Report:	2-Nov-2018
Grower Name:	IAN HOLLINGSWORTH				

Analyte	Result	Units	Method Code	Comments
Available Potassium ^	35	mg/kg	04-026-ICP8	Calculation
pH (1:5 CaCl2)	4.6		04-031-PH	1:5 soil/0.01M CaCl2
Total Nitrogen (Kjeldahl)	0.047	%	04-040-STOT1	
Phosphorus (Colwell)	8.6	mg/kg	04-077-COL_PK	0.5M NaHCO3 (pH 8.5)
Potassium (Colwell)	42	mg/kg	04-077-COL_PK	0.5M NaHCO3 (pH 8.5)
Potassium (Amm-acet.)	0.089	cmol(+)/kg	04-026-ICP8	
Calcium (Amm-acet.)	0.18	cmol(+)/kg	04-026-ICP8	
Magnesium (Amm-acet.)	0.19	cmol(+)/kg	04-026-ICP8	)
Sodium (Amm-acet.)	0.024	cmol(+)/kg	04-026-ICP8	
Aluminium (KCl)	50	mg/kg	04-027-ICP9	
Aluminium (KCl)	0.56	cmol(+)/kg	04-027-ICP9	
Cation Exchange Capacity (Amm-acet.)	1.04	cmol(+)/kg	04-026-ICP8	Calculation
Sodium % of cations	2.3	%	04-026-ICP8	Calculation
Aluminium % of Cations	54	%	04-026-ICP8	Calculation
Calcium/Magnesium Ratio	0.95		04-026-ICP8	Calculation
Sodium Adsorption Ratio (SAR, Sat. Ext.) ^	0.51		04-076-SP_ICP	Calculated from measurements
pH (1:5 Water)	5.6		04-031-PH	1:5 soil/water
Electrical Conductivity (1:5 water)	0.02	dS/m	04-031-PH	1:5 soil/water
Calcium (Sat. Ext.)	0.18	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Potassium (Sat. Ext.)	0.19	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Magnesium (Sat. Ext.)	0.30	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Sodium (Sat. Ext.)	0.25	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Sulphur ^	1.4	mg/L	04-076-SP_ICP	Measured on a Saturated Extract

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SOIL ANALYSIS REPORT

Report Number: 564289

HORIZON ENVIRONMENTAL SOIL
 36 WITHERDEW ST
 NAKARA
 NT 0810



Report Authorised
 Paul Kennelly
 Laboratory Manager
 NATA Accredited Laboratory
 Number: 11958

Sample Number:	021551646	Paddock Name:	2	Date Sampled:	4-Oct-2018
Test Code:	2018-110	Sample Name:	HESSE J00073 1A	Date Received:	25-Oct-2018
Purchase Order No:	J00073 POINT CEYLON	Sample Depth:	20 to 50 cm	Date of Report:	2-Nov-2018
Grower Name:	IAN HOLLINGSWORTH				

Analyte	Result	Units	Method Code	Comments
Available Potassium ^	27	mg/kg	04-026-ICP8	Calculation
pH (1:5 CaCl ₂)	4.6		04-031-PH	1:5 soil/0.01M CaCl ₂
Total Nitrogen (Kjeldahl)	<0.040	%	04-040-STOT1	
Phosphorus (Colwell)	7.7	mg/kg	04-077-COL_PK	0.5M NaHCO ₃ (pH 8.5)
Potassium (Colwell)	38	mg/kg	04-077-COL_PK	0.5M NaHCO ₃ (pH 8.5)
Potassium (Amm-acet.)	0.068	cmol(+)/kg	04-026-ICP8	
Calcium (Amm-acet.)	0.063	cmol(+)/kg	04-026-ICP8	
Magnesium (Amm-acet.)	0.27	cmol(+)/kg	04-026-ICP8	)
Sodium (Amm-acet.)	<0.022	cmol(+)/kg	04-026-ICP8	
Aluminium (KCl)	47	mg/kg	04-027-ICP9	
Aluminium (KCl)	0.52	cmol(+)/kg	04-027-ICP9	
Cation Exchange Capacity (Amm-acet.)	0.92	cmol(+)/kg	04-026-ICP8	Calculation
Sodium % of cations	<1	%	04-026-ICP8	Calculation
Aluminium % of Cations	57	%	04-026-ICP8	Calculation
Calcium/Magnesium Ratio	0.23		04-026-ICP8	Calculation
Sodium Adsorption Ratio (SAR, Sat. Ext.) ^	0.43		04-076-SP_ICP	Calculated from measurements
pH (1:5 Water)	5.7		04-031-PH	1:5 soil/water
Electrical Conductivity (1:5 water)	0.01	dS/m	04-031-PH	1:5 soil/water
Calcium (Sat. Ext.)	0.073	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Potassium (Sat. Ext.)	0.090	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Magnesium (Sat. Ext.)	0.20	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Sodium (Sat. Ext.)	0.16	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Sulphur ^	0.71	mg/L	04-076-SP_ICP	Measured on a Saturated Extract

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SOIL ANALYSIS REPORT

Report Number: 564290

HORIZON ENVIRONMENTAL SOIL
 36 WITHERDEW ST
 NAKARA
 NT 0810



Report Authorised
 Paul Kennelly
 Laboratory Manager
 NATA Accredited Laboratory
 Number: 11958

Sample Number:	021551683	Paddock Name:	3	Date Sampled:	4-Oct-2018
Test Code:	2018-110	Sample Name:	HESSE J00073 1A	Date Received:	25-Oct-2018
Purchase Order No:	J00073 POINT CEYLON	Sample Depth:	50 to 70 cm	Date of Report:	2-Nov-2018
Grower Name:	IAN HOLLINGSWORTH				

Analyte	Result	Units	Method Code	Comments
Available Potassium ^	18	mg/kg	04-026-ICP8	Calculation
pH (1:5 CaCl ₂)	4.8		04-031-PH	1:5 soil/0.01M CaCl ₂
Total Nitrogen (Kjeldahl)	<0.040	%	04-040-STOT1	
Phosphorus (Colwell)	15	mg/kg	04-077-COL_PK	0.5M NaHCO ₃ (pH 8.5)
Potassium (Colwell)	30	mg/kg	04-077-COL_PK	0.5M NaHCO ₃ (pH 8.5)
Potassium (Amm-acet.)	0.046	cmol(+)/kg	04-026-ICP8	
Calcium (Amm-acet.)	0.034	cmol(+)/kg	04-026-ICP8	
Magnesium (Amm-acet.)	0.37	cmol(+)/kg	04-026-ICP8	)
Sodium (Amm-acet.)	<0.022	cmol(+)/kg	04-026-ICP8	
Aluminium (KCl)	25	mg/kg	04-027-ICP9	
Aluminium (KCl)	0.27	cmol(+)/kg	04-027-ICP9	
Cation Exchange Capacity (Amm-acet.)	0.73	cmol(+)/kg	04-026-ICP8	Calculation
Sodium % of cations	<1	%	04-026-ICP8	Calculation
Aluminium % of Cations	38	%	04-026-ICP8	Calculation
Calcium/Magnesium Ratio	0.092		04-026-ICP8	Calculation
Sodium Adsorption Ratio (SAR, Sat. Ext.) ^	0.55		04-076-SP_ICP	Calculated from measurements
pH (1:5 Water)	5.9		04-031-PH	1:5 soil/water
Electrical Conductivity (1:5 water)	0.01	dS/m	04-031-PH	1:5 soil/water
Calcium (Sat. Ext.)	0.030	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Potassium (Sat. Ext.)	0.033	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Magnesium (Sat. Ext.)	0.12	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Sodium (Sat. Ext.)	0.15	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Sulphur ^	0.29	mg/L	04-076-SP_ICP	Measured on a Saturated Extract

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SOIL ANALYSIS REPORT

Report Number: 564291

HORIZON ENVIRONMENTAL SOIL
36 WITHERDEW ST
NAKARA
NT 0810



Report Authorised
Paul Kennelly
Laboratory Manager
NATA Accredited Laboratory
Number: 11958

Sample Number:	021551681	Paddock Name:	4	Date Sampled:	4-Oct-2018
Test Code:	2018-110	Sample Name:	HESSE J00073 5A	Date Received:	25-Oct-2018
Purchase Order No:	J00073 POINT CEYLON	Sample Depth:	0 to 20 cm	Date of Report:	2-Nov-2018
Grower Name:	IAN HOLLINGSWORTH				

Analyte	Result	Units	Method Code	Comments
Available Potassium ^	73	mg/kg	04-026-ICP8	Calculation
pH (1:5 CaCl ₂)	5.4		04-031-PH	1:5 soil/0.01M CaCl ₂
Total Nitrogen (Kjeldahl)	0.076	%	04-040-STOT1	
Phosphorus (Colwell)	6.1	mg/kg	04-077-COL_PK	0.5M NaHCO ₃ (pH 8.5)
Potassium (Colwell)	82	mg/kg	04-077-COL_PK	0.5M NaHCO ₃ (pH 8.5)
Potassium (Amm-acet.)	0.19	cmol(+)/kg	04-026-ICP8	
Calcium (Amm-acet.)	1.4	cmol(+)/kg	04-026-ICP8	
Magnesium (Amm-acet.)	0.74	cmol(+)/kg	04-026-ICP8	)
Sodium (Amm-acet.)	<0.022	cmol(+)/kg	04-026-ICP8	
Aluminium (KCl)	21	mg/kg	04-027-ICP9	
Aluminium (KCl)	0.24	cmol(+)/kg	04-027-ICP9	
Cation Exchange Capacity (Amm-acet.)	2.59	cmol(+)/kg	04-026-ICP8	Calculation
Sodium % of cations	<1	%	04-026-ICP8	Calculation
Aluminium % of Cations	9.1	%	04-026-ICP8	Calculation
Calcium/Magnesium Ratio	1.9		04-026-ICP8	Calculation
Sodium Adsorption Ratio (SAR, Sat. Ext.) ^	0.25		04-076-SP_ICP	Calculated from measurements
pH (1:5 Water)	6.5		04-031-PH	1:5 soil/water
Electrical Conductivity (1:5 water)	0.03	dS/m	04-031-PH	1:5 soil/water
Calcium (Sat. Ext.)	0.48	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Potassium (Sat. Ext.)	0.21	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Magnesium (Sat. Ext.)	0.67	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Sodium (Sat. Ext.)	0.19	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Sulphur ^	2.1	mg/L	04-076-SP_ICP	Measured on a Saturated Extract

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SOIL ANALYSIS REPORT

Report Number: 564292

HORIZON ENVIRONMENTAL SOIL
36 WITHERDEW ST
NAKARA
NT 0810



Report Authorised
Paul Kennelly
Laboratory Manager
NATA Accredited Laboratory
Number: 11958

Sample Number:	021551682	Paddock Name:	5	Date Sampled:	4-Oct-2018
Test Code:	2018-110	Sample Name:	HESSE J00073 5A	Date Received:	25-Oct-2018
Purchase Order No:	J00073 POINT CEYLON	Sample Depth:	20 to 50 cm	Date of Report:	2-Nov-2018
Grower Name:	IAN HOLLINGSWORTH				

Analyte	Result	Units	Method Code	Comments
Available Potassium ^	74	mg/kg	04-026-ICP8	Calculation
pH (1:5 CaCl2)	5.5		04-031-PH	1:5 soil/0.01M CaCl2
Total Nitrogen (Kjeldahl)	0.055	%	04-040-STOT1	
Phosphorus (Colwell)	6.6	mg/kg	04-077-COL_PK	0.5M NaHCO3 (pH 8.5)
Potassium (Colwell)	83	mg/kg	04-077-COL_PK	0.5M NaHCO3 (pH 8.5)
Potassium (Amm-acet.)	0.19	cmol(+)/kg	04-026-ICP8	
Calcium (Amm-acet.)	1.4	cmol(+)/kg	04-026-ICP8	
Magnesium (Amm-acet.)	0.59	cmol(+)/kg	04-026-ICP8	)
Sodium (Amm-acet.)	<0.022	cmol(+)/kg	04-026-ICP8	
Aluminium (KCl)	15	mg/kg	04-027-ICP9	
Aluminium (KCl)	0.16	cmol(+)/kg	04-027-ICP9	
Cation Exchange Capacity (Amm-acet.)	2.30	cmol(+)/kg	04-026-ICP8	Calculation
Sodium % of cations	<1	%	04-026-ICP8	Calculation
Aluminium % of Cations	7.2	%	04-026-ICP8	Calculation
Calcium/Magnesium Ratio	2.4		04-026-ICP8	Calculation
Sodium Adsorption Ratio (SAR, Sat. Ext.) ^	0.31		04-076-SP_ICP	Calculated from measurements
pH (1:5 Water)	6.6		04-031-PH	1:5 soil/water
Electrical Conductivity (1:5 water)	0.02	dS/m	04-031-PH	1:5 soil/water
Calcium (Sat. Ext.)	0.35	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Potassium (Sat. Ext.)	0.17	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Magnesium (Sat. Ext.)	0.34	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Sodium (Sat. Ext.)	0.18	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Sulphur ^	1.7	mg/L	04-076-SP_ICP	Measured on a Saturated Extract

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Toll-free: 1800 803 453 Fax: (61 3) 9974 0699

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SOIL ANALYSIS REPORT

Report Number: 564293

HORIZON ENVIRONMENTAL SOIL
 36 WITHERDEW ST
 NAKARA
 NT 0810



Report Authorised
 Paul Kennelly
 Laboratory Manager
 NATA Accredited Laboratory
 Number: 11958

Sample Number:	021551590	Paddock Name:	6	Date Sampled:	4-Oct-2018
Test Code:	2018-110	Sample Name:	HESSE J00073 5A	Date Received:	25-Oct-2018
Purchase Order No:	J00073 POINT CEYLON	Sample Depth:	50 to 100 cm	Date of Report:	2-Nov-2018
Grower Name:	IAN HOLLINGSWORTH				

Analyte	Result	Units	Method Code	Comments
Available Potassium ^	41	mg/kg	04-026-ICP8	Calculation
pH (1:5 CaCl ₂)	5.5		04-031-PH	1:5 soil/0.01M CaCl ₂
Total Nitrogen (Kjeldahl)	<0.040	%	04-040-STOT1	
Phosphorus (Colwell)	13	mg/kg	04-077-COL_PK	0.5M NaHCO ₃ (pH 8.5)
Potassium (Colwell)	56	mg/kg	04-077-COL_PK	0.5M NaHCO ₃ (pH 8.5)
Potassium (Amm-acet.)	0.10	cmol(+)/kg	04-026-ICP8	
Calcium (Amm-acet.)	0.74	cmol(+)/kg	04-026-ICP8	
Magnesium (Amm-acet.)	0.77	cmol(+)/kg	04-026-ICP8	)
Sodium (Amm-acet.)	<0.022	cmol(+)/kg	04-026-ICP8	
Aluminium (KCl)	<9.0	mg/kg	04-027-ICP9	
Aluminium (KCl)	<0.10	cmol(+)/kg	04-027-ICP9	
Cation Exchange Capacity (Amm-acet.)	1.62	cmol(+)/kg	04-026-ICP8	Calculation
Sodium % of cations	<1	%	04-026-ICP8	Calculation
Aluminium % of Cations	<1	%	04-026-ICP8	Calculation
Calcium/Magnesium Ratio	0.96		04-026-ICP8	Calculation
Sodium Adsorption Ratio (SAR, Sat. Ext.) ^	0.33		04-076-SP_ICP	Calculated from measurements
pH (1:5 Water)	6.5		04-031-PH	1:5 soil/water
Electrical Conductivity (1:5 water)	0.01	dS/m	04-031-PH	1:5 soil/water
Calcium (Sat. Ext.)	0.12	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Potassium (Sat. Ext.)	0.055	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Magnesium (Sat. Ext.)	0.14	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Sodium (Sat. Ext.)	0.12	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Sulphur ^	0.52	mg/L	04-076-SP_ICP	Measured on a Saturated Extract

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SOIL ANALYSIS REPORT

Report Number: 564294

HORIZON ENVIRONMENTAL SOIL
36 WITHERDEW ST
NAKARA
NT 0810



Report Authorised
Paul Kennelly
Laboratory Manager
NATA Accredited Laboratory
Number: 11958

Sample Number:	021551589	Paddock Name:	42	Date Sampled:	5-Oct-2018
Test Code:	2018-110	Sample Name:	HESSE J00073 3A	Date Received:	25-Oct-2018
Purchase Order No:	J00073 POINT CEYLON	Sample Depth:	0 to 20 cm	Date of Report:	2-Nov-2018
Grower Name:	IAN HOLLINGSWORTH				

Analyte	Result	Units	Method Code	Comments
Available Potassium ^	62	mg/kg	04-026-ICP8	Calculation
pH (1:5 CaCl ₂)	5.0		04-031-PH	1:5 soil/0.01M CaCl ₂
Total Nitrogen (Kjeldahl)	0.086	%	04-040-STOT1	
Phosphorus (Colwell)	7.7	mg/kg	04-077-COL_PK	0.5M NaHCO ₃ (pH 8.5)
Potassium (Colwell)	63	mg/kg	04-077-COL_PK	0.5M NaHCO ₃ (pH 8.5)
Potassium (Amm-acet.)	0.16	cmol(+)/kg	04-026-ICP8	
Calcium (Amm-acet.)	1.1	cmol(+)/kg	04-026-ICP8	
Magnesium (Amm-acet.)	0.43	cmol(+)/kg	04-026-ICP8	)
Sodium (Amm-acet.)	0.45	cmol(+)/kg	04-026-ICP8	
Aluminium (KCl)	11	mg/kg	04-027-ICP9	
Aluminium (KCl)	0.12	cmol(+)/kg	04-027-ICP9	
Cation Exchange Capacity (Amm-acet.)	2.28	cmol(+)/kg	04-026-ICP8	Calculation
Sodium % of cations	20	%	04-026-ICP8	Calculation
Aluminium % of Cations	5.2	%	04-026-ICP8	Calculation
Calcium/Magnesium Ratio	2.6		04-026-ICP8	Calculation
Sodium Adsorption Ratio (SAR, Sat. Ext.) ^	5.9		04-076-SP_ICP	Calculated from measurements
pH (1:5 Water)	5.9		04-031-PH	1:5 soil/water
Electrical Conductivity (1:5 water)	0.13	dS/m	04-031-PH	1:5 soil/water
Calcium (Sat. Ext.)	2.1	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Potassium (Sat. Ext.)	0.63	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Magnesium (Sat. Ext.)	1.9	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Sodium (Sat. Ext.)	8.3	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Sulphur ^	23	mg/L	04-076-SP_ICP	Measured on a Saturated Extract

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SOIL ANALYSIS REPORT

Report Number: 564295

HORIZON ENVIRONMENTAL SOIL
 36 WITHERDEW ST
 NAKARA
 NT 0810



Report Authorised
 Paul Kennelly
 Laboratory Manager
 NATA Accredited Laboratory
 Number: 11958

Sample Number:	021551591	Paddock Name:	43	Date Sampled:	5-Oct-2018
Test Code:	2018-110	Sample Name:	HESSE J00073 3A	Date Received:	25-Oct-2018
Purchase Order No:	J00073 POINT CEYLON	Sample Depth:	20 to 50 cm	Date of Report:	2-Nov-2018
Grower Name:	IAN HOLLINGSWORTH				

Analyte	Result	Units	Method Code	Comments
Available Potassium ^	37	mg/kg	04-026-ICP8	Calculation
pH (1:5 CaCl ₂)	4.9		04-031-PH	1:5 soil/0.01M CaCl ₂
Total Nitrogen (Kjeldahl)	0.073	%	04-040-STOT1	
Phosphorus (Colwell)	5.9	mg/kg	04-077-COL_PK	0.5M NaHCO ₃ (pH 8.5)
Potassium (Colwell)	45	mg/kg	04-077-COL_PK	0.5M NaHCO ₃ (pH 8.5)
Potassium (Amm-acet.)	0.095	cmol(+)/kg	04-026-ICP8	
Calcium (Amm-acet.)	0.52	cmol(+)/kg	04-026-ICP8	
Magnesium (Amm-acet.)	0.27	cmol(+)/kg	04-026-ICP8	)
Sodium (Amm-acet.)	0.31	cmol(+)/kg	04-026-ICP8	
Aluminium (KCl)	16	mg/kg	04-027-ICP9	
Aluminium (KCl)	0.18	cmol(+)/kg	04-027-ICP9	
Cation Exchange Capacity (Amm-acet.)	1.38	cmol(+)/kg	04-026-ICP8	Calculation
Sodium % of cations	23	%	04-026-ICP8	Calculation
Aluminium % of Cations	13	%	04-026-ICP8	Calculation
Calcium/Magnesium Ratio	1.9		04-026-ICP8	Calculation
Sodium Adsorption Ratio (SAR, Sat. Ext.) ^	7.1		04-076-SP_ICP	Calculated from measurements
pH (1:5 Water)	6.0		04-031-PH	1:5 soil/water
Electrical Conductivity (1:5 water)	0.09	dS/m	04-031-PH	1:5 soil/water
Calcium (Sat. Ext.)	0.77	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Potassium (Sat. Ext.)	0.34	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Magnesium (Sat. Ext.)	0.94	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Sodium (Sat. Ext.)	6.6	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Sulphur ^	14	mg/L	04-076-SP_ICP	Measured on a Saturated Extract

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SOIL ANALYSIS REPORT

Report Number: 564296

HORIZON ENVIRONMENTAL SOIL
 36 WITHERDEW ST
 NAKARA
 NT 0810



Report Authorised
 Paul Kennelly
 Laboratory Manager
 NATA Accredited Laboratory
 Number: 11958

Sample Number:	021551592	Paddock Name:	19	Date Sampled:	5-Oct-2018
Test Code:	2018-110	Sample Name:	HESSE J00073 4A	Date Received:	25-Oct-2018
Purchase Order No:	J00073 POINT CEYLON	Sample Depth:	0 to 20 cm	Date of Report:	2-Nov-2018
Grower Name:	IAN HOLLINGSWORTH				

Analyte	Result	Units	Method Code	Comments
Available Potassium ^	63	mg/kg	04-026-ICP8	Calculation
pH (1:5 CaCl ₂)	4.8		04-031-PH	1:5 soil/0.01M CaCl ₂
Total Nitrogen (Kjeldahl)	0.078	%	04-040-STOT1	
Phosphorus (Colwell)	13	mg/kg	04-077-COL_PK	0.5M NaHCO ₃ (pH 8.5)
Potassium (Colwell)	90	mg/kg	04-077-COL_PK	0.5M NaHCO ₃ (pH 8.5)
Potassium (Amm-acet.)	0.16	cmol(+)/kg	04-026-ICP8	
Calcium (Amm-acet.)	0.55	cmol(+)/kg	04-026-ICP8	
Magnesium (Amm-acet.)	0.63	cmol(+)/kg	04-026-ICP8	)
Sodium (Amm-acet.)	0.67	cmol(+)/kg	04-026-ICP8	
Aluminium (KCl)	23	mg/kg	04-027-ICP9	
Aluminium (KCl)	0.25	cmol(+)/kg	04-027-ICP9	
Cation Exchange Capacity (Amm-acet.)	2.26	cmol(+)/kg	04-026-ICP8	Calculation
Sodium % of cations	29	%	04-026-ICP8	Calculation
Aluminium % of Cations	11	%	04-026-ICP8	Calculation
Calcium/Magnesium Ratio	0.87		04-026-ICP8	Calculation
Sodium Adsorption Ratio (SAR, Sat. Ext.) ^	7.8		04-076-SP_ICP	Calculated from measurements
pH (1:5 Water)	5.5		04-031-PH	1:5 soil/water
Electrical Conductivity (1:5 water)	0.26	dS/m	04-031-PH	1:5 soil/water
Calcium (Sat. Ext.)	3.0	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Potassium (Sat. Ext.)	1.4	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Magnesium (Sat. Ext.)	7.6	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Sodium (Sat. Ext.)	18	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Sulphur ^	160	mg/L	04-076-SP_ICP	Measured on a Saturated Extract

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SOIL ANALYSIS REPORT

Report Number: 564297

HORIZON ENVIRONMENTAL SOIL
36 WITHERDEW ST
NAKARA
NT 0810



Report Authorised
Paul Kennelly
Laboratory Manager
NATA Accredited Laboratory
Number: 11958

Sample Number:	021551593	Paddock Name:	20	Date Sampled:	5-Oct-2018
Test Code:	2018-110	Sample Name:	HESSE J00073 30A	Date Received:	25-Oct-2018
Purchase Order No:	J00073 POINT CEYLON	Sample Depth:	0 to 20 cm	Date of Report:	2-Nov-2018
Grower Name:	IAN HOLLINGSWORTH				

Analyte	Result	Units	Method Code	Comments
Available Potassium ^	53	mg/kg	04-026-ICP8	Calculation
pH (1:5 CaCl ₂)	5.8		04-031-PH	1:5 soil/0.01M CaCl ₂
Total Nitrogen (Kjeldahl)	0.048	%	04-040-STOT1	
Phosphorus (Colwell)	8.9	mg/kg	04-077-COL_PK	0.5M NaHCO ₃ (pH 8.5)
Potassium (Colwell)	64	mg/kg	04-077-COL_PK	0.5M NaHCO ₃ (pH 8.5)
Potassium (Amm-acet.)	0.14	cmol(+)/kg	04-026-ICP8	
Calcium (Amm-acet.)	1.8	cmol(+)/kg	04-026-ICP8	
Magnesium (Amm-acet.)	0.66	cmol(+)/kg	04-026-ICP8	)
Sodium (Amm-acet.)	0.070	cmol(+)/kg	04-026-ICP8	
Aluminium (KCl)	<9.0	mg/kg	04-027-ICP9	
Aluminium (KCl)	<0.10	cmol(+)/kg	04-027-ICP9	
Cation Exchange Capacity (Amm-acet.)	2.64	cmol(+)/kg	04-026-ICP8	Calculation
Sodium % of cations	2.7	%	04-026-ICP8	Calculation
Aluminium % of Cations	<1	%	04-026-ICP8	Calculation
Calcium/Magnesium Ratio	2.7		04-026-ICP8	Calculation
Sodium Adsorption Ratio (SAR, Sat. Ext.) ^	0.85		04-076-SP_ICP	Calculated from measurements
pH (1:5 Water)	6.6		04-031-PH	1:5 soil/water
Electrical Conductivity (1:5 water)	0.06	dS/m	04-031-PH	1:5 soil/water
Calcium (Sat. Ext.)	1.9	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Potassium (Sat. Ext.)	0.46	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Magnesium (Sat. Ext.)	2.1	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Sodium (Sat. Ext.)	1.2	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Sulphur ^	24	mg/L	04-076-SP_ICP	Measured on a Saturated Extract

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SOIL ANALYSIS REPORT

Report Number: 564298

HORIZON ENVIRONMENTAL SOIL
36 WITHERDEW ST
NAKARA
NT 0810



Report Authorised
Paul Kennelly
Laboratory Manager
NATA Accredited Laboratory
Number: 11958

Sample Number:	021551596	Paddock Name:	44	Date Sampled:	5-Oct-2018
Test Code:	2018-110	Sample Name:	HESSE J00073 3A	Date Received:	25-Oct-2018
Purchase Order No:	J00073 POINT CEYLON	Sample Depth:	50 to 60 cm	Date of Report:	2-Nov-2018
Grower Name:	IAN HOLLINGSWORTH				

Analyte	Result	Units	Method Code	Comments
Available Potassium ^	24	mg/kg	04-026-ICP8	Calculation
pH (1:5 CaCl ₂)	5.0		04-031-PH	1:5 soil/0.01M CaCl ₂
Total Nitrogen (Kjeldahl)	<0.040	%	04-040-STOT1	
Phosphorus (Colwell)	7.2	mg/kg	04-077-COL_PK	0.5M NaHCO ₃ (pH 8.5)
Potassium (Colwell)	40	mg/kg	04-077-COL_PK	0.5M NaHCO ₃ (pH 8.5)
Potassium (Amm-acet.)	0.062	cmol(+)/kg	04-026-ICP8	
Calcium (Amm-acet.)	0.22	cmol(+)/kg	04-026-ICP8	
Magnesium (Amm-acet.)	0.22	cmol(+)/kg	04-026-ICP8	)
Sodium (Amm-acet.)	0.33	cmol(+)/kg	04-026-ICP8	
Aluminium (KCl)	13	mg/kg	04-027-ICP9	
Aluminium (KCl)	0.15	cmol(+)/kg	04-027-ICP9	
Cation Exchange Capacity (Amm-acet.)	0.97	cmol(+)/kg	04-026-ICP8	Calculation
Sodium % of cations	34	%	04-026-ICP8	Calculation
Aluminium % of Cations	15	%	04-026-ICP8	Calculation
Calcium/Magnesium Ratio	1.0		04-026-ICP8	Calculation
Sodium Adsorption Ratio (SAR, Sat. Ext.) ^	9.3		04-076-SP_ICP	Calculated from measurements
pH (1:5 Water)	6.0		04-031-PH	1:5 soil/water
Electrical Conductivity (1:5 water)	0.09	dS/m	04-031-PH	1:5 soil/water
Calcium (Sat. Ext.)	0.37	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Potassium (Sat. Ext.)	0.17	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Magnesium (Sat. Ext.)	0.46	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Sodium (Sat. Ext.)	6.0	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Sulphur ^	5.7	mg/L	04-076-SP_ICP	Measured on a Saturated Extract

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SOIL ANALYSIS REPORT

Report Number: 564299

HORIZON ENVIRONMENTAL SOIL
36 WITHERDEW ST
NAKARA
NT 0810



Report Authorised
Paul Kennelly
Laboratory Manager
NATA Accredited Laboratory
Number: 11958

Sample Number:	021551714	Paddock Name:	22	Date Sampled:	5-Oct-2018
Test Code:	2018-110	Sample Name:	HESSE J00073 10A	Date Received:	25-Oct-2018
Purchase Order No:	J00073 POINT CEYLON	Sample Depth:	0 to 20 cm	Date of Report:	2-Nov-2018
Grower Name:	IAN HOLLINGSWORTH				

Analyte	Result	Units	Method Code	Comments
Available Potassium ^	39	mg/kg	04-026-ICP8	Calculation
pH (1:5 CaCl ₂)	4.5		04-031-PH	1:5 soil/0.01M CaCl ₂
Total Nitrogen (Kjeldahl)	0.055	%	04-040-STOT1	
Phosphorus (Colwell)	5.9	mg/kg	04-077-COL_PK	0.5M NaHCO ₃ (pH 8.5)
Potassium (Colwell)	61	mg/kg	04-077-COL_PK	0.5M NaHCO ₃ (pH 8.5)
Potassium (Amm-acet.)	0.10	cmol(+)/kg	04-026-ICP8	
Calcium (Amm-acet.)	0.090	cmol(+)/kg	04-026-ICP8	
Magnesium (Amm-acet.)	0.47	cmol(+)/kg	04-026-ICP8	)
Sodium (Amm-acet.)	0.12	cmol(+)/kg	04-026-ICP8	
Aluminium (KCl)	59	mg/kg	04-027-ICP9	
Aluminium (KCl)	0.66	cmol(+)/kg	04-027-ICP9	
Cation Exchange Capacity (Amm-acet.)	1.44	cmol(+)/kg	04-026-ICP8	Calculation
Sodium % of cations	8.6	%	04-026-ICP8	Calculation
Aluminium % of Cations	46	%	04-026-ICP8	Calculation
Calcium/Magnesium Ratio	0.19		04-026-ICP8	Calculation
Sodium Adsorption Ratio (SAR, Sat. Ext.) ^	2.5		04-076-SP_ICP	Calculated from measurements
pH (1:5 Water)	5.5		04-031-PH	1:5 soil/water
Electrical Conductivity (1:5 water)	0.05	dS/m	04-031-PH	1:5 soil/water
Calcium (Sat. Ext.)	0.46	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Potassium (Sat. Ext.)	0.28	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Magnesium (Sat. Ext.)	1.7	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Sodium (Sat. Ext.)	2.6	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Sulphur ^	6.1	mg/L	04-076-SP_ICP	Measured on a Saturated Extract

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Nutrient Advantage is a trademark of Incitec Pivot Limited
Incitec Pivot Limited - ABN 42 004 080 264
8 South Rd, Werribee Vic 3030
Toll-free: 1800 803 453 Fax: (61 3) 9974 0699

Disclaimer: This analysis report is prepared solely for the client listed above. To the extent permitted by law, Incitec Pivot Limited excludes all liability in connection with this report and, where liability cannot be excluded, limits its liability, at its election, to the re-supply of the analysis services or the cost of the re-supply of such services

SOIL ANALYSIS REPORT

Report Number: 564300

HORIZON ENVIRONMENTAL SOIL
 36 WITHERDEW ST
 NAKARA
 NT 0810



Report Authorised
 Paul Kennelly
 Laboratory Manager
 NATA Accredited Laboratory
 Number: 11958

Sample Number:	021551715	Paddock Name:	23	Date Sampled:	5-Oct-2018
Test Code:	2018-110	Sample Name:	HESSE J00073 10A	Date Received:	25-Oct-2018
Purchase Order No:	J00073 POINT CEYLON	Sample Depth:	20 to 50 cm	Date of Report:	2-Nov-2018
Grower Name:	IAN HOLLINGSWORTH				

Analyte	Result	Units	Method Code	Comments
Available Potassium ^	19	mg/kg	04-026-ICP8	Calculation
pH (1:5 CaCl ₂)	4.5		04-031-PH	1:5 soil/0.01M CaCl ₂
Total Nitrogen (Kjeldahl)	<0.040	%	04-040-STOT1	
Phosphorus (Colwell)	<5.0	mg/kg	04-077-COL_PK	0.5M NaHCO ₃ (pH 8.5)
Potassium (Colwell)	52	mg/kg	04-077-COL_PK	0.5M NaHCO ₃ (pH 8.5)
Potassium (Amm-acet.)	0.048	cmol(+)/kg	04-026-ICP8	
Calcium (Amm-acet.)	0.093	cmol(+)/kg	04-026-ICP8	
Magnesium (Amm-acet.)	0.56	cmol(+)/kg	04-026-ICP8	)
Sodium (Amm-acet.)	0.034	cmol(+)/kg	04-026-ICP8	
Aluminium (KCl)	58	mg/kg	04-027-ICP9	
Aluminium (KCl)	0.65	cmol(+)/kg	04-027-ICP9	
Cation Exchange Capacity (Amm-acet.)	1.38	cmol(+)/kg	04-026-ICP8	Calculation
Sodium % of cations	2.4	%	04-026-ICP8	Calculation
Aluminium % of Cations	47	%	04-026-ICP8	Calculation
Calcium/Magnesium Ratio	0.17		04-026-ICP8	Calculation
Sodium Adsorption Ratio (SAR, Sat. Ext.) ^	1.2		04-076-SP_ICP	Calculated from measurements
pH (1:5 Water)	5.6		04-031-PH	1:5 soil/water
Electrical Conductivity (1:5 water)	0.02	dS/m	04-031-PH	1:5 soil/water
Calcium (Sat. Ext.)	0.11	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Potassium (Sat. Ext.)	0.13	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Magnesium (Sat. Ext.)	0.63	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Sodium (Sat. Ext.)	0.71	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Sulphur ^	2.7	mg/L	04-076-SP_ICP	Measured on a Saturated Extract

The results pertain only to the sample submitted.

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Analyses performed on soil dried at 40 °C and ground to 2mm or less.

^ NATA accreditation does not cover the performance of this service.

Accredited for compliance with ISO/IEC 17025 - Testing.

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 8 South Rd, Werribee Vic 3030
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SOIL ANALYSIS REPORT

Report Number: 564301

HORIZON ENVIRONMENTAL SOIL
 36 WITHERDEW ST
 NAKARA
 NT 0810



Report Authorised
 Paul Kennelly
 Laboratory Manager
 NATA Accredited Laboratory
 Number: 11958

Sample Number:	021551594	Paddock Name:	21	Date Sampled:	5-Oct-2018
Test Code:	2018-110	Sample Name:	HESSE J00073 30A	Date Received:	25-Oct-2018
Purchase Order No:	J00073 POINT CEYLON	Sample Depth:	20 to 50 cm	Date of Report:	2-Nov-2018
Grower Name:	IAN HOLLINGSWORTH				

Analyte	Result	Units	Method Code	Comments
Available Potassium ^	19	mg/kg	04-026-ICP8	Calculation
pH (1:5 CaCl ₂)	5.0		04-031-PH	1:5 soil/0.01M CaCl ₂
Total Nitrogen (Kjeldahl)	<0.040	%	04-040-STOT1	
Phosphorus (Colwell)	6.1	mg/kg	04-077-COL_PK	0.5M NaHCO ₃ (pH 8.5)
Potassium (Colwell)	66	mg/kg	04-077-COL_PK	0.5M NaHCO ₃ (pH 8.5)
Potassium (Amm-acet.)	0.049	cmol(+)/kg	04-026-ICP8	
Calcium (Amm-acet.)	0.51	cmol(+)/kg	04-026-ICP8	
Magnesium (Amm-acet.)	0.38	cmol(+)/kg	04-026-ICP8	)
Sodium (Amm-acet.)	0.10	cmol(+)/kg	04-026-ICP8	
Aluminium (KCl)	15	mg/kg	04-027-ICP9	
Aluminium (KCl)	0.16	cmol(+)/kg	04-027-ICP9	
Cation Exchange Capacity (Amm-acet.)	1.21	cmol(+)/kg	04-026-ICP8	Calculation
Sodium % of cations	8.6	%	04-026-ICP8	Calculation
Aluminium % of Cations	13	%	04-026-ICP8	Calculation
Calcium/Magnesium Ratio	1.3		04-026-ICP8	Calculation
Sodium Adsorption Ratio (SAR, Sat. Ext.) ^	3.1		04-076-SP_ICP	Calculated from measurements
pH (1:5 Water)	6.1		04-031-PH	1:5 soil/water
Electrical Conductivity (1:5 water)	0.04	dS/m	04-031-PH	1:5 soil/water
Calcium (Sat. Ext.)	0.54	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Potassium (Sat. Ext.)	0.26	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Magnesium (Sat. Ext.)	0.78	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Sodium (Sat. Ext.)	2.5	meq/L	04-076-SP_ICP	Measured on a Saturated Extract
Sulphur ^	13	mg/L	04-076-SP_ICP	Measured on a Saturated Extract

The results pertain only to the sample submitted.

This document shall not be reproduced except in full.

Analyses performed on soil dried at 40 °C and ground to 2mm or less.

^ NATA accreditation does not cover the performance of this service.

Accredited for compliance with ISO/IEC 17025 - Testing.

This results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national

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Disclaimer: This analysis report is prepared solely for the client listed above. To the extent permitted by law, Incitec Pivot Limited excludes all liability in connection with this report and, where liability cannot be excluded, limits its liability, at its election, to the re-supply of the analysis services or the cost of the re-supply of such services

APPENDIX C Laboratory QA/QC

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: EB1824560	Page	: 1 of 6
Client	: HORIZON ENVIRONMENTAL, SOIL SURVEY & EVALUATION	Laboratory	: Environmental Division Brisbane
Contact	: DR IAN HOLLINGSWORTH	Telephone	: +61-7-3243 7222
Project	: J000072 SEA FARMS PROJECT SEA DRAGON STAGE 1	Date Samples Received	: 11-Oct-2018
Site	: ----	Issue Date	: 18-Oct-2018
Sampler	: ----	No. of samples received	: 30
Order number	:	No. of samples analysed	: 30

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO** Method Blank value outliers occur.
- **NO** Duplicate outliers occur.
- **NO** Laboratory Control outliers occur.
- **NO** Matrix Spike outliers occur.
- For all regular sample matrices, **NO** surrogate recovery outliers occur.

Outliers : Analysis Holding Time Compliance

- **NO** Analysis Holding Time Outliers exist.

Outliers : Frequency of Quality Control Samples

- **NO** Quality Control Sample Frequency Outliers exist.

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for VOC in soils vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Evaluation: ✖ = Holding time breach ; ✔ = Within holding time.

Method		Sample Date	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA033-A: Actual Acidity								
Snap Lock Bag - frozen (EA033)		04-Oct-2018	16-Oct-2018	04-Oct-2019	✓	16-Oct-2018	14-Jan-2019	✓
7,	8,							
9,	10,							
11,	12							
Snap Lock Bag - frozen (EA033)		05-Oct-2018	16-Oct-2018	05-Oct-2019	✓	16-Oct-2018	14-Jan-2019	✓
13,	14,							
15,	16,							
17,	18,							
24,	25,							
26,	27,							
28,	29,							
30,	31,							
32,	33,							
34,	35,							
36,	37,							
38,	39,							
40,	41							

Evaluation: ✖ = Holding time breach ; ✔ = Within holding time.

Method		Sample Date	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA033-B: Potential Acidity								
Snap Lock Bag - frozen (EA033)								
7,	8,	04-Oct-2018	16-Oct-2018	04-Oct-2019	✓	16-Oct-2018	14-Jan-2019	✓
9,	10,							
11,	12							
Snap Lock Bag - frozen (EA033)								
13,	14,	05-Oct-2018	16-Oct-2018	05-Oct-2019	✓	16-Oct-2018	14-Jan-2019	✓
15,	16,							
17,	18,							
24,	25,							
26,	27,							
28,	29,							
30,	31,							
32,	33,							
34,	35,							
36,	37,							
38,	39,							
40,	41							
EA033-C: Acid Neutralising Capacity								
Snap Lock Bag - frozen (EA033)								
7,	8,	04-Oct-2018	16-Oct-2018	04-Oct-2019	✓	16-Oct-2018	14-Jan-2019	✓
9,	10,							
11,	12							
Snap Lock Bag - frozen (EA033)								
13,	14,	05-Oct-2018	16-Oct-2018	05-Oct-2019	✓	16-Oct-2018	14-Jan-2019	✓
15,	16,							
17,	18,							
24,	25,							
26,	27,							
28,	29,							
30,	31,							
32,	33,							
34,	35,							
36,	37,							
38,	39,							
40,	41							

Evaluation: ✖ = Holding time breach ; ✔ = Within holding time.

Method		Sample Date	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA033-D: Retained Acidity								
Snap Lock Bag - frozen (EA033)								
7,	8,	04-Oct-2018	16-Oct-2018	04-Oct-2019	✓	16-Oct-2018	14-Jan-2019	✓
9,	10,							
11,	12							
Snap Lock Bag - frozen (EA033)								
13,	14,	05-Oct-2018	16-Oct-2018	05-Oct-2019	✓	16-Oct-2018	14-Jan-2019	✓
15,	16,							
17,	18,							
24,	25,							
26,	27,							
28,	29,							
30,	31,							
32,	33,							
34,	35,							
36,	37,							
38,	39,							
40,	41							
EA033-E: Acid Base Accounting								
Snap Lock Bag - frozen (EA033)								
7,	8,	04-Oct-2018	16-Oct-2018	04-Oct-2019	✓	16-Oct-2018	14-Jan-2019	✓
9,	10,							
11,	12							
Snap Lock Bag - frozen (EA033)								
13,	14,	05-Oct-2018	16-Oct-2018	05-Oct-2019	✓	16-Oct-2018	14-Jan-2019	✓
15,	16,							
17,	18,							
24,	25,							
26,	27,							
28,	29,							
30,	31,							
32,	33,							
34,	35,							
36,	37,							
38,	39,							
40,	41							



Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL**

Evaluation: ✖ = Quality Control frequency not within specification ; ✔ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	Method	QC	Regular	Actual	Expected	Evaluation	
Laboratory Duplicates (DUP)							
Chromium Suite for Acid Sulphate Soils	EA033	4	40	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Chromium Suite for Acid Sulphate Soils	EA033	2	40	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Chromium Suite for Acid Sulphate Soils	EA033	2	40	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard



Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Chromium Suite for Acid Sulphate Soils	EA033	SOIL	In house: Referenced to Ahern et al 2004. This method covers the determination of Chromium Reducible Sulfur (SCR); pHKCl; titratable actual acidity (TAA); acid neutralising capacity by back titration (ANC); and net acid soluble sulfur (SNAS) which incorporates peroxide sulfur. It applies to soils and sediments (including sands) derived from coastal regions. Liming Rate is based on results for samples as submitted and incorporates a minimum safety factor of 1.5.
Preparation Methods	Method	Matrix	Method Descriptions
Drying at 85 degrees, bagging and labelling (ASS)	EN020PR	SOIL	In house



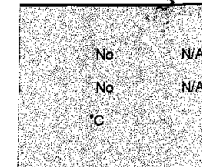
Environmental Division
Brisbane

Work Order Reference
EB1824560

ad Smithfield NSW 2164
ley@alsglobal.com
t Schile QLD 4818
nments@alsglobal.com
Woolongong NSW 2500
ls@alsglobal.com



Telephone : + 61-7-3243 7222



ED BY:

LANA AUS
DATE/TIME:
11-10-18 930

 CHAIN OF CUSTODY ALS Laboratory: please tick →	ADELAIDE 21 Burma Road Pooraka SA 5095 Ph. 08 8359 0830 E: adelaide@alsglobal.com BRISBANE 92 Shand Street Stafford QLD 4053 Ph. 07 3243 7222 E: samples.brisbane@alsglobal.com GLADSTONE 46 Calamondish Drive Clinton QLD 4650 Ph. 07 7471 5600 E: gladstone@alsglobal.com	MACKAY 78 Harbour Road Mackay QLD 4740 Ph. 07 4944 0177 E: mackay@alsglobal.com MELBOURNE 2-4 Westall Road Springvale VIC 3171 Ph. 03 8549 9600 E: samples.melbourne@alsglobal.com MUDGEE 27 Sydney Road Mudgee NSW 2850 Ph. 02 6372 6735 E: mudgee.mel@alsglobal.com	NEWCASTLE 5/585 Maitland St Ph. 02 4014 2500 E: samples.nw NOWRA 4/13 Geary Place North Nc Ph. 024423 2383 E: nowra@alsglobal PERTH 10 Hsd Way Malaga WA Ph. 08 9209 7855 E: samples.perth
---	--	--	---

CLIENT: HORIZON ENVIRONMENTAL, SOIL SUREY & EVALUATION	TURNAROUND REQUIREMENTS : ☒ Standard TAT (List due date):	COC SEQUENCE NUMBER (Circle) COC: 1 2 3 4 5 6 OF: 1 2 3 4 5 6
OFFICE:	(Standard TAT may be longer for some tests e.g.. Ultra Trace Organics) ☐ Non Standard or urgent TAT (List due date):	
PROJECT: J000072 SEA FARMS PROJECT SEA DRAGON STAGE 1	ALS QUOTE NO.: SY/198/18	
ORDER NUMBER:		
PROJECT MANAGER: IAN HOLLINGSWORTH	CONTACT PH: +61 0457 717 858	
SAMPLER: IAN HOLLINGSWORTH	SAMPLER MOBILE: +61 0457 717 858	RELINQUISHED BY: IAN HOLLINGSWORTH
COC emailed to ALS? (YES) NO	EDD FORMAT (or default):	RECEIVED BY: Lana AUS
Email Reports to (will default to PM if no other addresses are listed):		DATE/TIME: 09-10-18 1515
Email Invoice to (will default to PM if no other addresses are listed):		DATE/TIME:

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL: FROZEN STORAGE, ZIP LOCK BAG

ALS USE	SAMPLE DETAILS MATRIX: SOLID (S) WATER (W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).							Additional Information
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE codes below)	(refer to)	TOTAL CONTAINERS	EA033						Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
1		7 4/10/18 15:10	SOIL	EA033 ASS		1	1						OXIDISED Ph 4.62
2		8 4/10/18 15:10	SOIL	EA033 ASS		1	1						OXIDISED Ph 4.17
3		9 4/10/18 15:00	SOIL	EA033 ASS		1	1						OXIDISED Ph 3.47
4		10 4/10/18 15:00	SOIL	EA033 ASS		1	1						OXIDISED Ph 2.45
5		11 4/10/18 15:15	SOIL	EA033 ASS		1	1						OXIDISED Ph 2.82
6		12 4/10/18 15:15	SOIL	EA033 ASS		1	1						OXIDISED Ph 3.95
7		13 4/10/18 15:15	SOIL	EA033 ASS		1	1						OXIDISED Ph 3.05
8		14 4/10/18 15:15	SOIL	EA033 ASS		1	1						OXIDISED Ph 2.18
9		15 4/10/18 16:00	SOIL	EA033 ASS		1	1						OXIDISED Ph 2.42
10		16 4/10/18 16:00	SOIL	EA033 ASS		1	1						OXIDISED Ph 2.38
11		17 4/10/18 16:00	SOIL	EA033 ASS		1	1						OXIDISED Ph 1.52
12		18 4/10/18 16:00	SOIL	EA033 ASS		1	1						OXIDISED Ph 1.66
TOTAL						12	12						

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP = Airfreight Unpreserved Plastic
 V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
 Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag.

LAB OF ORIGIN.
DARWIN



CHAIN OF CUSTODY
ALS Laboratory:
please tick →

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GLADSTONE 46 Callamondah Drive Clinton QLD 4650
Ph: 07 7471 5800 E: gladstone@alsglobal.com

MACKAY 78 Harbour Road Mackay QLD 4740
Ph: 07 4944 0177 E: mackay@alsglobal.com

MELBOURNE 2-4 Westall Road Springvale VIC 3171
Ph: 03 8549 9800 E: samples.melbourne@alsglobal.com

MURDOGGEE 27 Sydney Road Mudgee NSW 2850
Ph: 02 5372 6735 E: mudgee@alsglobal.com

NEWCASTLE 6/585 Maitland Rd Mayfield West NSW 2304
Ph: 02 4014 2500 E: samples.newcastle@alsglobal.com

NOOWRA 4/13 Seary Place North Nowra NSW 2541
Ph: 024423 2053 E: nowra@alsglobal.com

PERTH 10 Hod Way Malaga WA 5090
Ph: 08 9209 7635 E: samples.perth@alsglobal.com

SYDNEY 277-289 Woodpark Road Smithfield NSW 2164
Ph: 02 8784 8555 E: samples.sydney@alsglobal.com

TOWNSVILLE 14-15 Desma Court Bohle QLD 4818
Ph: 07 4790 0900 E: townsville.environmental@alsglobal.com

WOLLONGONG 99 Kenny Street Wollongong NSW 2500
Ph: 02 4225 3125 E: portkemps@alsglobal.com

CLIENT: HORIZON ENVIRONMENTAL, SOIL SUREY & EVALUATION

OFFICE: *Geography & Soil & Water*

PROJECT: J000072 SEA FARMS PROJECT SEA DRAGON STAGE 1

ORDER NUMBER:

PROJECT MANAGER: IAN HOLLINGSWORTH

SAMPLER: IAN HOLLINGSWORTH

COC emailed to ALS? (YES / NO)

Email Reports to (will default to PM if no other addresses are listed):

Email Invoice to (will default to PM if no other addresses are listed):

TURNAROUND REQUIREMENTS :
(Standard TAT may be longer for some tests e.g..
Ultra Trace Organics)

ALS QUOTE NO.: SY198/18

RELINQUISHED BY:
IAN HOLLINGSWORTH

DATE/TIME:
2/10/2018 9:00AM

☒ Standard TAT (List due date):
☐ Non Standard or urgent TAT (List due date):

COC SEQUENCE NUMBER (Circle)
COC: 1 2 3 4 5 6 7
OF: 1 2 3 4 5 6 7

RECEIVED BY:
Lana JW
DATE/TIME:
09-10-18 1515

RECEIVED BY:

DATE/TIME:

FOR LABORATORY USE ONLY (Circle)

Custody Seal Intact? Yes No N/A

Free ice / frozen ice bricks present upon receipt? Yes No N/A

Random Sample Temperature on Receipt: °C

Other comment:

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL: FROZEN STORAGE, ZIP LOCK BAG

ALS USE	SAMPLE DETAILS MATRIX: SOLID (S) WATER (W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).										Additional information	
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE codes below)	(refer to)	TOTAL CONTAINERS	EA033										Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
25		36 5/10/18 15:15	S	EA033 ASS		1	1										pH ox 2.51
26		37 5/10/18 15:15	S	EA033 ASS		1	1										pH ox 2.1
27		38 5/10/18 15:15	S	EA033 ASS		1	1										pH ox 1.37
28		39 5/10/18 15:15	S	EA033 ASS		1	1										pH ox 1.92
29		40 5/10/18 15:15	S	EA033 ASS		1	1										pH ox 2.17
30		41 5/10/18 15:15	S	EA033 ASS		1	1										pH ox 2.00
TOTAL						30	30										

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP = Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag.

LAB OF ORIGIN:
DARWIN

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: EB1826387	Page	: 1 of 5
Client	: HORIZON ENVIRONMENTAL, SOIL SURVEY & EVALUATION	Laboratory	: Environmental Division Brisbane
Contact	: DR IAN HOLLINGSWORTH	Telephone	: +61-7-3243 7222
Project	: J000073 SEA FARMS PROJECT SEA DRAGON POINT CEYLON	Date Samples Received	: 01-Nov-2018
Site	: ----	Issue Date	: 08-Nov-2018
Sampler	: IAN HOLLINGSWORTH	No. of samples received	: 24
Order number	:	No. of samples analysed	: 24

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO** Method Blank value outliers occur.
- **NO** Duplicate outliers occur.
- **NO** Laboratory Control outliers occur.
- **NO** Matrix Spike outliers occur.
- For all regular sample matrices, **NO** surrogate recovery outliers occur.

Outliers : Analysis Holding Time Compliance

- **NO** Analysis Holding Time Outliers exist.

Outliers : Frequency of Quality Control Samples

- **NO** Quality Control Sample Frequency Outliers exist.



Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for VOC in soils vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **SOIL**

Evaluation: ✖ = Holding time breach ; ✔ = Within holding time.

Method	Sample Date	Extraction / Preparation			Analysis			
Container / Client Sample ID(s)		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation	
EA033-A: Actual Acidity								
80* dried soil (EA033)	01-Nov-2018	06-Nov-2018	01-Nov-2019	✔	06-Nov-2018	04-Feb-2019	✔	
23-10-18 12:30,								23-10-18 12:30,
23-10-18 12:30,								23-10-18 12:30,
23-10-18 12:30,								23-10-18 12:30,
23-10-18 13:00 PM,								23-10-18 13:00 PM,
23-10-18 13:00 PM,								23-10-18 13:00 PM,
23-10-18 13:00 PM,								23-10-18 13:00 PM,
23-10-18 13:30 PM,								23-10-18 13:30 PM,
23-10-18 13:30 PM,								23-10-18 13:30 PM,
23-10-18 13:30 PM,								23-10-18 13:30 PM,
23-10-18 14:00 PM,								23-10-18 14:00 PM,
23-10-18 14:00 PM,								23-10-18 14:00 PM,
23-10-18 14:00 PM,								23-10-18 14:00 PM,
23-10-18 14:00 PM,								23-10-18 14:00 PM,
EA033-B: Potential Acidity								
80* dried soil (EA033)	01-Nov-2018	06-Nov-2018	01-Nov-2019	✔	06-Nov-2018	04-Feb-2019	✔	
23-10-18 12:30,								23-10-18 12:30,
23-10-18 12:30,								23-10-18 12:30,
23-10-18 12:30,								23-10-18 12:30,
23-10-18 13:00 PM,								23-10-18 13:00 PM,
23-10-18 13:00 PM,								23-10-18 13:00 PM,
23-10-18 13:00 PM,								23-10-18 13:00 PM,
23-10-18 13:30 PM,								23-10-18 13:30 PM,
23-10-18 13:30 PM,								23-10-18 13:30 PM,
23-10-18 13:30 PM,								23-10-18 13:30 PM,
23-10-18 14:00 PM,								23-10-18 14:00 PM,
23-10-18 14:00 PM,								23-10-18 14:00 PM,
23-10-18 14:00 PM,								23-10-18 14:00 PM,
23-10-18 14:00 PM,								23-10-18 14:00 PM,



Matrix: **SOIL**

Evaluation: ✖ = Holding time breach ; ✔ = Within holding time.

Method		Sample Date	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA033-C: Acid Neutralising Capacity								
80* dried soil (EA033)		01-Nov-2018	06-Nov-2018	01-Nov-2019	✔	06-Nov-2018	04-Feb-2019	✔
23-10-18 12:30,	23-10-18 12:30,							
23-10-18 12:30,	23-10-18 12:30,							
23-10-18 12:30,	23-10-18 12:30,							
23-10-18 13:00 PM,	23-10-18 13:00 PM,							
23-10-18 13:00 PM,	23-10-18 13:00 PM,							
23-10-18 13:00 PM,	23-10-18 13:00 PM,							
23-10-18 13:30 PM,	23-10-18 13:30 PM,							
23-10-18 13:30 PM,	23-10-18 13:30 PM,							
23-10-18 13:30 PM,	23-10-18 13:30 PM,							
23-10-18 13:30 PM,	23-10-18 13:30 PM,							
23-10-18 14:00 PM,	23-10-18 14:00 PM,							
23-10-18 14:00 PM,	23-10-18 14:00 PM,							
23-10-18 14:00 PM,	23-10-18 14:00 PM,							
EA033-D: Retained Acidity								
80* dried soil (EA033)		01-Nov-2018	06-Nov-2018	01-Nov-2019	✔	06-Nov-2018	04-Feb-2019	✔
23-10-18 12:30,	23-10-18 12:30,							
23-10-18 12:30,	23-10-18 12:30,							
23-10-18 12:30,	23-10-18 12:30,							
23-10-18 13:00 PM,	23-10-18 13:00 PM,							
23-10-18 13:00 PM,	23-10-18 13:00 PM,							
23-10-18 13:00 PM,	23-10-18 13:00 PM,							
23-10-18 13:30 PM,	23-10-18 13:30 PM,							
23-10-18 13:30 PM,	23-10-18 13:30 PM,							
23-10-18 13:30 PM,	23-10-18 13:30 PM,							
23-10-18 13:30 PM,	23-10-18 13:30 PM,							
23-10-18 14:00 PM,	23-10-18 14:00 PM,							
23-10-18 14:00 PM,	23-10-18 14:00 PM,							
23-10-18 14:00 PM,	23-10-18 14:00 PM,							
EA033-E: Acid Base Accounting								
80* dried soil (EA033)		01-Nov-2018	06-Nov-2018	01-Nov-2019	✔	06-Nov-2018	04-Feb-2019	✔
23-10-18 12:30,	23-10-18 12:30,							
23-10-18 12:30,	23-10-18 12:30,							
23-10-18 12:30,	23-10-18 12:30,							
23-10-18 13:00 PM,	23-10-18 13:00 PM,							
23-10-18 13:00 PM,	23-10-18 13:00 PM,							
23-10-18 13:00 PM,	23-10-18 13:00 PM,							
23-10-18 13:30 PM,	23-10-18 13:30 PM,							
23-10-18 13:30 PM,	23-10-18 13:30 PM,							
23-10-18 13:30 PM,	23-10-18 13:30 PM,							
23-10-18 13:30 PM,	23-10-18 13:30 PM,							
23-10-18 14:00 PM,	23-10-18 14:00 PM,							
23-10-18 14:00 PM,	23-10-18 14:00 PM,							
23-10-18 14:00 PM,	23-10-18 14:00 PM,							



Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL**

Evaluation: ✖ = Quality Control frequency not within specification ; ✔ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	Method	QC	Regular	Actual	Expected	Evaluation	
Laboratory Duplicates (DUP)							
Chromium Suite for Acid Sulphate Soils	EA033	3	24	12.50	10.00	✔	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Chromium Suite for Acid Sulphate Soils	EA033	2	24	8.33	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Chromium Suite for Acid Sulphate Soils	EA033	2	24	8.33	5.00	✔	NEPM 2013 B3 & ALS QC Standard



Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Chromium Suite for Acid Sulphate Soils	EA033	SOIL	In house: Referenced to Ahern et al 2004. This method covers the determination of Chromium Reducible Sulfur (SCR); pHKCl; titratable actual acidity (TAA); acid neutralising capacity by back titration (ANC); and net acid soluble sulfur (SNAS) which incorporates peroxide sulfur. It applies to soils and sediments (including sands) derived from coastal regions. Liming Rate is based on results for samples as submitted and incorporates a minimum safety factor of 1.5.
Preparation Methods	Method	Matrix	Method Descriptions
Drying at 85 degrees, bagging and labelling (ASS)	EN020PR	SOIL	In house



Telephone : + 61-7-3243 7222

CHAIN OF
CUSTODYALS Laboratory
please tick →

QADELAIDE 21 Burma Road Port Adelaide SA 5095
Ph: 08 8339 0690 E: ade@alsglobal.com
QBRISBANE 32 Strand Street St. Lawrence QLD 4053
Ph: 07 5243 7222 E: samples.brisbane@alsglobal.com
QLDGLADSTONE 48 Callenmound Drive Clinton QLD 4830
Ph: 07 7471 5500 E: gladstone@alsglobal.com

QMACKAY 78 Harbour Road Mackay Q1 C 4740
Ph: 07 4541 6177 E: mackay@alsglobal.com

QMELSBORNE 2-4 Wattle Road Springvale VIC 3171
Ph: 03 8543 5500 E: samples.melbourne@alsglobal.com
QNEWCASTLE 27 Sydney Road Murrumbidgee NSW 2550
Ph: 02 6372 8735 E: murrumbidgee@alsglobal.com

QNEWCASTLE 5/565 Watland Rd Mayfield West NSW 2304
Ph: 02 4214 2500 E: samples.newcastle@alsglobal.com

QNOWRA 4/13 Geary Place North Nowra NSW 2541
Ph: 02 4423 2563 E: nowra@alsglobal.com

QPERTH 10 Red Way Manja WA 6090
Ph: 08 9209 7655 E: samples.perth@alsglobal.com

QSYDNEY 277-288 Wood
Ph: 02 8784 6555 E: samp

QTOWNSVILLE 14-16 Deane
Ph: 07 4795 0500 E: townsville

QWOLLONGONG 89 Kenny S
Ph: 02 4225 3125 E: wollongong

CLIENT: HORIZON ENVIRONMENTAL, SOIL SUREY & EVALUATION

OFFICE: 35 Macquarie Street, Sydney NSW 2000

PROJECT: J000073 SEA FARMS PROJECT SEA DRAGON POINT CEYLON

ORDER NUMBER:

PROJECT MANAGER: IAN HOLLINGSWORTH

CONTACT PH: +61 0457 717 858

SAMPLER: IAN HOLLINGSWORTH

SAMPLER MOBILE: +61 0457 717 858

COC emailed to ALS? (YES (NO))

EDD FORMAT (or default):

Email Reports to (will default to PM if no other addresses are listed):

Email Invoice to (will default to PM if no other addresses are listed):

TURNAROUND REQUIREMENTS :

☒ Standard TAT (List due date):

(Standard TAT may be longer for some tests e.g. Ultra Trace Organics)

☐ Non Standard or urgent TAT (List due date):

ALS QUOTE NO.:

SY/198/18

COC SEQUENCE NUMBER (Circle)

COC: 1 2 3 4 5 6 7

OF: 1 2 3 4 5 6 1

FOR LABORATORY USE ONLY (Circle)

Custody Seal intact?

Free ice / frozen ice bricks present upon receipt?

Random Sample Temperature on Receipt

Other comment:

RELINQUISHED BY:

IAN HOLLINGSWORTH

DATE/TIME:

1/11/2018 6:00

RECEIVED BY:

J. Smith ALS

DATE/TIME:

31-10-18 0920

RELINQUISHED BY:

L.C.

DATE/TIME:

01/11/18 0950

RECEIVED BY:

DATE/TIME:

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL: FROZEN STORAGE, ZIP LOCK BAG

ALS USE	SAMPLE DETAILS MATRIX: SOLID (S) WATER (W)			CONTAINER INFORMATION			ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).							Additional Information
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (to codes below)	(refer	TOTAL CONTAINERS	EA033							Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
	1	23-10-18 12:30	SOIL	EA033 ASS		1	1							OXIDISED pH 4.2
	2	23-10-18 12:30	SOIL	EA033 ASS		1	1							OXIDISED pH 4.5
	3	23-10-18 12:30	SOIL	EA033 ASS		1	1							OXIDISED pH 4.5
	4	23-10-18 12:30	SOIL	EA033 ASS		1	1							OXIDISED pH 4.2
	5	23-10-18 12:30	SOIL	EA033 ASS		1	1							OXIDISED pH 4.5
	6	23-10-18 12:30	SOIL	EA033 ASS		1	1							OXIDISED pH 4.7
	7	23-10-2018 13:00 PM	SOIL	EA033 ASS		1	1							OXIDISED pH 4.5
	8	23-10-2018 13:00 PM	SOIL	EA033 ASS		1	1							OXIDISED pH 4.5
	9	23-10-2018 13:00 PM	SOIL	EA033 ASS		1	1							OXIDISED pH 4.8
	10	23-10-2018 13:00 PM	SOIL	EA033 ASS		1	1							OXIDISED pH 4.5
	11	23-10-2018 13:00 PM	SOIL	EA033 ASS		1	1							OXIDISED pH 4.5
	12	23-10-2018 13:00 PM	SOIL	EA033 ASS		1	1							OXIDISED pH 4.8
TOTAL						12	12							

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP = Airfreight Unpreserved Plastic

V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass; Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag.

LAB OF ORIGIN:
DARWIN



**CHAIN OF
CUSTODY**

ALS Laboratory
please tick →

ADELAIDE 21 Burma Road Pooraka SA 5095
Ph: 08 8356 0890 E: adelaide@alsglobal.com

BRISBANE 32 Shand Street Stafford QLD 4053
Ph: 07 3243 7225 E: samples.brisbane@alsglobal.com

GLADSTONE 46 Callenondah Drive Clinton QLD 4680
Ph: 07 7471 5900 E: gladstone@alsglobal.com

MACKAY 78 Harbour Road Mackay QLD 4740
Ph: 07 4944 0177 E: mackay@alsglobal.com

MELBOURNE 2-4 Weirall Road Springvale VIC 3171
Ph: 03 9543 9600 E: samples.melbourne@alsglobal.com

MUDGEE 27 Sydney Road Mudgee NSW 2850
Ph: 02 6372 8705 E: mudgee@mail@alsglobal.com

NEWCASTLE 5/585 Maitland Rd Mayfield West NSW 2304
Ph: 02 4014 2508 E: samples.newcastle@alsglobal.com

NOOWARA 4/13 Quay Place North Noorra NSW 2941
Ph: 024423 2053 E: noorra@alsglobal.com

PERTH 10 Hod Way Malaga WA 6050
Ph: 08 9259 7695 E: samples.perth@alsglobal.com

SYDNEY 277-289 Woodpark Road Smithfield NSW 2154
Ph: 02 8784 8555 E: samples.sydney@alsglobal.com

TOWNSVILLE 14-16 Desma Court Bolnisi QLD 3818
Ph: 07 4795 0600 E: townsville.environmental@alsglobal.com

WOLLONGONG 69 Kenny Street Wollongong NSW 2500
Ph: 02 4225 2125 E: portken-nbla@alsglobal.com

CLIENT: HORIZON ENVIRONMENTAL, SOIL SUREY & EVALUATION		TURNAROUND REQUIREMENTS:		☒ Standard TAT (List due date):		FOR LABORATORY USE ONLY (Circle)	
OFFICE: 30 HILLSBORO STREET NAKARA NT 08 01		(Standard TAT may be longer for some tests e.g., Ultra Trace Organics)		☐ Non Standard or urgent TAT (List due date):		Custody Seal intact? Yes No N/A	
PROJECT: J000073 SEA FARMS PROJECT SEA DRAGON POINT CEYLON		ALS QUOTE NO.: SY/198/18		COC SEQUENCE NUMBER (Circle)		Free ice / frozen ice blocks present upon receipt? Yes No N/A	
ORDER NUMBER:				COC: 1 2 3 4 5 6 7		Random Sample Temperature on Receipt: °C	
				OF: 1 2 3 4 5 6 7		Other comment:	
PROJECT MANAGER: IAN HOLLINGSWORTH		CONTACT PH: +61 0457 717 858		RELINQUISHED BY:		RECEIVED BY:	
SAMPLER: IAN HOLLINGSWORTH		SAMPLER MOBILE: +61 0457 717 858		IAN HOLLINGSWORTH		LC	
COC emailed to ALS? (YES NO)		EDD FORMAT (or default):		DATE/TIME:		DATE/TIME:	
Email Reports to (will default to PM if no other addresses are listed):				01/11/2018 9:00am		31-10-18 0920 01/11/18 0950	
Email Invoice to (will default to PM if no other addresses are listed):							

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL: FROZEN STORAGE, ZIP LOCK BAG

ALS USE	SAMPLE DETAILS MATRIX: SOLID (S) WATER (W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).							Additional Information	
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE <i>to codes below</i>	(refer)	TOTAL CONTAINERS	EA033						Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.	
		13 23-10-2018 13:30 PM	S	EA033 ASS		1	1						OXIDISED pH 4.2	
		14 23-10-2018 13:30 PM	S	EA033 ASS		1	1						OXIDISED pH 4.2	
		15 23-10-2018 13:30 PM	S	EA033 ASS		1	1						OXIDISED pH 4.3	
		16 23-10-2018 13:30 PM	S	EA033 ASS		1	1						OXIDISED pH 4.4	
		17 23-10-2018 13:30 PM	S	EA033 ASS		1	1						OXIDISED pH 4.3	
		18 23-10-2018 13:30 PM	S	EA033 ASS		1	1						OXIDISED pH 4.2	
		19 23-10-2018 14:00 PM	S	EA033 ASS		1	1						OXIDISED pH 4.5	
		20 23-10-2018 14:00 PM	S	EA033 ASS		1	1						OXIDISED pH 4.5	
		21 23-10-2018 14:00 PM	S	EA033 ASS		1	1						OXIDISED pH 4.5	
		22 23-10-2018 14:00 PM	S	EA033 ASS		1	1						OXIDISED pH 4.2	
		23 23-10-2018 14:00 PM	S	EA033 ASS		1	1						OXIDISED pH 4.3	
		24 23-10-2018 14:00 PM	S	EA033 ASS		1	1						OXIDISED pH 4.2	
TOTAL						24	24							

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP = Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag.

**LAB OF ORIGIN:
DARWIN**

ESCP PROJECT SEA DRAGON PACKAGE 1

ATTACHMENT 3

ESCP REVIEW AND INSPECTION CHECKLISTS



NON-CONFORMANCE REPORT

Job Name:	Job No:
Date:	Client:
Details of non-conformance:	
Details of specification/procedure not conforming to:	
Non-conformance raised by:	Date:
Short-term preventative action:	
Estimated cost of rework/re-training/waste:	
Long-term preventative action:	
Accepted/rejected by the Client: Signed:	Date:
Non-conformance resolved: Signed:	Date:



Erosion & Sediment Control Plan Checklist

LOCATION OF DEVELOPMENT . NT Portion 3046 Victoria-Daly Regional Council.

.. REVIEWER **DATE**

SIGNATURE

N/A – not applicable

☐ – acceptable controls adopted

☐ – measures are not acceptable, or a potential problem exists

Part A: Initial plan review

Item	Consideration	Assessment
1	<i>Erosion Hazard Assessment Form</i> completed for the site.	.....
2	<i>Supporting Documentation</i> supplied with the ESCP.	.....
3	Copy of calculation sheets supplied.	.....
4	ESC specifications and construction drawings supplied.	.....
5	Inspection and Test Plan (ITP) supplied	.....
6	Legend provided to identify all ESC measures on the plans.	.....
7	ESC <i>Installation Sequence</i> supplied.	.....
8	<i>Installation Sequence</i> is appropriate for the site conditions.	.....
9	<i>Installation Sequence</i> clearly indicates which sediment control measures must be installed prior to land disturbance.	.....
10	Soil test results (including soil erodibility) supplied.	.....
11	Extent of land disturbance (including cut and fill areas) shown.	.....
12	Adequate identification/protection of non-disturbance areas.	.....
13	Buffer zones around temporary road construction work and accommodation camp areas identified.	.....
14	On-site watercourses and riparian zones protected.	.....
16	Existing contours shown (as required).	.....
17	Location of all ESC measures clearly shown.	.....
18	All ESC measures located within the property.	.....
19	Plans signed by appropriate professional(s).	.....



Part B: Site assessment

Item	Consideration	Assessment
20	Soil Map provided.	.....
21	Location of potential dispersive soils identified.	.....
22	Location of potential acid sulfate soils identified.	.....
23	High and extreme erosion risk areas identified and protected.	.....
24	Soils of extreme pH identified and amelioration specified.	.....

Part C: Site establishment

Item	Consideration	Assessment
25	Technical notes included on best practice site management including dust, chemical, oil, fuel, litter and debris control.	.....
26	Stockpile locations clearly identified and located away from protected vegetation and overland flow paths.	.....
27	Stockpiles located at least 5m away from top of watercourse banks.	.....
28	Adequate up-slope drainage controls (if necessary) and down-slope sediment controls placed adjacent to stockpiles.	.....
29	Temporary access roads/tracks identified, with appropriate drainage/erosion controls specified.	.....
30	<i>Temporary Watercourse Crossings</i> identified and protected.	.....

Part D: Drainage controls

Item	Consideration	Assessment
31	All temporary construction roads and access tracks shown on the Construction Drainage Plans.	.....
32	Temporary drainage controls designed to the appropriate standard and hydraulic analysis provided.	.....
33	Hydraulic analysis indicates appropriate flow velocities.	.....
34	Hydraulic analysis indicates appropriate flow capacity.	.....
35	Flow from "clean" external catchments diverted around/through site in a non-erosive manner.	.....
36	Internal "dirty" water drainage lines identified and directed to sediment controls.	.....
37	Appropriate drainage controls located immediately up-slope of neighbouring, down-slope residential areas.	.....
38	All site drainage inflow and outflow points identified.	.....
39	All water discharges through stabilised outlets onto stable land.	.....
40	Appropriate flow velocity controls (e.g. <i>Check Dams</i>) or scour controls (e.g. turf or <i>Erosion Control Mats</i>) specified.	.....
41	<i>Catch Drains</i> or <i>Flow Diversion Banks</i> located at top of cut and	.....



fill batters.

- | | |
|----|---|
| 42 | Rock <i>Check Dams</i> <u>not</u> specified in shallow (i.e. < 500mm deep) drains. |
| 43 | Water flow is appropriately conveyed down constructed earth slopes (e.g. through <i>Slope Drains</i> or <i>Chutes</i>). |
| 44 | All <i>Slope Drains</i> and <i>Chutes</i> have stabilised inlets and outlets. |
| 45 | Appropriate drainage controls on unsealed roads and access tracks. |
| 46 | Overland flow appropriately controlled around <i>Temporary Watercourse Crossings</i> |

Part E: Erosion control

Item	Consideration	Assessment
47	The erosion control standard is consistent with the rainfall erosivity, environmental risk, and clay content of exposed soil.	.....
48	The erosion control standard is consistent with the requirements of regulatory authority.	.....
49	Synthetic (plastic) mesh reinforced <i>Erosion Control Blankets</i> <u>not</u> specified in or adjacent to susceptible wildlife habitats.	.....
50	Emergency short-term erosion control measures specified (e.g. in event of construction delays, pre-storm activities).	.....
51	Technical notes indicate what additional works are required if construction occurs during the wet season.	.....
52	Dust control measures specified.	.....
53	Disturbed soil with an Exchangeable Sodium Percentage (ESP) greater than 6% is to be treated to control soil dispersion.	.....

Part F: Site stabilisation/revegetation

Item	Consideration	Assessment
54	Site stabilisation/rehabilitation plan provided.	.....
55	Minimum soil protective cover of 80 % specified on ESCP or in the Supporting Documentation.	.....
56	Appropriate soil preparation measures specified prior to revegetation.	.....
57	Timing and specification for any temporary vegetation is provided.	.....
58	Application of permanent site revegetation is appropriately staged.	.....
59	Specifications and application rates for soil adjustments provided (soil report).	.....
60	Specifications and application rates for seeding, mulches and hydraulically applied soil covers provided.	.....

Part G: Supplementary sediment controls

Item	Consideration	Assessment
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|----|---|
| 61 | Every appropriate opportunity has been taken to trap sediment as close to the initial source of erosion as is practicable <u>without</u> placing sediment controls in locations where they could cause hydraulic, erosion, or safety issues. |
| 62 | The ESCP provides sufficient information to control the installation and use of supplementary sediment traps. |

Part H: Sediment control “sheet” flow

Item	Consideration	Assessment
63	No sediment-laden water leaves the site untreated.	.....
64	“Sheet flow” control measures (e.g. <i>Buffer Zones, Grassed Filter Strips, and Sediment Fence</i>) <u>not</u> specified in areas of concentrated flow.	.....
65	The width of sediment control <i>Buffer Zones</i> is appropriate for the land slope (gradient).	.....
66	Geotextile <i>Filter Fences</i> are only used to control sediment runoff from earth stockpiles.	.....

Part I: Sediment control “concentrated” flow

Item	Consideration	Assessment
67	Appropriate sediment control standard specified (i.e. Type 1, Type 2, or Type 3)	.....
68	Location of all sediment control measures clearly shown.	.....
69	The location and operation of sediment control measures will <u>not</u> cause safety issues or flooding of adjacent properties.	.....
70	Appropriate sediment control measures specified for all culverts and pipe inlets.	.....
71	Type 2 sediment traps (e.g. <i>Rock Filter Dams, Sediment Trenches, Sediment Weirs</i>):	.....
	(a) Have adequate up-slope pond area.	.....
	(b) Have an appropriately sized sediment collection pit.	.....
	(c) Designed for an appropriate storm frequency.	.....
71	Appropriate access is provided to all sediment traps for maintenance and sediment removal.	.....
72	Sediment controls placed in and around drainage channels are appropriate for the expected flow conditions.	.....

Part L: Site monitoring and maintenance

Item	Consideration	Assessment
73	Site inspection program supplied.	.....
74	Monitoring and Maintenance Program provided for all drainage, erosion and sediment controls.	.....

Site inspection checklist

LOCATION POINT CEYLON NT Portion 03192 BYNOE

INSPECTION OFFICER **DATE**

SIGNATURE

Legend: ☐ OK ☐ Not OK N/A Not applicable

Item	Consideration	Assessment
1	The construction site is clear of litter and unconfined rubbish.	.....
3	Site dust is being adequately controlled.	.....
4	Drainage and sediment controls have been installed prior to new areas being cleared or disturbed according to plan.	.....
5	Up-slope "clean" water is being appropriately diverted around/through the site.	.....
6	Drainage lines are free of soil scour and sediment deposition.	.....
7	No areas of exposed soil are in need of erosion control.	.....
8	Sediment-laden stormwater is not simply flowing "around" the sediment fences or other sediment traps.	.....
9	All sediment traps are free of excessive sediment deposition.	.....
10	All reasonable and practicable measures are being taken to control sediment runoff from the site.	.....
11	All soil surfaces are being appropriately prepared (i.e. pH, nutrients, roughness and density) prior to revegetation.	.....
12	Stabilised surfaces have a minimum 80% vegetation or rock coverage.	.....
13	The site is adequately prepared for imminent storms.	.....
14	All ESC measures are in proper working order.	

NOTES:

CORRECTIVE MEASURES:



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GPO Box 381, Darwin 0801

12 February 2019

Job No.: EZ18106

Meghan Farr
Consultant
CO2 Australia
meghan.farr@co2australia.com.au

Re: Review of Project Sea Dragon ESCP – Bynoe BMF

Dear Meg,

I have reviewed the updated Erosion and Sediment Control Plan (ESCP) for the proposed Project Sea Dragon 2019 civil works involving construction of a breeding and maturation facility at Point Ceylon, Bynoe Harbour. The scope of this review relates to the requirements of condition 2 of Development Permit issued under the NT Planning Act (DP17/0371), as described below:

“engage a person who holds a current certification as a CPESC with IECA (auditor) to review the ESCP and provide written confirmation that the ESCP was prepared in accordance with the Key Principles of erosion and sediment control as specified in the IECA Best Practice Erosion and Sediment Control guidelines 2008 (or higher standard).”

The following documents (collectively referred to as the ESCP) prepared by Horizon Environmental Soil Survey and Evaluation were included in the review:

- *Point Ceylon Breeding and Maturation Facility, 2019 erosion and sediment control plan supporting documentation (J000073_PointCeylon_ESCP_rev1_ver4, dated 12/2/19).*
- *ESCP Sheets 1-11 Rev1 Ver 1 (Sheets 1-4 & 6-11 dated 7/2/19; Sheet 5 dated 11/2/19).*
- *Attachment 2 (J000073_SoilFactualReport_rev0-v3, dated 18/1/19).*
- *Attachment 3 (Doc: HOR20181217001).*

Assessment

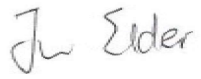
The ESCP provides an assessment of the erosion and sedimentation risks reflecting the construction and stabilisation stages of the Point Ceylon facilities. The ESCP includes information, techniques and procedures to enable Seafarms (and subcontractors) to implement effective soil and water management strategies in accordance with Project approval requirements.

It is acknowledged that management and implementation of ESC measures will be regularly monitored throughout the course of construction activities. Additionally, ESCP documents may be updated (in the form of Progressive ESCPs) by Seafarms or nominated subcontractors (as determined by a CPESC).

Certification

As a CPESC (#4399), I certify that the ESCP has been prepared in accordance with the key principles of erosion and sediment control as specified by IECA.

Yours sincerely,

A handwritten signature in black ink that reads "Tim Elder". The signature is written in a cursive, slightly slanted style.

Tim Elder
Managing Consultant
EcOz Environmental Consultants
tim.elder@ecoz.com.au