VANZ Plan

Soil and Water Management Plan - Woodlawn Bioreactor

MAN-13302-2

Issue Date: 15/03/2023

PURPOSE	This Soil and Water Management Plan (SWMP) has been prepared in accordance with conditions 13 - 18 of the COCs for the Woodlawn Bioreactor (the Bioreactor) to ensure that soil and water is successfully controlled and managed during the operation of the Bioreactor.

Scope	This SWMP has been prepared to provide the management measures implemented to minimise potential soil and water related adverse impacts during the operation stage of the Bioreactor.
Review Frequency	Yearly

CONTENTS

Quality Information
Definitions/Abbreviations
Section 1 Introduction
- 1.1 Overview
  - 1.1.1 Eco-Precinct Context
  - 1.1.2 Auxiliary Operations
- 1.2 Scope and Objectives
- 1.3 Legal and Other Requirements
  - 1.3.1 Project Approval 10-0012
  - 1.3.2 Veolia's Statement of Commitments
  - 1.3.3 Development Consent (DA-31-02-99)
  - 1.3.4 Environment Protection Licence
- 1.4 Stakeholder Consultation
  - 1.4.1 Government Agencies
  - 1.4.2 Community Consultation

Section 2 Goals of the SWMP
- 2.1 Roles and Responsibilities

Section 3 Environmental and Operational Impacts
- 3.1 Existing Environment
  - 3.1.1 Topography
  - 3.1.2 Hydrogeology
  - 3.1.3 Hydrology
  - 3.1.4 Soils

3.1.5 Vegetation
3.1.6 Surface Water Management
3.1.6.1 Design
3.1.6.2 Stormwater/surface water within the Bioreactor
3.1.6.3 Surface Water Drainage
3.1.7 ED2 Management
3.1.7.1 ED2 Survey Data
3.1.7.2 ED2 Management
3.1.7.3 ED2 Freeboard
3.1.8 ED1 Management
3.1.8.1 ED1 Management
3.1.8.2 ED1 Freeboard
3.1.8.3 ED1 Coffer Dam Freeboard
3.1.9 ED3 Management
3.1.10 ED3S Management
3.1.10.1 ED3S Survey Data
3.1.10.2 ED3S Management
3.1.10.3 ED3S Freeboard
3.1.11 ED3S-S Management
3.1.11.1 ED3S-S Survey Data
3.1.11.2 ED3S-S Management
3.1.11.3 ED3S-S Freeboard
3.1.12 ED3N Management
31.12.1 ED3N Survey Data
3.1.12.2 ED3N Management
3.1.12.3 ED3N Freeboard
3.1.13 Operational Water Use
3.1.14 Imported Liquids
3.1.15 Leachate Management System
3.1.16 Existing Barrier Systems
3.1.17 Leachate Extraction and Treatment
3.1.18 Existing Sewerage System
3.1.19 Water Balance
3.1.19.1 Water Management Simulation (WMS)
3.2 Roads
3.3 Cover and Aggregate Materials
3.4 Soil and Water Quality Impacts
Section 4 Soil and Water Management Measures
4.1 Soil Control Measures
4.1.1 Minimising soil erosion
4.1.2 Progressive stabilisation of disturbed areas
4.1.3 Maximising sediment retention onsite
4.1.4 Wetting of unsealed roads
4.1.5 Appropriately integrating operations with site constraints

4.1.6 Controlling water movement outside the Bioreactor
4.1.7 Minimising the extent and duration of land disturbance
4.1.8 Maintaining asphalt sealed access roads for high traffic areas
4.1.9 Inspecting soil and water control measures
4.1.10 Maintaining drainage, erosion and sediment control measures
4.2 Water Control Measures
4.2.1 Clay liner at the base of the Bioreactor
4.2.2 Clay lining to seal crack, faults and slip areas in Bioreactor wall
4.2.3 Maintaining an inward hydraulic gradient to the Bioreactor
4.2.4 Operating separate leachate and surface water capture systems
4.2.5 Lining of leachate dams in accordance with minimum standards
4.2.6 Storing of fuels and chemicals in appropriately bunded areas/containers
4.2.7 Wetting of unsealed roads
4.2.8 Evaporation of excess liquids
4.2.9 Undertaking of a water quality monitoring program
Section 5 Soil and Water Monitoring and Reporting
5.1 Monitoring Program
5.1.1 Surface Water Monitoring
5.1.2 Groundwater Monitoring
5.1.3 Dams Monitoring and Inspection Program
5.2 Performance Reporting and Review
5.3 Exceedances and Corrective Actions
5.4 Publishing of Data
Section 6 Soil and Water Monitoring and Reporting
Reference and Related Documents
Appendices
Appendix A Surface Water Management
Appendix B Construction Quality Control Assurance for Lining Evaporation Dam (ED3SS)
Appendix C Surface water and Groundwater Monitoring location
Appendix D WSP Revised Water Balance (2017)
Appendix E Water Management Simulation for Woodlawn Bioreactor
Appendix F Groundwater Monitoring Bore Details

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0.4	Final	NSW Environment Protection Authority NSW DPIE	11 May 2023

Definitions/Abbreviations

See definitions in the BMS Dictionary - Only definitions directly pertaining to this document are included.

Term	Definition
AECOM Report	Woodlawn Evaporation Dams ED1 and ED2 Investigation Report (2017)
AEMR	Annual Environmental Management Report
AHD	Australian Height Datum
Bioreactor	Woodlawn Bioreactor
BMS	Business Management System
BTT	Banksmeadow Transfer Terminal
CTT	Clyde Transfer Terminal
CLC	Community Liaison Committee
DA	Development Application
DPIE	NSW Department of Planning, Industry and Environment
DPI	Department of Primary Industries
EA	Environmental Assessment
ED1 Coffer Dam 1	Evaporation Dam 1 Coffer Dam No. 1
ED1 Coffer Dam 2	Evaporation Dam 1 Coffer Dam No. 2
EMR	Environmental Management Representative
EIS	Environmental Impact Statement
EP & A	Environmental Planning and Assessment Act 1979 (and Regulations)
EPA	NSW Environment Protection Authority
EPL	Environment Protection Licence
GMC	Goulburn Mulwaree Council
GHG	Greenhouse Gas
IMF	Crisps Creek Intermodal Facility
ISO	International Standard Organisation
LEMP	Landfill Environmental Management Plan
LEP	Local Environment Plan

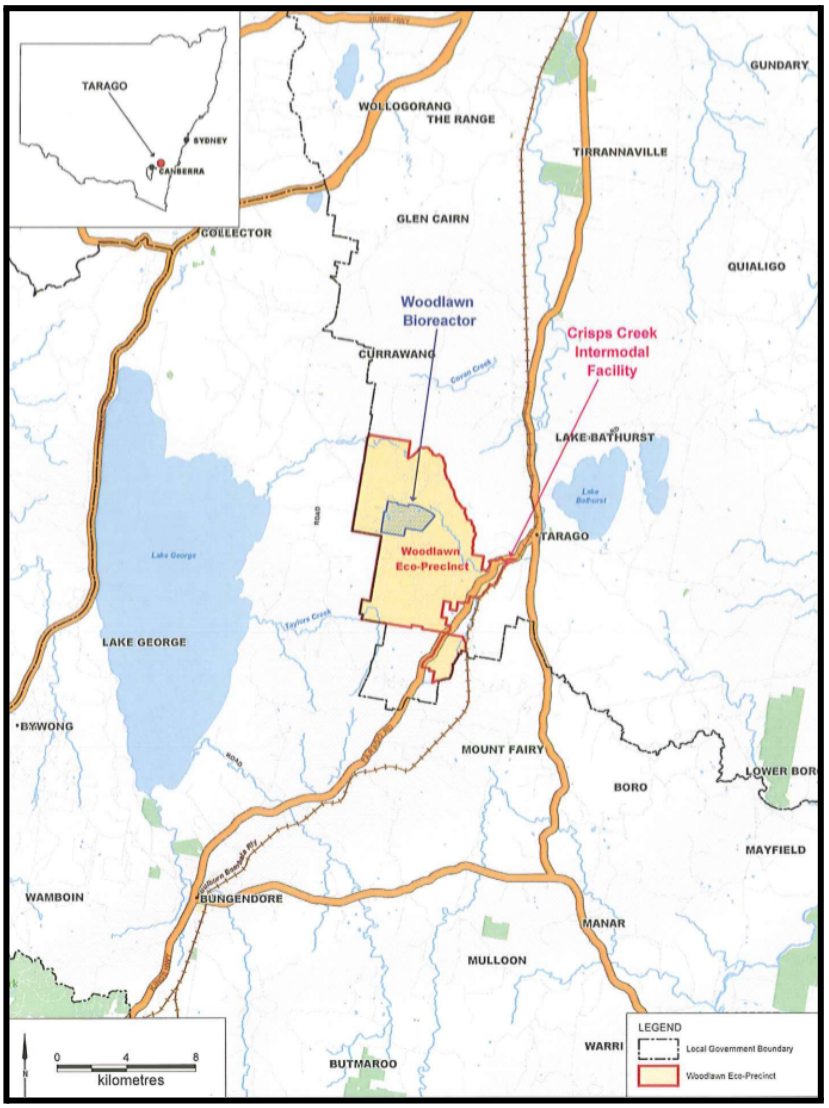
LGA	Local Government Area
LTP	Leachate Treatment Plan
MSW	Municipal Solid Waste
MBT	Woodlawn Mechanical Biological Facility
MWOO	Mixed Waste Organics Outputs
OEMP	Operational Environmental Management Plan (MBT)
PA	Project Approval
POEO	Protection of the Environment Operations Act 1997 (and Regulations)
RTA	Roads and Transport Authority
SEPP	State Environmental Planning Policy
SHEQ	Safety Health Environment Quality
TPA	Tonnes per Annum
Veolia	Veolia Australia and New Zealand
WARR Act	Waste avoidance & Resource Recovery Act

Section 1 Introduction

1.1 Overview

Veolia Australia and New Zealand (Veolia) own and operate the Woodlawn Eco-Precinct (the Eco-Precinct), which is located approximately 40 km south of Goulburn and 50km north of Canberra and comprises of the Woodlawn Bioreactor (the Bioreactor), which also incorporates the Woodlawn Bio Energy Power Station (the Power Station) and Leachate Treatment Plant (LTP), the Crisps Creek Intermodal Facility (IMF) and the Woodlawn Mechanical Biological Treatment Facility (MBT) as depicted in **Figure 1.1**.

Figure 1.1 Eco-Precinct Location Plan



1.1.1 Eco-Precinct Context

The Eco-Precinct has been developed in stages by Veolia to encompass innovative practices, supplemented with renewable energy. Access to the Site is off Collector Road, which runs in an east-west direction from its

intersection with Bungendore Road. The operations that form part of the Eco-Precinct are described in **Table 1.1**.

Table 1.1 Eco-Precinct Operations

Operation	Description
The Bioreactor, including the Woodlawn Bioenergy Power Station (the Power Station);	The Bioreactor was the first stage of the Eco-Precinct developed by Veolia. Landfilling operations, which commenced in September 2004 are located in the Bioreactor of the former open cut Woodlawn Mine. Waste is deposited in the Bioreactor and with the use of optimal moisture and temperature conditions, achieves enhanced degradation to produce landfill gas, collected through a vast network of infrastructure within the Bioreactor. Methane is extracted from the landfill gas within the Power Station for conversion and supply as electricity into the energy grid. The Bioreactor forms part of Veolia's integrated waste management services and is augmented with the following transfer facilities: ● The Crisps Creek Intermodal Facility (IMF). ● The Clyde Transfer Terminal (CTT) in Sydney; and ● The Banksmeadow Transfer Terminal (BTT) in Sydney
The Crisps Creek Intermodal Facility (IMF);	The IMF, which forms an integral part of the logistical operations of the Eco-Precinct, is located 8km from the Bioreactor in the township of Tarago, adjacent to the Goulburn-Bombala Railway line. Waste containers transported from the Sydney region via rail are unloaded and transferred onto road trailers at the IMF for transport to the Bioreactor. The IMF was approved to accept 1,180,000 TPA from Sydney when the Bioreactor was granted expanded operations.
Aquaculture and horticulture operations;	In keeping with the objectives of utilising as many resources as possible within the Woodlawn Eco-Precinct, Veolia has been looking for ways to utilise the waste heat created through the production of renewable energy from the landfill gas. As a part of this project, Veolia is using waste heat from the Power Station's engines in aquaculture operations to cultivate fish, with a horticultural system operating to remove excess nutrients.
Woodlawn and Pylara farms;	The original Woodlawn mine site included an operating farm on the property, which acted as a buffer zone during the mine operations. When Veolia was granted development consent for the Woodlawn Bioreactor, the condition of the development consent required Veolia to acquire the neighbouring farm Pylara to create a larger buffer zone around the Bioreactor operations. The surrounding land on the 3,000 ha Woodlawn property is utilised either for farming practices or requires rehabilitation from former mining activities. Adjacent to the south of the Woodlawn property is the 3,000 ha Pylara property, a working farm which utilises sustainable farming practices such as a sheep breeding program that includes genetic

	selection, nutrition and grazing rotation, to increase meat and wool productivity and reduce impacts on soils.
The Woodlawn Wind Farm (the Wind Farm) operated by Infigen Energy.	The 48 MW Woodlawn Wind Farm comprises 23 turbines and is located along a ridgeline running through both the Woodlawn and Pylara properties. This operation commenced in 2011. While on Veolia land it is owned and operated by Infigen Energy and supplements the Eco-Precinct's renewable energy production.
The Woodlawn Mechanical Biological Treatment (MBT) Facility (operational from mid 2017);	The MBT Facility was approved in 2007 and is located to the north-west of the Bioreactor as illustrated in 1. At full capacity, it will receive up to 280,000 tpa of mixed waste from Councils (SSROC and NSROC) in the Sydney Metropolitan Area. The waste is processed to extract recyclable materials or produce compost. The compost is matured on site and is approved to be trialled for use in the rehabilitation of mine tailings dams. Changes to site layout, technology and operating hours were approved in 2014. Stage 1 of the facility is able to process up to 184,000 TPA, which includes 144,000 TPA of mixed waste and 40,000 TPA of food and garden waste (FO/GO) as specified within the EPL.
The Woodlawn Leachate Treatment Plant (LTP) (operational from end of 2018)	Veolia's modification application with the Department of Planning and Environment (DPE) for construction and operations of leachate treatment plant (LTP) to process leachate was approved on 22 December 2017. The LTP was built and commenced accepting leachate on 4th October 2018. The LTP facilitates better environmental and operational performance by allowing greater volumes of leachate to be extracted from the Bioreactor. This, in turn, enables more efficient gas extraction maximising the waste to energy benefits of the Bioreactor and minimises generation of odour. Biological treatment at the LTP removes odorous components from leachate prior to being evaporated.

In addition to these operations, Heron Resources Limited (formerlyTriAusMin Pty Ltd) was granted planning approval for the Woodlawn Mine Project (Application No. 07_0143) to recommence mining operations within the Eco-Precinct for both re-mining of existing tailings dams and further underground mining.

There are remnant mining degraded areas within the Eco-Precinct that are subject to remediation requirements under the SML20 mining lease. The compost derived from the MBT Facility shall provide for the undertaking of this remediation in agreement between Veolia and Heron.

Heron Resources suspended operations in March 2020, entering a care and maintenance phase followed by voluntary administration on 16 July 2021.

1.1.2 Auxiliary Operations

The Eco-Precinct and its operations form part of Veolia's integrated waste management services and are augmented with the following transfer facilities in Sydney:

- The Clyde Transfer Terminal (CTT); and

- The Banksmeadow Transfer Terminal (BTT).

The CTT is approved to receive up to 600,000 TPA of putrescible waste from within the Sydney Metropolitan Area (SMA) from municipal, commercial and industrial sectors of the SMA, which is unloaded, screened, compacted and containerised into shipping containers for transport via rail to the IMF.

In order to facilitate the expansion of the Eco-Precinct through the increased waste receipt capability of the Bioreactor and the MBT Facility, Veolia has constructed an additional waste transfer station and associated rail infrastructure at an existing industrial site in Banksmeadow (southern Sydney).

The Banksmeadow Transfer Terminal (BTT) in Sydney is approved to receive up to 500,000 TPA of putrescible waste similarly to the CTT. Waste from the BTT is destined for either the Bioreactor or the MBT Facility, depending on Veolia's contractual obligations with its customers.

This Soil and Water Management Plan (SWMP) has been prepared in accordance with the regulatory requirements pertaining to the Woodlawn Bioreactor (the Bioreactor). This Plan details potential soil and water impacts from Veolia's operations and details the relevant control strategies and monitoring procedures to be undertaken to minimise the chances of the impacts occurring.

This plan additionally provides control measures for leachate in relation to soil and water impacts. For further management measures around leachate refer to the Leachate Management Plan (LMP), Appendix D3 of the Woodlawn Bioreactor Landfill Environmental Management Plan.

1.2 Scope and Objectives

The objective of the SWMP is to ensure that there is minimal impact on soils, surface water and groundwater systems from the operations at the Bioreactor.

The key goals of the SWMP are to:

- Facilitate compliance with the relevant State legislations, regulations and/or approvals.
- Detail how soil and water (and leachate) will be managed at the Bioreactor including Evaporation Dam 3 (ED3).
- Provide a water balance for the Woodlawn site
- Provide mitigation measures to minimise the potential for erosion and sediment transport processes
- Provide mitigation measures to minimise the potential for contamination of surface water and groundwater systems
- Provide an understanding of the management of leachate in relation to soil, surface water and groundwater at the Bioreactor
- Detailed suitable monitoring programs for detecting changes in surface water and groundwater quality.

1.3 Legal and Other Requirements

The following regulatory framework applies to this SWMP:

- Project Approval (PA) – Woodlawn Expansion Project (10-0012) as modified, issued under the Environmental Planning and Assessment Act 1979 (EP&A Act)
- Environment Protection Licence 11436 issued under the Protection of the Environment Operations (POEO) Act 1997 in particular Section 120 (EPL)
- Water Access Licence: Willeroo Borefield (# 40BL106422-106425)
- Licence to Operate an Onsite Sewage Treatment Plant - Goulburn Mulwaree Council

- Development Consent (DA-31-02-99) as modified, issued under the Environmental Planning and Assessment Act 1979 (DA)

1.3.1 Project Approval 10-0012

The relevant conditions of consent (COC) from the PA are provided in **Table 1.1.**

Table 1.1 PA Conditions

Relevant COC	Requirement	SWMP Reference
Sch 4 **Cond 13**	**Pollution of Waters** Except as may be expressly provided in the EPL for the site, the Proponent shall comply with Section 120 of the POEO Act	Sections 1.3.4 & 3, 4
Sch 4 **Cond 14**	**Soil** The Proponent shall: a) minimise any soil loss through erosion on site b) where possible, set aside any topsoil won on site for the proposed revegetation and rehabilitation of the site c) ensure that any topsoil stockpiles on site are appropriately managed to ensure that the topsoil in these stockpiles can be beneficially used in the proposed revegetation and rehabilitation of the site.	Section 4.1.1
Sch 4 **Cond 15**	**Bunding** The Proponent shall store all chemicals, fuels and oils used on sit in appropriately bunded areas, with impervious flooring and sufficient capacity to contain 110% of the largest container stored within the bund, unless double-skinned tanks are used. Any bunds shall be designed and installed in accordance with the requirements of all relevant Australian Standards, and/or OEH's Environmental Protection Manual: Technical Bulletin Bunding and Spill Management.	Section 4.2.6
Sch 4 **Cond 16**	**Erosion and Sediment Control** During the construction, the Proponent shall implement suitable erosion and sediment control measures on site, in accordance with the relevant requirements in the latest version of the Managing Urban Stormwater: Soils and Construction Guideline	Section 4.1
Sch 4 **Cond 17**	**Soil and Water Management** The Proponent shall prepare and implement a Soil & Water Management Plan for the Landfill to the satisfaction of the Secretary. This plan must: (a) be prepared in consultation with EPA, Water NSW and DPI Water by a suitably qualified and experienced expert whose appointment has been endorsed by the Secretary; (b) be approved by the Secretary prior to the commencement of expanded operations;	Covered in this document (SWMP) a) Section 1.4 b) Noted c) Section 3.1.7, 3.1.9 & 4.1

	(c) must specifically consider soil and water management (including leachate management) at the Landfill and ED3N, EDS3, ED3S-S, ED2, cofferdam(s) and ED1; (d) include a water balance for the project; (e) include a surface water monitoring program; (f) include a groundwater monitoring program; and (g) ensure that suitable measures are implemented to minimise water use, control soil erosion, prevent groundwater contamination, and comply with any surface water discharge limits. This plan must be documented in the Landfill EMP (see condition 3 in schedule 7).	d) Section 3.1.19 e) Section 5.1.1 f) Section 5.1.2 g) Section 4
Sch 4 **Cond 17A**	**Soil and Water Management** The Proponent shall update the Soil and Water Management Plan for the landfill by including the proposed changes to water and leachate management in MOD 1. The Plan shall be prepared in accordance with the requirements of Condition 17, in consultation with Water-NSW and the EPA to the satisfaction of the Secretary. The updated Plan must be submitted for approval to the Secretary within two months of the date of this approval or as otherwise agreed to by the Secretary	Noted and revised SMP submitted 9 November 2016
Sch 4 **Cond 18D**	**Soil and Water Management** Seepage or leakage points in ED2 must be identified and repaired to the satisfaction of the Secretary and EPA prior to the transfer of any stormwater from ED3S to ED2.	Noted , refer to section 3.1.7
Sch 4 **Cond 18S**	**Soil and Water Management** The volume of mine water stored in ED1 must be no more than 10 ML by 31 December 2023.	Noted, refer to section - 3.1.8.1

1.3.2 Veolia's Statement of Commitments

The relevant statement of commitments for air quality and odour made by Veolia and incorporated into the PA consent are detailed in Table 1.2 below

Table 1.2 PA Statement of Commitments

Condition	Mitigation Measure	SWMP Reference
Erosion	Restrict traffic to defined access roads where possible	Section 3.2, 4.1.4, 4.1.8
	Use a wheel wash to remove soil adhering to the wheels and undercarriage of trucks prior to departure from the landfill site	Section 4.1.3
	Install diversion drains and erosion and sediment control structures around the site to divert clean water from contaminated areas	Section 3.1.6

Groundwater and Surface Water	Divert rainfall runoff from the sides of the pit before it comes in contact with the waste	Section 3.1.6
	Dewatering of groundwater from the base of the pit in accordance with the Leachate Management Plan	Section 3.1.12
	Routinely assess rainfall, evaporation, groundwater levels, piezometer levels, pump hours, flow meters, surface water chemistry, groundwater chemistry	Section 5.1
	Clean any drains that have become blocked through sediment pollution	Section 4.1.10
	Check that drains are operated as intended	Section 4.1.10
	Check that rehabilitated lands have established sufficient groundcover to reduce the erosion hazard effectively and initiate repair as appropriate	Section 4.1.10
	Control emissions of dust from unsealed roads and other exposed surfaces by use of surface sealants and/or water spray carts or other appropriate equipment. Keep surfaces moist rather than wet.	Section 4.1.4
	Keep all sediment detention systems in good, working condition	Section 4.1.10
	Dispose of any pollutants removed from sediment basins in areas where further pollution to downslope lands and waterways should not occur	Section 4.1.10
	Construct additional erosion and/or sediment control works as might become necessary to ensure the desired protection is given to downslope lands and waterways	Section 4.1

1.3.3 Development Consent (DA-31-02-99)

The relevant COC from the development consent are provided in **Table 1.3**. Where conditions are similar to the PA, the PA takes precedence

Table 1.3 DA Conditions

Relevant COC	Requirement	SWMP Reference
SCHEDULE 2		
Operational Staging and Landfill Management		
Cover Material		
36	Cover material must be virgin excavated natural material, unless otherwise approved in writing by the EPA. (EPA GTA) Note: The Applicant is encouraged to identify alternative daily cover materials and examine the feasibility of adopting such materials so as to minimise impacts of utilising virgin excavated natural material.	Section 3.3
Water Quality and Management		
Waste Management Facility Site		

47	The premises and the activities carried out therein must not pollute surface water or groundwater. (EPA GTA)	Sections 1.3, 3, 4 & 5
Groundwater and Leachate Management		
48	The mine void must be managed to ensure the groundwater gradient directs groundwater flows towards the mine void, unless otherwise approved in writing by the EPA. (EPA GTA)	Section 3.1.2 & 4.2.3
49	Maintenance of the groundwater gradient post closure of active landfill operations (including a period of after-care) must ensure that impact of any degraded residue from the landfill on groundwater represents no threat to human health or the environment.	Section 4.2.3
51	A barrier system must be designed and installed on the surfaces identified in condition 52 to limit the quantity of groundwater flowing into the mine void and to contain leachate over the period of time that the landfilled waste poses a potential environmental risk. The system must be documented in the LEMP. (EPA GTA)	Section 3.1.16
52	The Applicant shall install the barrier system on the following surfaces of the mine void wherever these surfaces do not meet the performance requirements of Condition 53: a) the base and the top elevation of the mine void; and b) the localised joints, fracture zones and adits/portals.	Section 3.1.16
53	The barrier system must at least achieve the performance of a 900 mm thick recompacted clay liner with an in-situ coefficient of permeability of less than 10^{-9} metres per second.	Section 3.1.16
56	The Applicant must not import water or other liquids into the mine void, unless otherwise approved by the EPA, except for first flush waters collected at the Intermodal Facility site and waters contained in ED3. (EPA GTA)	Section 3.1.14
57	The Applicant shall develop a plan (known as bioreactor water management plan) which addresses the treatment of water, prior to any water being added (other than by direct rainfall) to the landfilled waste. This plan shall be included in the LEMP. Note: The goals of this plan are to ensure that water which is of a low pH and contains heavy metals and other inorganic substances does not inhibit the biological degradation of the landfilled waste and that the groundwater gradient direction is maintained into the void.	Incorporated into this plan (SWMP) Section 3.1.6
Surface Water Management		
58	There must be no discharge or waters from the area subject to the Development Application, unless more than 210mm of rain falls within a 72 hour time period (1 in 100 year ARI of 72 hours duration). (EPA GTA)	Section 3.1.8

59	At the commencement of waste being received into the mine void the volume of water stored in ED3 shall be no greater than 40 ML.	Noted
60	The Applicant shall install drainage so that the West Ridge Catchment shall not drain into the mine void.	Section 3.1.6.2
61	Contaminated water shall only be applied for dust suppression in the mine void, and in any areas around the perimeter of the void where any contaminated water will drain back into the void.	Section 4.2.7
62	The evaporation of water by spraying shall not result in the drifting of the sprayed liquid from the area subject to the DA and also shall not cause any adverse impact to public health. The proposed method for the spray evaporation of water shall be documented in the LEMP.	Section 4.2.8
63	ED3 shall not receive water stored in the Waste Rock Dam.	Section 3.1.6.3
64	Stormwater in the mine void must only be discharged into ED3S sump, for transfer via pipeline to ED2, or otherwise used for operational purposes within the landfill, as approved in writing by the EPA. (EPA GTA)	Section 3.1.6.2
65	Stormwater collected in the mine void may only be transferred into ED3S sump and ED2 provided that: a) The Applicant can always comply with condition 58; and; *b)* The stormwater to be transferred contains no leachate, unless otherwise approved in writing by the EPA. (EPA GTA)	Section 3.1.6
66	The Applicant must design and implement a Stormwater Management Scheme for the premises demonstrating compliance with Conditions 47, 48, 58, 63, 64, 65, and 8(b). This plan must be documented in the LEMP. (EPA GTA) Note: The scheme will need to consider the method of the removal of excessive quantities of rainwater that falls in the mine void.	Incorporated into this plan (SWMP) Section 3.1.6
66A	Prior to the operation of the LTP or as otherwise agreed by the Secretary, the Applicant must submit a revised Stormwater Management Plan to the satisfaction of the Secretary. The plan must be prepared in consultation with the EPA and Water NSW and include the changes to stormwater management in MOD 2 and MOD 3, in accordance with the requirements of Condition 66.	Noted

66B	Prior to the operation of the LTP or as otherwise agreed by the Secretary, the Applicant must submit a revised Management Plan for ED3N, ED3S, ED3S-S and the Coffer Dam to the satisfaction of the Secretary. The LTP is not permitted to operate until the revised Management Plan is approved by the Secretary. The plan must be prepared in consultation with the EPA and Water NSW and include the changes to water and leachate management in MOD 2 and MOD 3, in accordance with the requirements of Condition 70. The plan must be documented in the LEMP.	Noted
67	Vehicles leaving the area subject to the DA shall not track materials to external surfaces. Details of the equipment or facilities must be specified in the LEMP (EPA GTA)	Section 4.1.3
68	Containers used for transporting waste must only be washed at the container wash facility as frequently as is necessary to minimise environmental impacts from the containers. The container wash down facility must be designed, installed and operated with the aim to collect, treat and dispose of any washdown waters to the leachate collection system. Any collected solids must be returned to the active tipping face. The container wash down facility must be documented in the LEMP. (EPA GTA)	Section 3.1.9
69	Impervious bunds must be constructed around all fuel, oil and chemical storage areas and the bund volume must be large enough to contain 110 per cent of the volume held in the largest container. The bund must be designed and installed in accordance with the requirements of the EPA Environment Protection Manual Technical Bulletin Bunding and Spill Management. (EPA GTA)	Section 4.2.6
ED3N, ED3S and ED3S-S Management		

70	ED3N, ED3S and ED3S-S and CofferDam(s)– Management The Applicant must prepare a management plan for ED3N, ED3S, ED3S-S and cofferdam(s), ED1, the LTP and pipeline to ensure that: a) each dam is lined in consultation with Water NSW and to the satisfaction of the EPA and maintained to prevent leakage from the dams in order to protect groundwater and surface water; b) a monitoring and inspection program is implemented including installation of monitoring bores, a review of monitoring data and six-monthly inspections to evaluate the integrity of the barrier and to assess if leakage from the dam is occurring; c) adequate capacity is retained in ED3N, ED3S and cofferdam(s) to meet the environmental performance requirements in condition 58 d) measures are identified to maintain adequate capacity within a suitable time period after receiving water from a rainfall event; e) there is an emergency plan for the management of leachate in excess of the capacity of ED3N,ED3S and cofferdam(s); f) the sources of leachate that are collected or received in ED3N, ED3S and cofferdam(s) are identified; g) the quantity of leachate from each source that reports to ED3is monitored and compared in graphical format with rainfall data; h) ED3N is emptied of effluent from the existing leachate system by 31 December 2022; i) all pipelines which transfer leachate and treated leachate are monitored to ensure leaks do not occur; j) the operational details of the LTP include: the leachate quality targets; a description of the performance indicators that would be used to judge the performance of the LTP; a description of the management measures that would be implemented to manage the operational impacts of the LTP including the chemical storage area and sludge skip bin; contingency measures to manage any unpredicted impacts such as the bioreactor membrane failing; and	a) 3.1.3 of LMP b) 5.1.3 c) 4.3 of LMP d) 4.3 and 4.5 of LMP e) Section 6 and refer to ERP f) 3.1.3 of LMP g) 5.1.1 of LMP h) 3.1.3 of LMP i) 4.2 of LMP j) (i) 3.1.2.1 of LMP (ii) 3.1.2.1 of LMP (iii) 3.4.1 and 4.4.1 of the LEMP (iv) 3.1.2.1 of LMP (v) 2.1 of LMP

	the roles, responsibility, authority and accountability of all key personnel involved in the environmental management of the LTP. k) An updated plan including MOD 2 and MOD 3 must be documented in the LEMP.	
ED2 Management		
70B	The Applicant must prepare a management plan for ED2 to ensure that; a) only mine void stormwater that does not contain leachate and direct rainfall and runoff is received and stored within ED2; b) the dam is lined and maintained to prevent the leakage of stored acid mine drainage waters in order to protect groundwater and surface water; c) a monitoring and inspection program is implemented including installation of monitoring bores, a review of monitoring data and six-monthly inspections to evaluate the integrity of the barrier and to assess if leakage from the dam is occurring; d) adequate capacity is retained in ED2 to meet the environmental performance requirements in condition 58 e) measures are identified to maintain adequate capacity within a suitable time period after receiving water from a rainfall event. f) there is an emergency plan for the management of water in excess of the capacity of ED2; g) the sources of water that are collected or received in ED2 are identified; and h) the quantity of water from each source that reports to ED2 is monitored and compared in graphical format with rainfall data. The plan must be prepared in consultation with the EPA and submitted to the Secretary for approval within two months of the date of approval for MOD 2 or as otherwise agreed by the Secretary. The revised plan shall be documented in the LEMP.	Conditions related to ED2 will triggered in the event of transfer of water from ED3S to ED2, however addressed as follows: a) Section 3.1.7 b) Section 3.1.7.2 c) Section 3.1.7.2 d) Section 3.1.7.3 e) Section 3.1.7.3 f) Section 3.1.7.2 g) Section 5.1.1 h) Section 3.1.7.2
70C	Seepage or leakage points in ED2 must be identified and repaired to the satisfaction of the Secretary and EPA prior to the transfer of any stormwater from ED3S to ED2.	Section 3.1.7

71 (b)	The sewage management system must be designed, installed and operated to meet the following criteria: b) Protection of Lands. The application of waste-water to land must not result in the deterioration of the quality of the land through soil structure degradation, salinisation, waterlogging, chemical contamination of soil erosion.	Section 3.1.18
71 (c)	The sewage management system must be designed, installed and operated to meet the following criteria: c) Protection of Surface Waters. Surface waters must not become contaminated by any flows discharged from the waste-water management system including waste-water, rainfall runoff, contaminated subsurface runoff or contaminated groundwater.	Section 3.1.18
71 (d)	The sewage management system must be designed, installed and operated to meet the following criteria: d) Protection of Groundwaters. Underground water resources must not become contaminated by either the waste-water, or any flows discharged from the waste-water management system.	Section 3.1.18
72	Waste-water must only be applied to utilisation areas in conformance with Condition 71. (EPA GTA)	Section 3.1.18
73	Spray from waste-water application must not drift beyond the boundary of the waste-water utilisation area to which it is applied. (EPA GTA) Note: The EPA may include a buffer area for spray as part of a waste-water utilisation area.	Section 3.1.18
74	Waste-water utilisation areas must effectively utilise the waste-water applied to those areas. This includes the use for pasture or crop production, as well as ensuring the soil is able to absorb the nutrients, salts, hydraulic load and organic materials in the solids or liquids. Monitoring of land and receiving waters to determine the impact of waste-water application may be required by the EPA. (EPA GTA)	Section 3.1.18
Environmental Monitoring (EPA GTAs)		
Groundwater Monitoring		
131	The Applicant shall prepare and implement a groundwater monitoring program that can detect groundwater flow and direction and any occurrence of groundwater pollution. The groundwater monitoring program must be documented in the LEMP. The program must include details on: a) location of bore holes around the perimeter of the mine void and ED3 and the coffer dam – including the depth	refer to PA (Sch 4 Cond 17)

	at which they are screened to enable access of groundwater; b) monitoring the height of the groundwater table; c) monitoring the groundwater gradient and to determine the direction of groundwater flow; d) monitoring methodologies and standards to be employed; e) reporting and assessment of results; f) opportunities to integrate the monitoring program with other monitoring programs in the vicinity; g) the parameters and substances that are proposed to be monitored, including sampling and analysis frequencies; and h) groundwater height should be reported against water table contours around the site to assess any variation over time.	
Surface Water Monitoring		
132	The Applicant shall prepare and implement a surface water-monitoring program to monitor the environmental performance of the construction, operation and rehabilitation of the development on surface water. The surface water-monitoring program must be documented in the LEMP. The program must include details on: a. Monitoring locations including: ● Crisps Creek ; ● Allianoyonyiga Creek; ● Cofferdam (s) ● ED1 ● ED3N; ● ED3S ● ED3S-S ● ED2 ● downstream receiving waters of ED2; ● treated leachate effluent discharge line; ● discharge line from ED3S to ED2; and ● rainwater collected in the mine void; b. monitoring methodologies and standards to be employed; c. monitoring frequency based on rainfall events and creek flow assessment; d. an assessment of the contribution of surface water pollution from the Woodlawn Waste Management Facility as distinct from the Woodlawn Mine site;	a) 5.1.1 b) 5.1 c) 5.1 d) Noted e) 6.1 f) 5.1.3 g) Section 5.1.3 of the LMP h) 5.1.3 of LMP i) 5.1.1 j) 5.1.3 k) 3.1.3 of LMP l) 3.1.3 of LMP m) Not triggered n) Not triggered o) 5.1.3 of LMP p) 5.1.3 of LMP q) 5.1.3 of LMP r) 5.2 of LMP

	e. the quantity of water relocated from the mine void into ED3; f. the quantity of water relocated from ED3 into the mine void; g. the chemical composition of liquids added to the landfilled waste; h. the chemical composition of treated leachate in the effluent discharge line; i. the chemical composition of leachate within ED3S-S; j. the quantity of water that reports to ED3 , including its sources; k. the quantity of water removed and/or discharged from ED3, including its destination; l. the total quantity of water contained in ED3; m. the quantity of water transferred from ED3S-S into ED2 n. the quantity of water that reports to ED2 from Woodlawn Waste Management Facility, including its sources; o. the total quantity of water contained in ED2; p. the total quantity of treated leachate contained in the coffer dam (s); q. the total quantity of water contained in ED1; r. the parameters and substances that are proposed to be monitored, including sampling and analysis frequencies; s. reporting and assessment of results; and t. opportunities to integrate the monitoring program with other monitoring programs in the vicinity. The monitoring of ED2 will initially be at weekly intervals once the transfer of stormwater from ED3S to ED2 has commenced and will be reviewed 12 months after commencement of MOD 2.	s) Noted
Leachate Monitoring		
134	The Applicant shall notify the EPA as soon as practicable after becoming aware that the height of the saturation level in the waste is above the height of the groundwater table that surrounds the mine void.	Section 4.4.3 of LMP

1.3.4 Environment Protection Licence

EPL 11436 stipulates the environmental obligations for Veolia under the POEO Act. The relevant conditions to the SWMP and Section 120 of the POEO Act are provided in **Table 1.4**.

Table 1.4 EPL Condition

Relevant Condition	Requirement	SWMP Reference
2 – Discharges to Air and Water and Applications to Land		
P1 – Location of monitoring/discharge points and areas		
P1.3 **Point 13**	Surface Water Monitoring Site 115 – Allianoyonyige Creek, Drawing No. GO25/6/02 in the Surface Water Management Scheme in Section 8.6 LEMP - Aug 2004. (E731953 - N6118394)	Section 5.1.1
P1.3 **Point 14**	Surface Water Monitoring Spring 2 – Crisps Creek, Drawing No. GO25/6/02 in the Surface Water Management Scheme in Section 8.6 LEMP -Aug 2004. (E734806 - N6118144)	Section 5.1.1
P1.3 **Point 15**	Surface Water Monitoring Site 105 – Crisps Creek, Drawing No. O25/6/02 in the Surface Water Management Scheme in Section 8.6 LEMP - Aug 2004. (E737459 - N6115805)	Section 5.1.1
P1.3 **Point 16**	Surface Water Monitoring Site WM200 – Raw Water Dam, Drawing No. GO25/6/02 in the Surface Water Management Scheme in Section 8.6 LEMP - Aug 2004. (E733593 - N6117249)	Section 5.1.1
P1.3 **Point 17**	Surface Water Monitoring and Discharge Site WM201 – Existing Mine Buildings, Drawing No. GO25/6/02 in the Surface Water Management Scheme in Section 8.6 LEMP - Aug 2004. (E737459 - N6115805)	Section 5.1.1
P1.3 **Point 18**	Surface Water and Volume Monitoring ED3SS (info@earthpower.com.au) as shown on Drawing No. 16800-180, Issue F, prepared by LandTeam Australia Pty Ltd and dated 21/7/16. (E733627, N6117473)	Section 5.1.1
P1.3 **Point 19**	Surface Water and Volume Monitoring ED3 North, as shown on Drawing No. 16800-180, Issue F, prepared by LandTeam Australia Pty Ltd and dated 21/7/16. (E733627, N6117473)	Section 5.1.1
P1.3	Surface Water Monitoring	Section 5.1.1

Point 22	Pond 5, located within the landfill void. 734211 N6117034	
P1.3 **Point 25**	Groundwater Monitoring MB1, Drawing GO25/5/01 Rev B in the Groundwater Monitoring Program in Section 8.12 LEMP - Aug 2004. (E734474 - N6117559)	Section 5.1.2
P1.3 **Point 26**	Groundwater Monitoring MB2, Drawing GO25/5/01 Rev B in the Groundwater Management Program in Section 8.12 LEMP – Aug 2004. (E734332 - N6118045)	Section 5.1.2
P1.3 **Point 27**	Groundwater Monitoring MB3, Drawing No. GO25/5/01 Rev B in the Groundwater Monitoring Program in Section 8.12 LEMP - Aug 2004. (E734710 - N6118632)	Section 5.1.2
P1.3 **Point 28**	Groundwater Monitoring MB4, Drawing GO25/5/01 Rev B in the Groundwater Monitoring Program in Section 8.12 LEMP - Aug 2004. (E734968 - N6116965)	Section 5.1.2
P1.3 **Point 30**	Groundwater Monitoring MB6, Drawing No. GO25/5/01 Rev B in the Groundwater Monitoring Program in Section 8.12 LEMP - Aug 2004. (E733864 - N61170797)	Section 5.1.2
P1.3 **Point 31**	Groundwater Monitoring MB7, Drawing No. GO25/5/01 Rev B in the Groundwater Monitoring Program in Section 8.12 LEMP - Aug 2004. (E733204 - N6117328)	Section 5.1.2
P1.3 **Point 33**	Groundwater Monitoring MB10, Drawing No. GO25/5/01 Rev B in the Groundwater Monitoring Program in Section 8.12 LEMP - Aug 2004. (E734028 - N6118065)	Section 5.1.2
P1.3 **Point 41**	Groundwater Monitoring ED3B Drawing No. GO 25/5/01 Rev B in the Groundwater Monitoring Program in Section 8.12 LEMP - Aug 2004. (E733505 - N6117045)	Section 5.1.2
P1.3 **Point 42**	Groundwater Monitoring WM1 Drawing No. GO25/5/01 Rev B in the Groundwater Monitoring Program in Section 8.12 LEMP - August 2004. (E729012 - N6115901)	Section 5.1.2
P1.3 **Point 44**	Groundwater Monitoring WM4 Drawing No. GO25/5/01 Rev B in the Groundwater Monitoring Program in Section 8.12 LEMP - Aug 2004. (E728655 - N6116052)	Section 5.1.2
P1.3 **Point 45**	Groundwater Monitoring WM5 Drawing No. GO25/5/1 Rev B in the Groundwater Monitoring Program in Section 8.12 LEMP - Aug 2004. (E727738 - N6116221)	Section 5.1.2
P1.3 **Point 46**	Groundwater Monitoring WM6 Drawing No. GO25/5/1 Rev B in the Groundwater Monitoring Program in Section 8.12 LEMP - Aug 2004. (E733387 - N6117459)	Section 5.1.2

P1.3 **Point 48**	Groundwater Monitoring P38, as described in the Groundwater Monitoring Program in Section 8.12 LEMP - Aug 2004. (E734320 - N6116639)	Section 5.1.2
P1.3 **Point 49**	Groundwater Monitoring P44 as described in the Groundwater Monitoring Program in Section 8.12 LEMP - Aug 2004. (E734601 - N6117010)	Section 5.1.2
P1.3 **Point 50**	Groundwater Monitoring P45 as described in the Groundwater Monitoring Program in Section 8.12 LEMP - Aug 2004. (E734590 - N6116968)	Section 5.1.2
P1.3 **Point 51**	Groundwater Monitoring P58 as described in the Groundwater Monitoring Program in Section 8.12 LEMP - Aug 2004. (E734068 - N6117037)	Section 5.1.2
P1.3 **Point 52**	Groundwater Monitoring P59 as described in the Groundwater Monitoring Program in Section 8.12 LEMP - Aug 2004. (E734059 - N6116941)	Section 5.1.2
P1.3 **Point 53**	Groundwater Monitoring P100 as described in the Groundwater Monitoring Program in Section 8.12 LEMP - Aug 2004. (E734284 - N6117237)	Section 5.1.2
P1.3 **Point 54**	Surface Water and Volume Monitoring ED3S as shown on Drawing No. 16800-180, Issue F, prepared by LandTeam Australia Pty Ltd and dated 21/7/16. (E733654 N6117240)	Section 5.1.2
P1.3 **Point 55**	Groundwater Monitoring Groundwater monitoring wells labelled as "MW8S" - Figure 1 Earth2Water Report - Nov 2007. (E733827 - N6117392)	Section 5.1.2
P1.3 **Point 56**	Groundwater Monitoring Groundwater monitoring well labelled as "MW8D" - Figure 1 Earth2Water Report - Nov 2007. (E733829 - N6117387)	Section 5.1.2
P1.3 **Point 57**	Groundwater Monitoring Groundwater Monitoring well labelled as "MW9S" referred to in Figure 1 Earth2Water Report on new groundwater well locations 15 November 2007. E733632 N6117611	Section 5.1.2
P1.3 **Point 58**	Groundwater Monitoring Groundwater Monitoring Well labelled as "GW10"S Figure 1 Earth2Water Report - Nov 2007. (E733919 - N6117407)	Section 5.1.2
P1.3 **Point 59**	Surface Water Monitoring Evaporation Dam 1 (ED1) As shown on the plan titled “Attachment 1-Woodlawn Site EPL Monitoring Sites – Drawing No TOP-G-001” prepared by Dean Oliver and dated 17 March 2017. The plan is held by the EPA as DOC17/168187.	

P1.3 **Point 60**	Groundwater Monitoring MB28 as shown on the map titled “WOODLAWN ENVIRONMENTAL PROTECTION LICENCE SITE MONITORING LOCATIONS” prepared by LandTeam Australia Pty Ltd and dated 21/04/2021 (EPA ref DOC21/307664). E734335 N6117795	Section 5.1.2
P1.3 **Point 62**	Surface Water ED1 Coffer Dam 1 as shown on the map titled “WOODLAWN ENVIRONMENTAL PROTECTION LICENCE SITE MONITORING LOCATIONS” prepared by LandTeam Australia Pty Ltd and dated 21/04/2021 (EPA ref DOC21/307664). E734210 N 6117559	Section 5.1.2
P1.3 **Point 63**	Groundwater Monitoring SP2-MW1 as shown on the map titled “WOODLAWN ENVIRONMENTAL PROTECTION LICENCE SITE MONITORING LOCATIONS” prepared by LandTeam Australia Pty Ltd and dated 21/04/2021 (EPA ref DOC21/307664). E734743 N6118122	Section 5.1.2
P1.3 **Point 64**	Groundwater Monitoring MW-FRC1 as shown on the map titled “WOODLAWN ENVIRONMENTAL PROTECTION LICENCE SITE MONITORING LOCATIONS” prepared by LandTeam Australia Pty Ltd and dated 21/04/2021 (EPA ref DOC21/307664). E734528 N6118196	Section 5.1.2
P1.3 **Point 65**	Groundwater Monitoring MB10S as shown on the map titled “WOODLAWN ENVIRONMENTAL PROTECTION LICENCE SITE MONITORING LOCATIONS” prepared by LandTeam Australia Pty Ltd and dated 21/04/2021 (EPA ref DOC21/307664). E734052 N6118048	Section 5.1.2
P1.3 **Point 66**	Groundwater Monitoring MB33 as shown on the map titled “WOODLAWN ENVIRONMENTAL PROTECTION LICENCE SITE MONITORING LOCATIONS” prepared by LandTeam Australia Pty Ltd and dated 21/04/2021 (EPA ref DOC21/307664). E734258 N6117332	Section 5.1.2
P1.3 **Point 67**	Groundwater Monitoring MB34 as shown on the map titled “WOODLAWN ENVIRONMENTAL PROTECTION LICENCE SITE MONITORING LOCATIONS” prepared by LandTeam Australia Pty Ltd and dated 21/04/2021 (EPA ref DOC21/307664). E734605 N6116744	Section 5.1.2
P1.3 **Point 68**	Groundwater Monitoring MB35 as shown on the map titled “WOODLAWN ENVIRONMENTAL PROTECTION LICENCE SITE MONITORING LOCATIONS” prepared by LandTeam Australia Pty Ltd and dated 21/04/2021 (EPA ref DOC21/307664). E734028 N6117026	Section 5.1.2
P1.3 **Point 69**	Surface Water (Proposed) ED1 Coffer Dam 2 as shown on the map titled “WOODLAWN ENVIRONMENTAL PROTECTION LICENCE SITE MONITORING	Section 5.1.2

(Proposed)	LOCATIONS" prepared by LandTeam Australia Pty Ltd and dated 18/01/2023 (EPA ref DOCXX/XXXXXX). EXXXXXX NXXXXXX	
3 – Limit Conditions		
L1 – Pollution of Waters		
L1.1	Except as may be expressly provided in any other condition of this licence, the licensee must comply with section 120 of the Protection of the Environment Operations Act 1997.	Sections 1.3.4, 3 & 4
L1.2	There must be no pollution of surface water or groundwater.	Sections 3 & 4
L1.3	There must be no discharge of water from the premises unless more than 210 mm of rain falls within a 72 hour time period (1 in 100 year ARI of 72 hours duration).	Section 3.1.7
4 – Operating Conditions		
O5 – Processes and management		
O5.1	Water from the West Ridge Catchment, as shown on Figure GO25/6/02 contained in the Surface Water Management Scheme in Section 8.6 of the Landfill Environmental Management Plan dated August 2004, must not drain into the landfill void.	Section 3.1.6
O5.2	Stormwater in the landfill void must only be discharged into Evaporation Dam 3, or used for operational purposes within the landfill such as bioreactor water and dust suppression as approved in writing by the EPA	4.2.7
O5.3	Where contaminated water is used for dust suppression, it must only be applied in the landfill void, and in any areas around the perimeter of the void where contaminated water will drain back into the landfill void.	4.2.7
O5.4	The evaporation of water by spraying must not result in the drifting of the sprayed liquid from the premises.	4.2.8
O5.5	Untreated leachate must not be transferred to Evaporation Dam 3 unless approved in writing by the EPA.	3.1.12
O5.6	Containers used for transporting waste must only be washed at the container wash facility as frequently as is necessary to minimise environmental impacts from the containers. The container wash down facility must be designed, installed and operated with the aim of collecting, treating and disposing of any washdown waters to the leachate collection system. Any collected solids must be returned to the active tipping face.	3.1.6
O5.7	The licensee must ensure that the holder of Environment Protection Licence No. 11437, the supervisory licence, has adequate access to the premises and records held at the premises in order to be able to ensure that the design, construction, extension and maintenance of all engineered features of the premises being supervised are done in	noted

	compliance with the conditions of the development approval and as further defined in conditions of this environment protection licence.	
O6 – Waste Management		
O6.2	The landfill void must be managed to ensure the groundwater gradient directs groundwater flows towards the landfill void.	Section 4.2.3
O6.3	A leachate collection/storage/recirculation/treatment system must be designed, installed and operated to: a) accept, in addition to leachate, other waste-waters and contaminated storm-waters allowed by this licence to be introduced into the waste; b) efficiently operate, despite settlement of the waste; c) ensure that liquid is not deliberately stored in the landfilled waste, unless it is necessary for the efficient decomposition of the landfilled waste; d) ensure that leachate can be recirculated within the biologically active zones of the landfilled waste; e) comply with condition O5.2; and f) ensure to the maximum extent practicable the biological decomposition of all organic waste and productive capture of methane.	Refer to LMP
O6.7	The licensee must not import water or other liquids into the landfill void, unless otherwise approved by the EPA, except for first flush waters collected at the Crisps Creek Intermodal Facility site (Environment Protection Licence No. 11455), container washdown waters, and raw dam water. The licensee may also import leachate and washdown water generated at the Clyde Intermodal Facility (Environment Protection Licence No. 11763) from the compaction and loading of waste into rail containers that are subsequently transported to the Woodlawn Landfill. The leachate and washdown water generated at the Clyde Intermodal Facility must be able to be classified as Liquid Waste.	Section 3.1.9
O6.8	Cover material must be virgin excavated natural material, unless otherwise approved in writing by the EPA. Note: The licensee is encouraged to identify alternative daily cover materials and examine the feasibility of adopting such materials so as to minimise impacts of utilising virgin excavated natural material	Section 3.3
O6.9	Cover material must be of a quality that will not inhibit the biological decomposition of the landfilled waste.	Section 3.3

O6.10	Cover material must be applied to a minimum depth of 15 centimetres over all exposed landfilled waste prior to ceasing operations at the end of each day, unless otherwise approved in writing by the EPA. Note: This condition does not exclude removal of daily cover at the beginning of each day to provide for the efficient operation of the bioreactor and to avoid perching of leachate within the landfilled waste mass.	Section 3.3
O6.11	Cover material must be applied to a depth of 30 centimetres over surfaces of the landfilled waste which have had 15 centimetres of cover material for more than 90 days, unless otherwise approved in writing by the EPA. Note: This condition does not exclude removal of cover prior to recommencement of active landfilling to provide for the efficient operation of the bioreactor and to avoid perching of leachate within the landfilled waste mass.	Section 3.3
06.12	At least two weeks supply of cover material must be available at the premises under all weather conditions, unless otherwise approved in writing by the EPA.	Section 3.3
5 – Monitoring and Recording Conditions		
M2 – Requirement to monitor concentration of pollutants discharged		
M2.3 – Water and/or Land Monitoring Requirements		
M2.3	Monitoring points listed for surface water monitoring; Points 13, 14, 15, 16, 17, 18, 19,, 22, 54,59	Section 5.1.1
M2.3	Monitoring points listed for leachate quality monitoring; Points 23, 24	Section 5.1
M2.3	Monitoring points listed for groundwater monitoring; Points 25, 26, 27, 28, 30, 31, 33, , 41, 42, 44, 45, 46, 55, 56, 57, 58	Section 5.1.2
M2.3	Monitoring points listed for groundwater monitoring; Points 48, 49, 50, 51, 52, 53	Section 5.1.2
M3 – Testing methods – concentration limits		
M3.2	Subject to any express provision to the contrary in this licence, monitoring for the concentration of a pollutant discharged to waters or applied to a utilisation area must be done in accordance with the Approved Methods Publication unless another method has been approved by the EPA in writing before any tests are conducted.	Section 5.1.2
M7 – Requirement to monitor volume or mass		

<table>
<tr><td>M7.1</td><td>For each discharge point or utilisation area specified below, the licensee must monitor:
a) the volume of liquids discharged to water or applied to the area;
b) the mass of solids applied to the area;
c) the mass of pollutants emitted to the air;
at the frequency and using the method and units of measure, specified below
POINT 54<table><tr><th>Frequency</th><th>Unit of Measure</th><th>Sampling Method</th></tr><tr><td>Monthly</td><td>megalitres</td><td>Other Approved Method 1</td></tr></table>Other Approved Method 1 is by inspection of a calibrated marker post.</td><td>Section 5.1</td></tr>
<tr><td colspan="3">6 – Reporting Conditions</td></tr>
<tr><td colspan="3">R3 – Written Report</td></tr>
<tr><td>R3.5</td><td>Whenever the height of the saturation level in the waste is above the height of the groundwater table that surrounds the perimeter of the mine void, the licensee must provide a written report to the EPA within 3 months.</td><td>Noted</td></tr>
<tr><td>R3.6</td><td>The report must contain the following information:
a) the height of the saturation level of the leachate in the mine void and the height of the groundwater at the perimeter of the mine void; and
a) a program of actions to reduce the height of leachate in the mine void and the expected time duration for the actions and works.</td><td>Noted</td></tr>
<tr><td colspan="3">R4 – Other Reporting Conditions</td></tr>
<tr><td>R4.1</td><td>Whenever the volume of water stored in Evaporation Dam 3 reaches the freeboard level in condition O6.4, the licensee must notify the EPA in accordance with the requirements of R2 and provide a written report to the EPA within 1 month. The report must contain the following information:
a) the volume of water stored in Evaporation Dam 3; and
b) a program of actions to reduce volume of water stored in Evaporation Dam 3 below the 0.5m freeboard level and/or a program for the design and construction of works to increase the capacity of Evaporation Dam 3 to maintain the freeboard to contain the rainfall from a 1:100 year ARI storm of 72 hours duration, and the expected time duration for the actions and works.</td><td>Section 4.4.3 of LEMP</td></tr>
<tr><td colspan="3">8 – Pollution Studies and Reduction Programs</td></tr>
<tr><td colspan="3">U2 – Evaporation Dam 1 (ED1) and Evaporation Dam 2 (ED2) improvements</td></tr>
</table>

U2.1	By 30 September 2016, the licensee must engage a suitably qualified independent consultant (as approved by the EPA) to investigate the integrity of the ED1 and ED2 liners, all points of potential leakage from ED1 and ED2 and the nature and extent of any leakage or migration from ED1 and ED2.	Completed
U2.2	By 30 November 2016, the licensee must submit a report to the EPA detailing the results of the consultant's investigation required by condition U2.1. The report must include: a) an assessment of the geophysical conditions underlying and surrounding ED1 and ED2; b) an assessment of the integrity of the liner mechanism for ED1 and ED2; c) an assessment of the identified points of liner failure/faults; d) an assessment of the pathways for the migration of pollutants from ED1 and ED2 into the surrounding environment (including into Allianoyonyiga Creek and Crisps Creek); e) an assessment of the current nature and extent of groundwater and surface water pollution from ED1 and ED2; and f) recommended control and remediation measures to improve the integrity of ED1 and ED2, prevent the occurrence of seepage from ED1 and ED2, and repair or make good any groundwater or surface water pollution caused by ED1 and ED2.	Completed
U 3.1	By 30 December 2016, the licensee must submit a plan to the EPA detailing how it will reduce the amount of water entering the landfill void and making contact with the waste. The plan must: a) identify groundwater recharge points outside of the void; b) Identify groundwater seepage points within the void; c) Identify any other inputs; and d) Include a program of works aimed at minimising water ingress into the landfill void and increasing the capture and diversion of runoff from the walls of the void.	Noted

1.4 Stakeholder Consultation

Veolia is committed to meaningful stakeholder engagement and has worked in collaboration with relevant government agencies and the local community in the township of Tarago since the commencement of operations of the Bioreactor to resolve issues that impact local environmental amenity, as a result of operations at the Bioreactor.

1.4.1 Government Agencies

The following government agencies have been consulted with in association with the operations of the Bioreactor pertaining to soil and water management:

- DPE
- EPA
- NSW Department of Primary Industries – Water (DPI Water)
- Water NSW;
- Goulburn Mulwaree Council

1.4.2 Community Consultation

Veolia has formed a Community Liaison Committee (CLC), which acts as an interface between the residents of Tarago and Veolia to proactively resolve issues that potentially impact on local amenity from operations at the Bioreactor.

The key objectives of the communication and consultation program include:

- Educating stakeholders regarding key aspects of the Bioreactor; and
- Informing community groups and neighbours to help Veolia understand concerns.
- Meeting quarterly with Tarago and District Progress Association Incorporated (TADPAI) representatives on the CLC to provide updated information on odour incidents, leachate management, gas extraction and resolution of incidents related to the community.

Community consultation activities include:

- A dedicated Veolia webpage, offering general information on the Bioreactor: http://www.veolia.com/anz/our-services/services/municipal-residential/recovering-resources-waste/woodlawn-bioreactor
- A community telephone line to provide a central point of contact for community enquiries;
- Proving regular updates in the local newspaper, the Tarago Times, which is non-profit community service published monthly by the Tarago Sporting Association Inc. The newspaper is distributed throughout Tarago, Lake Bathurst, Mayfield, Boro, Taylors Creek and the surrounding district.
- Active participation in the TADPAI, which is a community group aimed at promoting the district and assisting the community in the development and maintenance of a rural lifestyle.

Veolia makes the following information publicly available on their website:

- Statutory approvals:
- Environmental Management Plan required under this approval
- Annual Environmental Management Report (including monitoring results (over the past 5 years)
- Independent Environmental and Odour Audit, and the Applicants' response to the recommendations in any audit
- A copy of the minutes of the Community Liaison Committee Meetings: and
- any other matters required bv the Director-General.
- report of the complaints and the response/action taken to resolve the complaint as required bv Condition 7 of the PA.

Section 2 Goals of the SWMP

The goals of the SWMP is to:

- Detail how soil and water is managed at the Bioreactor, including Evaporation Dams 2 & 3
- Detail measures to minimise soil erosion and mobilisation of sediment at the Bioreactor
- Detail measures to protect surface water and groundwater from activities associated with the Bioreactor
- Detail measures to separate stormwater and leachate management systems at the Bioreactor
- Detail suitable monitoring schedules for surface water and groundwater
- Provide a water balance for surface water storages and the Bioreactor

This plan additionally considers leachate management in relation to soil and surface water and groundwater at the Bioreactor. Further detail on leachate management and mitigation measures are provided in the LMP.

2.1 Roles and Responsibilities

Table 2.1 outlines the responsibilities of Veolia personnel with respect to soil and water management.

Table 2.1 SWMP Responsibilities

Action	Responsibility
Overall implementation of the SWMP	Woodlawn Facilities Manager and Operational Personnel
Implement management measures for soil and water	Woodlawn Facilities Manager and Operational Personnel
Maintenance of soil and water management controls	Woodlawn Facilities Manager and Operational Personnel
Coordinate monitoring and compile reports	Woodlawn Environmental Officer or nominee
Maintain internal records of monitoring	Woodlawn Environmental Officer or nominee
Undertake inspection of soil and water management controls	Woodlawn Facilities Manager / Woodlawn Environmental Officer or nominee
Facilitate training programs for soil and water	Woodlawn Facilities Manager / Woodlawn Environmental Officer or nominee
Collate and maintain records of complaints, respond to complainants.	Woodlawn Environmental Officer or nominee
Identify non-conformances and notify Facility Manager/ Safety Health Environment Quality (SHEQ) Representative	Woodlawn Environmental Officer or nominee
Authorise and confirm the implementation of mitigation measures	Woodlawn Facilities Manager/ Woodlawn Environmental Officer or nominee
Liaise with government agencies and regulators, Notify EPA when leachate in waste exceeds natural groundwater table and if volume in ED3 exceeds the 0.5 metre freeboard for each dam	Woodlawn Facilities Manager / Woodlawn Environmental Officer/SHEQ Representative

Section 3 Environmental and Operational Impacts

3.1 Existing Environment

3.1.1 Topography

The average elevation of the Woodlawn Site is approximately 800 metres above Australian Height Datum (m AHD), with a range in elevation from 760 m AHD in the north-east corner of the Site to 1000 m AHD along the ridgeline of the Great Dividing Range (GDR). The region generally comprises rolling undulating pastoral plains with the GDR running through the Site in a north–south direction. The western side of the GDR (roughly one-third of the Woodlawn Site) forms part of the Lake George Catchment, an ephemeral lake, while the remainder on the eastern side of the Great Dividing Range is part of the Wollondilly Catchment.

The Bioreactor has steep slopes, although many of these are either excavated within in-situ rock or are constructed from waste rock and are generally erosion resistant.

3.1.2 Hydrogeology

The aquifer systems in the area of the Bioreactor can be broadly divided into the fractured basement Ordovician and Silurian-Devonian aged volcanic, intrusive and sedimentary rocks and the overlying fluvial and hillwash sequences. The basement rocks exhibit low permeability which is due entirely to fractures.

Higher permeabilities in the fractured bedrock aquifer are associated with secondary (solution derived) porosity in limestone rocks which occur in outcrop to the north-east of the Bioreactor, however these rocks are not intersected in the former mine sequence and have no hydraulic influence on the Bioreactor.

Higher permeability sedimentary aquifers separated by low permeability clays and silts occur within overlying sediments where they exist at the bottom of the valleys and to a lesser extent on the slopes. The hydrological significance of these colluvial and alluvial permeable layers is that they are the ultimate conduit through which groundwater discharges and releases to the downstream environment. Importantly, however, this aquifer system is not intersected by the Bioreactor.

Groundwater recharge occurs to the bedrock primarily through direct rainfall infiltration to open fractures and joints in areas where bedrock outcrops. Groundwater discharges from the bedrock aquifer only where open fracture conduits exist and where the permeability of these conduits is sufficient to produce a flow rate which is significant in terms of the local catchment hydrology.

Regional groundwater flow gradients are a subdued reflection of surface topography and gradients away from the GDR can be expected to exist.

Modelling of groundwater flows shows a cone of depression is evident around the Bioreactor (Earth2Water, 2016) and this is expected to continue at least until the waste level approaches the natural water table.

3.1.3 Hydrology

Allianoyonyiga Creek and Crisps Creek are the primary receptors for discharges occurring from the Woodlawn site. The great dividing range bisects the Bioreactor and diverts flows to the Lake George (south- via Allianoyonyiga Creek) and Wollondilly (north via Crisps Creek) catchments.

A number of water users exist within the catchment downstream of the bioreactor site. Downstream water uses include local/domestic (township), stock (farm dams) and irrigation (agriculture). Within farms surrounding the bioreactor site, surface water run-off is often retained in dams for stock water supply.

3.1.4 Soils

The soil landscapes of the Woodlawn site are mapped in the Soil Landscapes of the Braidwood (Jenkins, 1996). The soil landscape mapping shows the entire area covered by anthropogenic soils which are soils that are disturbed by human activities

Site soils have been substantially disturbed and modified by mining activities. Large areas of exposed rock (Bioreactor, cut batters) and dumped waste rock exist on site. There are virtually no topsoil resources in the Bioreactor operational area and any previous topsoil resources would appear to be either lost during the mining phase or used for site rehabilitation works.

Extrapolation of the soil landscape maps indicates that the soils that existed on site prior to mining were either the Duckfield Hut Soil Landscape or the Kalbili (Variant) Soil Landscape.

The properties and constraints of the three soil landscapes are listed in **Table 3.1**.

Table 3.1 Soil landscapes properties and constraints

Soil Landscape	Soils	Properties
Duckfield Hut	Shallow, well drained Lithosols on crests, moderately deep Red Podzolic Soils on well drained side slopes and upper slopes. Moderately deep, moderately well to imperfectly drained Yellow Podzolic Soils on mid to lower slopes. Moderately deep to deep, poorly drained Soloths, Solodic Soils and Solodised Solonetz on lower slopes and drainage lines.	Seasonal waterlogging with localised rock outcrop, foundation hazard, saline seepage and waterlogging. Soils are infertile and locally shallow and topsoils are hard-setting. Subsoils are highly erodible, sodic, hard-setting, have low wet bearing strength and shrink-swell properties.
Kalbili (Variant)	Shallow, moderately well drained Earthy Sands/Loams on upper slopes. Moderately deep to deep, poorly drained Yellow Podzolic Soils and Solodic Soils on lower slopes.	Seasonal waterlogging, water erosion hazard, foundation hazard and run-on. Infertile soils, topsoils are acid. Subsoils are sodic, erodible, hard-setting and have low permeability.
Disturbed Terrain	Varies from level plains to undulating terrain and has been disturbed by human activity to a depth of at least 1m. The original soil has been removed, greatly disturbed or buried. Most of these areas have been levelled to slopes of <5%. Landfill includes a wide variety of soil, rock building and waste material. The original vegetation has been completely cleared.	Dependent on the nature of the fill material and may include mass movement hazard, soil impermeability leading to poor drainage, low fertility and toxic material.

3.1.5 Vegetation

Vegetation within the Woodlawn site is highly fragmented with large expanses of cleared land surrounding predominantly isolated remnants along the rocky ridges and roadsides.

Derived Grassland is the most abundant vegetation community, particularly on the mid to lower slopes and areas of the valley floor containing rocky and shale loam soils. The community is dominated by a variety of exotic and native pasture grasses, and has been significantly modified by earth movement associated with activities at the Woodlawn site and a history of intensive agricultural activities, including clearing, grazing and pasture improvement through the introduction of exotic and non-endemic grasses.

3.1.6 Surface Water Management

3.1.6.1 Design

The stormwater system was originally designed to manage a 1 in 100 year average recurrence interval (or 1% annual exceedance probability) 72 hour event. As the waste level has risen by approximately 100m, the volume of rain water required to be managed in a similar event is considered to be significantly less due to the decrease in surface area. As a contingency measure to prevent overflow, the water volume stored in ED3 is measured on a monthly basis to ensure that the minimum 0.5m freeboard requirements are maintained.

3.1.6.2 Stormwater/surface water within the Bioreactor

The haul road within the Bioreactor has been reshaped and catch drains have been installed along the edge of the haul road to collect and direct any stormwater to the surface water ponds located within the Bioreactor. The majority of stormwater within the Bioreactor is collected and stored as surface water for pumping to ED3.

Surface water collected on the covered landfill surface is drained to temporary storage ponds and is transferred to Pond 3. Where surface water comes in contact with waste or leachate, the water is managed as leachate through the leachate management system.

Surface water is managed in four sub-catchments, as shown in Appendix A. Each sub-catchment has either natural or engineered drainage and flow control infrastructure, such as concrete dish drains, clay berms, pumps and pipes to manage surface water. These systems minimise the amount of surface water flow from the Bioreactor walls onto the waste. This minimises the potential generation of excess leachate from surface water flows.

Pond 3, located on the western side of the Bioreactor on the 725 Reduced Level (RL). The water transfer rate from Pond 3 is 360 L/s, which consists of three 120L/s pumps operated on separate float switches. Water is pumped from Pond 3 via two transfer tanks to ED3S for storage. Locations of storage dams and pipe arrangements are shown in Appendix A.

Pond 3 has been designed to handle a short duration, high intensity rainfall event equivalent to 15mm/hr over three hours. This is based on pond capacity, pumping capacity and calculated inflow rates.

Water from Pond 3 will be transferred, after field-testing (using Hach Nitrogen-Ammonia Reagent Set, TNT, AmVer (Salicylate), High Range (0-50 mg/L) or similar) by taking a representative water sample from the transfer tanks. Ammonia has been selected as the key performance indicator (KPI) to determine the discharge criteria and transfer location as shown in the **Table 3.2** below.

Table 3.2 Discharge Criteria to ED3S from Pond 3

KPI	Criteria	Classification	Transfer Location

Ammonia (mg/L)	Less than 15 mg/L	Surface water	ED3S
	Greater than 15 mg/L	Leachate	ED3N and/or ED3S-S

This discharge criteria has been selected based on the potential for the presence of litter in Pond 3, particularly in windy conditions that can contribute to ammonia concentration from decaying waste. Veolia anticipates that despite this, there will be minimal odour impact from Pond 3 as a result.

Before commissioning of Evaporation Dam 2 to receive stormwater from the Bioreactor void, ED2 will be lined in accordance with recommendations of AECOM report. Stormwater will be transferred via pipeline from a sump located in ED3S once it has been commissioned.

3.1.6.3 Surface Water Drainage

Surface water drainage is managed as follows:

- Any water falling within the Bioreactor catchment area is managed within the Bioreactor sub-catchment areas and transferred to ED3
- Depending on independent integrity assessment of the ED2 liner system and completion of any rectification works, stormwater may be further transferred via pipeline from ED3S to ED2.
- The rehabilitated Western Ridge area drains back to clean catchment rather than ED3 or the Bioreactor.
- Surface water from the dolerite stockpile is diverted to ED1 via a series of engineered drains and pipes.
- Run off from the Plant Collection Area, including the power station, drains to the Plant Collection Dam (PCD). The PCD is pumped to Evaporation Dam 1, as needed.
- Any excess water from the Waste Rock Dam is diverted to ED1, as required. Note ED3 will not receive water stored in the Waste Rock Dam.
- The office and car park areas have extensive areas of lawn and have sealed roads with engineered drainage and culverts. These areas drain to clean catchment.
- ED3 ponds are confined catchment areas and any rainfall in the dams will mix with the dam contents.
- Erosion and sediment control and velocity abatement systems are incorporated into the surface water drainage system

3.1.7 ED2 Management

ED2 will continue to be managed by Develop in accordance with the existing approval requirements. ED2 will remain as a contingency measure for stormwater from the Bioreactor if required.

3.1.7.1 ED2 Survey Data

ED2 has been surveyed and the relevant details are provided in **Table 3.3** below:

Table 3.3 ED2 Survey Data

Dam Detail	ED2
Base of dam	783.0 RL
Top of dam walls	788.8 RL

Top of dam (0.5m freeboard)	788.3 RL
Maximum water volume *	846 ML
Surface area *	211,320 m^2

* At 788.3m RL

3.1.7.2 ED2 Management

If ED2 is commissioned for the storage of stormwater, a sump will be built in the ED3S lagoon for transfer of stormwater via pipeline to ED2 (see Appendix A - Surface Water Management Plan).

Before the use of the dam for the storage of stormwater from the Bioreactor, ED2 will be lined in accordance with the recommendation of the AECOM Report.

In order to manage the volume of water in ED2, the following actions will be undertaken:

- The dam will be lined and maintained to prevent leakage of stored acid mine drainage in order to protect groundwater and surface water.
- The sources of water that are collected or received in ED2 will be identified
- The volume of water pumped from the proposed ED3S sump to ED2 will be measured and recorded in order to track the amount of inflow into the dam.
- Rainfall volumes will be recorded at the onsite weather station
- Water levels will be measured after every rainfall event.
- Monthly calculations of volume and water level in ED2 will be monitored and compared in graphical format with rainfall data
- Water level will be recorded monthly using a surveyed marker post
- Water will be subjected to natural evaporation.
- Groundwater and surface water monitoring will be undertaken to demonstrate containment of water within ED2
- An emergency management plan for stormwater exceeding the capacity of the dam is included in the Woodlawn Bioreactor Emergency Response Plan.

3.1.7.3 ED2 Freeboard

Adequate capacity in the dam is maintained to ensure 0.5 metre freeboard. Measures to reduce the volume if liquid in ED2 following a significant rainfall event include:

- Pump and spray water over the Bioreactor walls for evaporation; or
- Use of mechanical evaporators to enhance evaporation.

Contingency measures to manage potential overflow of ED2 include:

- Pump water to Evaporation Dam 1 (ED1) located at the adjacent mine site.

3.1.8 ED1 Management

To ensure the integrity of ED1 against leakage and to separate the mine water from the treated effluent from LTP, ED1 will be subdivided into separate cofferdams to contain the effluent from the LTP. The HDPE lining

specification outlined in the AECOM report will be adopted for any dams to be used to contain treated effluent. Management of coffer dam(s) constructed within the footprint of ED1 are detailed in Section 4.2 of the LMP.

3.1.8.1 ED1 Management

In order to manage the volume of water in ED1, the following actions will be undertaken:

- Separation of mine water and treated effluent within the ED1 utilising HDPE lined coffer dams.
- The sources of water that are collected or received in ED1 will be identified.
- Rainfall volumes will be recorded at the onsite weather station
- Water levels will be measured after every rainfall event.
- Monthly calculations of volume and water level in ED1 will be monitored and compared in graphical format with rainfall data
- Water level will be recorded monthly using a surveyed marker post
- Water will be subjected to natural evaporation.
- Implementation of aggressive evaporation techniques on ED1 to remove water to reduce the volume to 10ML by 31 December 2023
- An emergency management plan for storm water exceeding the capacity of the dam is included in the Woodlawn Bioreactor Emergency Response Plan.

3.1.8.2 ED1 Freeboard

Adequate capacity in the dam is maintained to ensure 0.5-metre freeboard.

Measures to reduce the volume if liquid in ED1 following a significant rainfall event include:

- Pump and spray water over the Bioreactor walls for evaporation; or
- Use of mechanical evaporators to enhance evaporation.

Contingency measures to manage potential overflow of ED1 include:

- Pump water to Evaporation Dam 2 (ED2) located at the adjacent mine site.

3.1.8.3 ED1 Coffer Dam Freeboard

Adequate capacity in the dams are maintained to ensure 0.5-metre freeboard.

Measures to reduce the volume if liquid in the ED1 Coffer Dam(s) following a significant rainfall event include:

- Transfer excess volume shall be transferred to another dam with sufficient capacity; and
- Use of mechanical evaporators to enhance evaporation.

Contingency measures to manage potential overflow of ED1 Coffer dams include:

- Transfer treated leachate to approved lined sections of ED1; and
- If no capacity exists in other storages onsite, transfer of liquid to Bioreactor as a storage point as a last resort i.e storage bladders or purpose built storage dams.

Before any ED1 coffer dam(s) exceed 80 % capacity, sufficient space will be made available in new or existing HDPE lined dam in accordance with conditions of DA and PA for the discharge of effluent from LTP.

3.1.9 ED3 Management

ED3 is the primary storage dam for storing and managing collected stormwater and leachate from the Bioreactor. Surface water is managed in the southern section of ED3 (ED3S), while leachate is managed in the

northern section of ED3 (ED3N-1,2,3, & 4) and ED3S-S. The leachate and stormwater dams are separated by breakwalls to enable leachate and stormwater to be managed separately.

Management measures at ED3 ensure that the site can be operated as a zero discharge site, with discharge only acceptable in an event equivalent to or exceeding a 1% AEP of 72 hours duration.

3.1.10 ED3S Management

ED3S receives water from direct rainfall over the dam and stormwater pumped from the Bioreactor only. No treated leachate is stored in ED3S.

3.1.10.1 ED3S Survey Data

ED3S has been surveyed and the relevant details are provided in **Table 3.4** below.

Table 3.4 ED3S Survey Data

Dam Detail	ED3S
Base of dam	786.40m RL
Top of dam walls	791.00m RL
Top of dam (0.5m freeboard)	790.50m RL
Maximum water volume *	134.28 ML
Surface area *	74,531.5 m^2

* At 790.20m RL

3.1.10.2 ED3S Management

Stormwater is pumped through two transfer tanks from Pond 3 in the Bioreactor and discharged into the northeastern section of ED3S (Appendix A). This process is automated and occurs as required, following rainfall events that generate runoff. In the event it's identified that the quality of stormwater is not within the acceptance criteria as outlined in table 3.2 of section 3.1.6.2, the automated process is turned off.

In order to manage the volume of water in ED3S, the following actions are undertaken:

- The volume of water pumped from the Bioreactor to ED3S is measured and recorded in order to track the amount of inflow into the dam.
- Rainfall volumes are recorded at the onsite weather station
- Water level is recorded monthly using a surveyed marker post
- Water is subjected to natural evaporation
- Monthly calculation of volume and water level in ED3S
- Dam inspections of wall integrity, erosion and potential seepage are undertaken by a suitably qualified consultant
- Groundwater and surface water monitoring is undertaken to demonstrate containment of water within ED3S.
- An emergency management plan for stormwater exceeding the capacity of the dam is included in the Woodlawn Bioreactor Emergency Response Plan.

3.1.10.3 ED3S Freeboard

Adequate capacity in the dam is maintained to ensure 0.5 metre freeboard. ED3S is only subjected to incidental rainfall with the dam footprint and a 0.5m freeboard is sufficient to contain the rainfall volume.

Measures to reduce the volume of liquid in ED3S following a significant rainfall event include:

- Pump and spray water over the Bioreactor walls for evaporation; or
- Use of mechanical evaporators to enhance evaporation.

Contingency measures to manage potential overflow of ED3S include:

- Pump water to Evaporation Dam 2 (ED2) located at the adjacent mine site.

3.1.11 ED3S-S Management

ED3S-S is located to the south of ED3S and is separated by a breakwall. ED3S-S receives treated leachate from the Bioreactor via the leachate treatment system (LTS). Treated leachate is transported to ED3S-S depending on the capacity of ED3N leachate storage system for evaporation.

3.1.11.1 ED3S-S Survey Data

ED3S-S has been surveyed and the relevant details are provided in Table 3.5 below:

Table 3.5 ED3S-S Survey Data

Dam Detail	ED3S-S
Base of dam	785.79
Top of dam walls	794.12
Top of dam (0.5m freeboard)	793.62
Maximum water volume *	111.44
Surface area *	2.2 Ha

* At 790.50m RL

3.1.11.2 ED3S-S Management

ED3S-S receives treated leachate from the leachate treatment system. In order to manage the volume of water in ED3S-S, the following actions are undertaken:

- The volume of leachate pumped from the Bioreactor to the leachate storage dams is measured and recorded in order to track the amount of inflow into the dams
- The volume of treated leachate within ED3S-S ponds is surveyed each month
- Rainfall volumes are recorded at the onsite weather station and monthly calculation of volume and water level in ED3S-S is monitored and compared in graphical format with rainfall data
- Leachate treatment rates can be adjusted to reduce flow
- Leachate is subjected to natural evaporation
- ED3S-S is lined with a 1.5 m thick dual clay liner system which was independently verified by report (Construction Quality Control Assurance for Lining Evaporation Dam (ED3SS), November 2015 to July 2016) prior to initial receival of treated leachate(refer to Appendix B)
- Dam inspections of wall integrity, erosion and potential seepage are undertaken by a suitably qualified consultant

- Monitoring of the existing groundwater and surface water network is undertaken to demonstrate containment of leachate within ED3S-S
- An emergency management plan for leachate exceeding the capacity of the dam is included in the Woodlawn Bioreactor Emergency Response Plan.

3.1.11.3 ED3S-S Freeboard

Adequate capacity in the dam is maintained to ensure 0.5 metre freeboard. ED3S-S is only subjected to incidental rainfall within the dam footprint and a 0.5m freeboard is sufficient to contain the rainfall volume.

Measures to reduce the volume of liquid in ED3S-S following a significant rainfall event include:

- Pump leachate between the ponds should adequate space be available

Contingency measures to manage potential overflow of a pond in ED3S-S include:

- Pump leachate between the ponds should adequate space be available; and/or
- Pump leachate back to the Bioreactor for storage.

3.1.12 ED3N Management

ED3N consists of four ponds separated by breakwalls. There is no operational requirement for the separated dams and this is a result of the completion of dam lining in series.

31.12.1 ED3N Survey Data

ED3N has been surveyed and the relevant details are provided in **Table 3.6** below:

Table 3.6 ED3N Survey Data

Dam Detail	ED3N-1	ED3N-2	ED3N-3	ED3N-4
Base of dam	787.40m RL	788.00m RL	787.80m RL	786.20m RL
Top of dam walls	791.80m RL	791.60m RL	791.50m RL	791.80m RL
Top of dam (0.5m freeboard)	791.30m RL	791.10m RL	791.00m RL	791.30m RL
Maximum water volume *	22.59 ML	18.08 ML	14.80 ML	104.21 ML
Surface area *	8,572.60 m^2	7,103.60 m^2	6,304.2 m^2	39,715.50 m^2

* At 790.30m RL

3.1.12.2 ED3N Management

ED3N receives treated leachate from the leachate treatment system. In order to manage the volume of water in ED3N, the following actions are undertaken:

- The volume of leachate pumped from the Bioreactor to ED3N is measured and recorded in order to track the amount of inflow into the dam.
- The volume of treated leachate within each of the ED3N ponds is surveyed each month
- Rainfall volumes are recorded at the onsite weather station
- Monthly calculation of volume and water level in ED3N
- Leachate treatment rates can be adjusted to reduce flow
- Leachate is subjected to natural evaporation and mechanical aided evaporation
- ED3N dams are lined with 500mm of clay

- Dam inspections of wall integrity, erosion and potential seepage are undertaken
- Groundwater and surface water monitoring is undertaken to demonstrate containment of leachate within ED3N

These processes are discussed in further detail in the Leachate Management Plan.

3.1.12.3 ED3N Freeboard

Adequate capacity in the dam is maintained to ensure 0.5 metre freeboard. ED3N is only subjected to incidental rainfall with the dam footprint and a 0.5m freeboard is sufficient to contain the rainfall volume.

Measures to reduce the volume if liquid in ED3N following a significant rainfall event include:

- Pump leachate between the ponds should adequate space be available; and/or
- Use of mechanical evaporators to enhance evaporation.

Contingency measures to manage potential overflow of a pond in ED3N include:

- Pump leachate between the ponds should adequate space be available; and/or
- Pump leachate back to the Bioreactor for storage; and/or
- Pump leachate to Evaporation Dam 1 (ED1) or Evaporation Dam 2 (ED2) located at the adjacent mine site, if other options are not satisfactory.

3.1.13 Operational Water Use

Onsite water use is primarily used for the following activities:

- Wheel wash facility to minimise the potential to track mud and dirt from the site
- Container wash down to enable cleaning and maintenance containers transferring waste to minimise potential environmental impacts. These activities are only undertaken on an as needed basis to ensure that containers are maintained in appropriate condition.
- Services to office, lunch room and ablution facilities.
- Spraying of unsealed roads and waste surface with the water cart to minimise dust generation (bore water)
- Upkeep of the aquaponics project. The aquaponics project is a fish cultivation initiative using waste heat from the generators to heat water for growing fish. The water is purified by passing through hydroponic plants which filter nutrients from the water.

Veolia holds a water extraction licence which allows for the abstraction of 600 ML of groundwater from the Willeroo borefield. This water is pumped to the raw water dam and is utilised to save on potable water usage at the site.

3.1.14 Imported Liquids

Leachate and wash down waters from Veolia's Transfer Terminals in Sydney are imported to the Bioreactor under the EPL's. This can be managed either through direct discharge into the leachate aeration dam or recirculation within the Bioreactor.

Any liquids required to be imported to supplement moisture within the Bioreactor process would be tested to determine the chemical composition, prior to injection into the waste. Approval from the EPA would be obtained prior to undertaking these activities.

3.1.15 Leachate Management System

Leachate is managed separately to surface water at the Bioreactor. Further detail on leachate management is provided in the Leachate Management Plan.

3.1.16 Existing Barrier Systems

A 900mm thick compacted clay liner with a maximum in-situ permeability of $1x10^{-9}$ m/s was installed in the base of the Bioreactor to limit the potential for leachate seepage at the base of the landfill.

Clay lining in sections of the Bioreactor where the rock formation is discontinuous, such as faults and slips have been lined with at least 1m thick clay with a maximum in-situ permeability of $1x10^{-9}$ m/s.

Details of the existing barrier systems for the mine audits and seeps are provided within the Leachate Management Plan.

3.1.17 Leachate Extraction and Treatment

To manage liquid levels within the Bioreactor leachate is extracted and removed from the system. This process has succeeded previous liquid management measures such as groundwater extraction from the base of the void.

All leachate extracted from the Bioreactor shall be subjected to treatment prior to storage in ED3, unless otherwise agreed with the EPA. The leachate treatment system is discussed in detail in the Leachate Management Plan.

3.1.18 Existing Sewerage System

All sewerage is collected within a wastewater treatment system which is located adjacent to the Plant Collection Dam (refer Appendix A). All wastewater and solids enter the system via a sewer main into the primary treatment tank where digestion processes take place. Anaerobic microorganisms breakdown faecal solids to an inert waste.

Two chambers then provide aerobic treatment using a flow through a media pack fixed below water level. Aerobic microorganisms quickly form and attach to the media pack cleaning the water as it passes through.

Surge control allows water to rise and fall by up to 250 litres controlling flow to less than 10 litres per minute. The settling sludge in the sedimentation chamber is returned to the primary inlet of the septic tank. Treated effluent is disinfected and pumped to a small spray irrigation area adjacent to the system for evaporation. The aim of this is to maintain a moist surface without waterlogging the area, causing potential runoff.

Pump outs of the system are required on an infrequent basis which is managed as required. Quarterly servicing and maintenance of the system is carried out in accordance with the licence to ensure that the system is operating efficiently.

The sewage treatment system is regulated by Goulburn-Mulwaree Council with inspections undertaken following notification. Any follow up actions identified by the Council Officer are addressed as soon as practicable.

No further requirements are provided by the EPA within the EPL.

3.1.19 Water Balance

Veolia engaged WSP (Parson Brinckerhoff) in September 2017 to complete a revised water balance (Appendix D) to provide clarity regarding the Management of the treated effluent from LTP and Treated leachate from LTD and surface water for the Bioreactor.

The scope of the revised water balance model included:

- Discharge rate of 4L/s to new cofferdam
- Implementation of aggressive evaporation techniques on ED1 to remove water including 2 x 75kW Atomisers, each with a throughput rate of 25L/s and assumed to be operating 30% of the time
- Separation of mine water and treated effluent within ED1 utilising new coffer dams in the southern section of ED1
- Heron water usage assumed 7L /s as worst case scenario and include 2L/s of treated effluent, 5L/s of mine water from ED1 and ED2
- Additional mechanical sprayers to be utilised in ED3 lagoons to maintain capacity in existing ED3 lagoons until the LTP is operational and to reduce volume over time
- Existing LTD to be maintained at an additional 2L/s for the first 12 months operation of new LTP to reduce leachate levels in the void and maximise landfill gas production. The average required leachate extraction rate is expected to reduce to between 2 and 3L/s over time once the waste level exceeds the height of the piezometric water level within the bioreactor.

The outcomes of the water balance identified the following:

- That the timeframe required emptying all the water in ED3N is within 5 years with the aid of Mechanical Evaporators.
- New 150ML cofferdam within the footprint of ED1 is sufficient to manage treated effluent for a 4-year period.
- Once the new coffer dam reaches free board level volumes, ED3N dams will be able to be used to store treated effluent from LTP. ED3N dams will be individually assessed for permeability using in-situ testing techniques to prove they meet the required permeability standards already approved for the site before storing treated effluent. Water balance for the Bioreactor was completed as part of the EA. This is referenced within the LMP.

To supplement this, Veolia commissioned WSP / Parsons Brinckerhoff to complete a detailed water balance for all surface water storages outside of the Bioreactor. The purpose of this study was to determine if there is sufficient storage within existing dams at the Woodlawn site for current and planned surface water and leachate management.

The outcomes of the surface water storages water balance identified the following:

- Management of dams with a 0.5m freeboard was sufficient, over the range of simulated scenarios, to contain the dam contents without overflow. Level adjustment may be required following significant events.
- ED2 has sufficient capacity to handle stormwater flow from the Bioreactor under all climatic sequence simulated,

ED2 will continue to be managed by Heron in accordance with the existing approval requirements and will remain as a contingency measure for stormwater from the Bioreactor if required.

3.1.19.1 Water Management Simulation (WMS)

Veolia completed water Management Simulation for Woodlawn Bioreactor, (Appendix E) in Nov 2017. The purpose of this simulation was to determine if the water can be managed on the site post 2028 when Hereon stops using the 2L/s from the LTP and the net inflow rate into the leachate storage dams would go up to 4 L/s. The WMS assumed leachate storage dams will be considered as whole dams, with the status shown in **Table 3.7** below.

Table 3.7 WMS Storage Assumption

Residual storage capacity (ML)	Evaporation per year (ML)	Rainwater catchment per year (ML)	Net inflow per year (ML)	Water accumulation per year (ML)
386.1	195.5	93.7	126.2	24.4

The WMS showed that water could be managed on the site till 2059 with the help of evaporators and construction of a new effluent dam before Jan 2045 within the footprint of existing ED1.

3.2 Roads

The main haul route from Collector Road to the Bioreactor is sealed including the haul road down to the waste surface. This road receives the highest traffic flow at site for heavy vehicles.

Other site access roads are unsealed but generally receive light vehicle traffic or dump truck movements. Where dump truck movements occur the roads are maintained with road base materials from the Dolerite stockpile and graded frequently. The water cart will be activated in these areas while dump trucks are operating.

3.3 Cover and Aggregate Materials

Natural materials used in the operation of the Bioreactor may be extracted from the Woodlawn site or imported from offsite locations. These stockpiles provide sufficient material for covering for at least the next 5 – 10 years.

The materials extracted are taken from borrow areas associated with the Woodlawn SML 20 and associated Mining Operations Plan and include:

- Clay for lining of dams and the Bioreactor walls;
- Soil (as Virgin Excavated Natural Material) for covering of waste; and
- Aggregate screened to various sizes for use as drainage media.

Daily and intermediate cover is applied in accordance with the requirements of the EPL. The use of VENM ensures that the material will not inhibit the biological decomposition processes occurring within the Bioreactor.

3.4 Soil and Water Quality Impacts

Additional soil and water impacts are not anticipated based on the EA. The existing potential soil and water impacts associated with operations of the Bioreactor are:

- Erosion of land and soils within operational areas, that may or may not have been previously disturbed by mining activities;
- Mobilisation and transport of sediment into nearby surface water systems;
- Contamination of surface water systems from activities associated with the Bioreactor; and
- Contamination of groundwater systems from activities associated with the Bioreactor.

The potential risks are shown in **Table 3.7** below:

Table 3.7 Soil and Water Risk Rating

Issue	Potential Impact	Source	Risk Ranking	Key Issue
Soil and Water	Erosion of land and soils	Areas that have been disturbed by mining activities or areas that are un-vegetated may be subject to erosion of topsoil under wet weather events	Moderate	Yes Refer to 4.1.1
	Mobilisation and transport of sediment	Areas subjected to erosion and runoff may transport sediment offsite and//or into surface water systems	Low	Yes Refer to 4.1.6
	Contamination of surface water system from operational activities	If not properly managed, conducting waste filling operations in the vicinity of surface water systems could lead to contamination from waste, leachate, sediments, chemicals, acid rock drainage or other pollutants	Moderate	Yes Refer to 4.2.4
	Contamination of groundwater system from operational activities	If not properly managed, conducting waste filling operations in could lead to contamination of groundwater from waste, leachate, sediments, chemicals, acid rock drainage or other pollutants	Moderate	Yes Refer to 4.2.4

Section 4 Soil and Water Management Measures

4.1 Soil Control Measures

Mitigation measures that have been incorporated into the operations of the Bioreactor to minimise the risk and consequences associated with the key soil management issues identified are summarised below:

- Minimising soil erosion
- Progressive stabilisation of disturbed areas
- Maximising sediment retention onsite
- Integration of Bioreactor with site topography
- Wetting of unsealed roads
- Controlling water movement through the site
- Minimising the extent and duration of land disturbance
- Inspecting soil and water control measures
- Maintaining asphalt sealed access roads for high traffic areas
- Maintaining drainage, erosion and sediment control measures

Erosion and sediment control measures have been adapted in accordance with NSW Department of Climate Change, 2008. Managing Urban Stormwater, Soils and Construction Volume 2E Mines and Quarries. Additional erosion and sediment control structures shall be implemented over the life of the Bioreactor, where and if required.

4.1.1 Minimising soil erosion

Sediment and turbid water is only generated when erosion occurs. Effective erosion control is therefore a fundamental component of drainage, erosion and sediment control strategies. Energy dissipators will be considered at the outlets of drains and spillways to reduce flow velocities to less than the maximum permissible velocity for the soil type.

Where possible, vegetation has been established over exposed soils to minimise the soil erosion. This will not be considered on cover material over the waste.

Where topsoil can be won onsite, material will be stockpiled and reused for operational activities or rehabilitation of the Woodlawn mine site.

Management practices for stockpiles consider geofabric covers, vegetation or bunding where erosion is likely to occur.

4.1.2 Progressive stabilisation of disturbed areas

The Woodlawn site has previously been extensively disturbed by mining activities. Progressive rehabilitation will be undertaken at the Woodlawn site and may include areas of the Bioreactor.

The next stage of remediation and rehabilitation works will commence on the Disused Plant Area. A remediation options report has been developed for this area.

4.1.3 Maximising sediment retention onsite

Catchments associated with the Bioreactor report to either the Bioreactor, the Evaporation Dams or the Plant Collection Dam. Any sediment generated is managed within these systems and there is no discharge from site from these catchments.

The office and office car park which are considered a clean water catchment discharges to a natural drainage channel and on to Crisps Creek.

A wheel wash facility located at the entrance to the Bioreactor is used to clean the wheels and undercarriage of vehicles leaving the site. This process washes off and captures any potential accumulated sediment.

Sediment is cleared from the wheel wash facility, as required. This material is used as cover material in the Bioreactor.

4.1.4 Wetting of unsealed roads

Unsealed roads are watered where traffic is continuous to minimise loss of windblown soils with the aim of ensuring that roads remain moist but not wet.

4.1.5 Appropriately integrating operations with site constraints

The Bioreactor utilises the existing topography created by previous mining operations to avoid extensive land reshaping. This includes using the open cut mine void as the Bioreactor and ED3 for storage of stormwater and leachate.

4.1.6 Controlling water movement outside the Bioreactor

Drainage systems consist of lined and unlined drains and diversion banks. Existing clean water drains and banks will be maintained to continue to divert run-on water around the Bioreactor towards natural drainage channels.

Installation of new drainage channels will incorporate lining or vegetation to minimise erosive effects. Where required, velocity control structures will be implemented to slow down the flow of water through a channel. The excavation of unlined channels in dispersive soils will be avoided where possible to minimise the potential for gully and tunnel erosion

Future progressive rehabilitation of the site will aim to use compost generated from the Mechanical Biological Treatment (MBT) facility process to improve soil conditions and facilitate vegetation on previously disturbed areas. Once effective vegetative cover is achieved, structural erosion controls may be removed to facilitate sheet flow conditions which have less erosion potential and do not require ongoing maintenance.

4.1.7 Minimising the extent and duration of land disturbance

Works that require land disturbance are inspected prior to disturbance and necessary drainage and erosion and sediment controls will be planned and implemented as required.

Ongoing earthwork activities associated with the Bioreactor and Woodlawn site include:

- Lining, desilting and/or improving existing dams
- Maintaining haul roads and other structural control works
- Establishment of borrow areas to provide cover and capping materials
- Extraction and screening of material in the Dolerite stockpiles to provide aggregate
- Minor reshaping of land to facilitate remediation and rehabilitation of disturbed mining areas

If additional land disturbances are required in the future, Veolia will schedule and sequence major land disturbing activities to avoid higher rainfall erosivity periods associated with the summer storms, where practical, to minimise erosion.

4.1.8 Maintaining asphalt sealed access roads for high traffic areas

The main haul road from the site entrance to the waste surface consists of a sealed surface. This will be maintained, as required, to minimise the potential for erosion along high traffic routes.

4.1.9 Inspecting soil and water control measures

Frequent inspections of the performance and integrity of erosion and sediment control structures are undertaken as follows:

- Monthly as part of the general site inspection practices
- Following a rainfall event causing runoff to occur on or from the Bioreactor operational areas.

Inspections are undertaken on drainage channels, erosion control structures, stormwater pits and ED3.

4.1.10 Maintaining drainage, erosion and sediment control measures

Maintenance and remedial actions to be undertaken, as required. The actions specified in **Table 4.1** relate to controls that are applicable to the Bioreactor, although not all controls may be implemented.

Table 4.1 Maintaining drainage, erosion and sediment control measures

CONTROL	MAINTENANCE AND REMEDIAL ACTIONS
Drainage control	
Clean water diversion drains and banks	• Clear sediment accumulation where necessary. • Ensure flow is not diverting from drainage channel

	• Maintain minimum soil surface cover of 70%. • Repair any erosion and line channels if necessary.
Dirty water diversion drains and banks	• Repair any erosion, re-line if necessary. • Repair tunnel erosion if present.
Temporary clean water culverts	• Ensure turbid water cannot enter the pipe or outlet channel. • Monitor for erosion around the inlet and outlet headwalls and repair as necessary. • Check the pipe outlet energy dissipater for erosion and repair and/or modify as necessary.
Erosion Control	
Vegetate exposed areas	• Test soil if there is poor growth of evidence of nutrients deficiencies. • Apply additional soil ameliorants and reseed if soil surface cover is less than 70%.
Polymer soil stabiliser	• Use of polymer stabilisers should be considered in areas where erosion is evident. Reapply following significant rainfall or heavy vehicle traffic.
Lined channel and drains	• Look for water flows under or beside the structure and repair and/or modify as necessary. • Look for erosion around and downstream of the energy dissipater and repair and/or modify as necessary.
Unsealed Roads	• Apply more gravel if roads become rutted or the desired profile is reduced.
Revegetation and rehabilitated areas	• Inspect for evidence of rill, gully, tunnel erosion, poor soil surface cover and nutrient deficiencies. • Apply compost when available and if deemed necessary.
Sediment Control	
Silt fences	• Ensure silt fences pond water. If not, install additional panels. • Check for blow-outs in the anchor trench. Re-anchor as necessary. • Replace any ripped or damaged sediment fence.
Truck and container wash down bays	• Remove accumulated sediment, leachate and any waste.
Stormwater Ponds, Leachate Dams and Evaporation Dams	• Check basin inlets and outlets for erosion and repair as necessary. • Check dam walls for seepage, slumping or tunnel erosion. Repair as necessary. • De-silt/desludge as required. Sludge from the leachate dam shall be buried within the Bioreactor. Any silt shall be used for covering the waste

4.2 Water Control Measures

Mitigation measures that have been incorporated into the operations of the Bioreactor to minimise the risk and consequences associated with the key water management issues identified are summarised below:

- Clay liner installed at the base of the Bioreactor
- Clay lining to seal crack, faults and slip areas in the Bioreactor wall
- Maintaining and inward hydraulic gradient to the Bioreactor
- Operating separate leachate and surface water capture systems
- Lining of leachate dams in accordance with minimum standards
- Storing of fuels and chemicals in appropriately bunded areas/containers
- Wetting of unsealed roads
- Undertaking of water quality monitoring
- Assessment of the integrity of ED2, as detailed in **Section 3.1.2**, before mine void stormwater and direct rainfall and run-off is received and stored in ED2.

4.2.1 Clay liner at the base of the Bioreactor

900mm thick compacted clay liner with a maximum in-situ permeability of $1x10^{-9}$ m/s was installed in the base of the Bioreactor to limit the potential for leachate to contaminate groundwater. A 300 mm deep gravel drainage blanket was installed with high density polyethylene (HDPE) leachate collection pipes placed in a herringbone arrangement to facilitate dewatering of the leachate.

4.2.2 Clay lining to seal crack, faults and slip areas in Bioreactor wall

Clay is used to seal any crack or known inflow area (such as in rock fault and slip areas) in the rock in the Bioreactor walls. This is a progressive measure which would be managed in the designated areas as the height of the waste increases.

The entire top 20m of the Bioreactor walls will be lined with clay to ensure any pathways that are above the natural water table are sealed to minimise the potential for leachate to spread into local groundwater aquifers.

Sealing of mining audits is detailed in the Leachate Management Plan.

4.2.3 Maintaining an inward hydraulic gradient to the Bioreactor

An inward hydraulic gradient will be maintained by:

- Determination of a long term leachate extraction rate, which may change over time
- Extraction and treatment of leachate
- Diversion of stormwater, where feasible
- Diversion of groundwater, where feasible
- Monitoring of groundwater and leachate levels

Where required, these actions will continue into the post closure management period of the Bioreactor.

4.2.4 Operating separate leachate and surface water capture systems

Diversion systems including concrete drains, engineered ponds, bunding, pump and pipe systems have been installed around the Bioreactor walls to capture and divert stormwater and groundwater seeps into surface water collection systems. Water from these systems is directed into Pond 3, located on the western side of the Bioreactor on the 725 RL bench.; Water from Pond 3 is then pumped to ED3S for storage and/or transfer to

ED2, following work to the liner. The performance of these systems will be reviewed, as needed, and where required modifications or new systems will be implemented.

Any rainfall or surface water that comes in contact with waste or leachate is managed as leachate. Leachate will either be recirculated back into the waste mass or extracted for leachate treatment. Leachate extraction will aim to maintain an inward groundwater hydraulic gradient. Further detail is provided in the LMP.

4.2.5 Lining of leachate dams in accordance with minimum standards

All onsite treated leachate storage dams are lined with clay to manage integrity of the dams and prevent migration of leachate into receiving waters.

The Evaporation Dam North (ED3N) storage dam is lined with 500mm thick clay. The leachate aeration dam, which holds raw leachate from the Bioreactor, has a HDPE membrane and is housed within the capture area of the Bioreactor.

All new leachate dams will be designed and lined in accordance with minimum standards. Construction works will be independently verified and the appropriate documentation will be submitted to the EPA for approval, where required. Further details on leachate management are provided in the LMP.

4.2.6 Storing of fuels and chemicals in appropriately bunded areas/containers

Appropriate containment of fuels and chemicals will be undertaken to prevent soil and water contamination from leaks and spills.

Diesel is stored in a 70 kL double skinned self bunded tank. This tank is to be inspected and tested in accordance with the site Inspections and Testing register.

Drums of chemicals and hydrocarbons are stored on bunded pallets with a capacity of at least 110% of the largest container stored within the bund. Drums and bunding are located in covered areas.

Bunding shall comply with Australian Standards, and the OEH Environmental Protection Manual: Technical Bulletin Bunding and Spill Management. Any spills of chemicals and fuel are managed in accordance with responses detailed in the site Emergency Response Plan (ERP). Containment may include the use of absorbent material to contain the spill/discharge. Spill kits are available onsite at all times and training in their use is provided to personnel. Spill kits are replenished every three months in accordance with the site Inspections and Testing register.

4.2.7 Wetting of unsealed roads

As part of the water control and dust suppression measures used onsite, potable and non-potable water for operational uses is determined as follows:

- Wetting of roads outside the Bioreactor catchment shall only be undertaken with bore water or mains water. Any change to this would be agreed with the EPA.
- Wetting of roads within the Bioreactor may be comprised of treated leachate, container wash down water, stormwater, bore water or mains water.

4.2.8 Evaporation of excess liquids

Evaporation is the main process to manage excess liquid at the Bioreactor. The use of both natural and mechanical spray units may be used on both stormwater and treated leachate under controlled conditions. To achieve this the mechanical sprayers will be automated based on ambient climatic conditions such as wind direction to ensure that any spray is directed back over onsite dams. This ensures no drifting of sprayed liquid occurs to cause any adverse impact to public health.

4.2.9 Undertaking of a water quality monitoring program

Veolia has an established groundwater and surface water monitoring program which is specified in EPL 11436. Veolia will continue to implement the program in accordance with the EPL. The monitoring program is detailed in **Section 5.1**.

Section 5 Soil and Water Monitoring and Reporting

5.1 Monitoring Program

Veolia undertakes an environmental monitoring program in accordance with the requirements in EPL 11436. Environmental monitoring is completed in accordance with Veolia's environmental monitoring procedures, which specify the relevant standards and methodologies.

The surface water and groundwater monitoring locations at the Bioreactor are provided in the Monitoring Location Plan in **Appendix C**.

Leachate monitoring requirements are detailed in the LMP.

Soil monitoring is not undertaken as there is minimal risk of further contamination from water sources given the degraded nature of the disturbed mine site. However, erosion and sediment control measures have been implemented onsite to ensure storage water storages are protected from contaminated run-off.

In addition, groundwater monitoring is undertaken to ensure negative trends are identified. The existing groundwater network in the vicinity of the surface water storage dams will be utilised to evaluate the integrity of dam barriers and to assess if leakage is occurring.

Surface water and groundwater monitoring data is routinely assessed in combination with

- Meteorological data such as rainfall and evaporation
- Pump hours, flows and flow rates
- Dam levels

Guidance provided in the Australian Water Quality Guidelines for Fresh and Marine Waters (ANZECC, 2000) has also been considered to ensure performance measures are met.

5.1.1 Surface Water Monitoring

Surface water monitoring required under EPL 11436 is detailed in **Table 5.1**. Refer to Appendix C for the monitoring locations

Table 5.1 EPL Surface Water Monitoring Schedule

Parameter	Monitoring Location	Frequency
BOD, Conductivity, Dissolved Oxygen, Nitrogen (Ammonia), pH, Potassium, Redox Potential, Total Dissolved Solids, Total Organic Carbon	Site 115 – Allianoyonyige Creek (Downstream receiving waters of ED2) Spring 2 - Crisps Creek Site 105 - Crisps Creek Site WM200 - Raw Water Dam Site WM201 - Existing Mine Buildings Site WM202 - ED3 South Site WM203 - ED3 North ED3SS – ED3 South-South Pond 5 ED1	Quarterly

	ED1 Coffer Dam 1 ED1 Coffer Dam 2	
Volume (ML)	ED3 Dam network: • ED3 South • ED3 North Lagoon 1 (ED3N1) • ED3 North Lagoon 2 (ED3N2) • ED3 North Lagoon 3 (ED3N3) • ED3 North Lagoon 4 (ED3N4) • ED3 South-South Lagoon 5 (ED3S5) ED1 Coffer Dam 1 ED1 Coffer Dam 2 ED1	Monthly
Transfer Volume (ML)	ED3S to ED2 (proposed) Source and Volume of ED2	Weekly intervals once the transfer of stormwater from ED3S to ED2 has commenced and will be reviewed 12 months after commencement of MOD 2.
Ammonia(mg/L)	Stormwater from Pond 5 to ED3S	Before the transfer

The surface water-monitoring program will also address the chemical composition of leachate within ED3S-S as well as within the effluent discharge line.

Surface water monitoring data will be correlated with:

- Pump hours, flow volumes, flow rates
- Inflows and outflows to surface water storages
- Dam levels

Any surface water discharge monitoring is completed in accordance with the relevant EPA Approved Method.

5.1.2 Groundwater Monitoring

Groundwater monitoring required under EPL 11436 is detailed in **Table 5.2**. Refer to **Appendix C** for the monitoring locations

Borelogs, coordinates and construction details of all groundwater wells (**Appendix F**) are maintained and referenced within Veolia's environmental monitoring records. This information is also supplied to the EPA for each well listed on the EPL.

Groundwater monitoring bores MW8S, MW8D, MW10S and MB28 will be used to identify any potential seepage from the ED1 effluent dam.

Exploration drill holes shall be considered for the future replacement of any monitoring wells.

Table 5.2 EPL Groundwater Monitoring Schedule

Parameter	Monitoring Location(s)*	Frequency
Alkalinity (as calcium carbonate), Calcium, Chloride, Magnesium, Nitrogen (Ammonia), pH, Potassium, Sodium, Standing Water Level, Sulfate, Total Dissolved Solids,	MB1, MB2, MB3, MB4,MB6, MB7, MB10, ED3B, WM1, WM5, WM6, MW8S,MW8D, MW9S, MW10S, MB28, MB33, MB34, MB35	Quarterly
Aluminium, Arsenic, Barium, Benzene, Cadmium, Chromium (hexavalent), Cobalt, Copper, Ethyl Benzene, Fluoride, Lead, Manganese Mercury, Nitrate, Nitrite, Organochlorine Pesticides, Organophosphate Pesticides, Polycyclic Aromatic Hydrocarbons, Toluene, Total Organic Carbon, Total Petroleum Hydrocarbons, Total Phenolics, Xylene, Zinc	MB1, MB2, MB3, MB4, MB6, MB7, MB10, ED3B, WM1, WM5, WM6, , MW8S, MW8D, MW9S, MW10S, MB28, MB33, MB34, MB35	Annual
Standing Water Level	P38,200A,200 B, P58, P59, P100	Quarterly

5.1.3 Dams Monitoring and Inspection Program

Table 5.3 outlines the monitoring and inspection program for evaporation dams. Groundwater and surface monitoring locations, as indicated in the table, in the vicinity of these dams will be used to determine performance. The analytes and frequency of testing are provided in **Tables 5.1** and **5.2** above. Review of the monitoring data and inspection, to evaluate the integrity of the dams, shall be undertaken 6 monthly.

Table 5.3 Dams monitoring and inspection program

Dam	Reference Monitoring Point	Location Description	Parameter	Compliance Requirement
ED1	ED1 Coffer Dam 1	Evaporation Dam 1	Surface Water	EPL
	ED1 Coffer Dam 2	Evaporation Dam 1	Surface Water	EPL
	ED1	Evaporation Dam 1	Surface Water	SML20
	MB1	Monitoring Bore 1	Groundwater	EPL/SML20
	MB2	Monitoring Bore 2	Groundwater	EPL/SML20
	MB10	Monitoring Bore 10	Groundwater	EPL/SML20
ED3S Dam System	ED3B	Evaporation Dam 3 Piezometer	Groundwater	EPL
	WM202	Evaporation Dam 3 South	Surface Water	EPL
	WM5	Monitoring Well 5	Groundwater	EPL/SML20
	MB6	Monitoring Bore 6	Groundwater	EPL/SML20
	MB7	Monitoring Bore 7	Groundwater	EPL/SML20
	WM5	Monitoring Well 5	Groundwater	EPL
ED3N	WM203	Evaporation Dam 3 North	Surface Water	EPL

	MW9	Monitoring Well 9	Groundwater	EPL
	WM6	Monitoring Well 6	Groundwater	EPL
	MW8D	Monitoring Well 8 Deep	Groundwater	EPL
	MW8S	Monitoring Well 8 Shallow	Groundwater	EPL

5.2 Performance Reporting and Review

All monitoring data collected is presented in a consolidated Annual Environmental Management Report (AEMR) which is submitted to DP&E, EPA and other relevant stakeholders. Where performance reporting is required, the EPL stipulates that all relevant data and information pertaining to environmental monitoring must be recorded and maintained on site, including but not limited to:

- Sampling dates, times and name of sampler;
- Chain of Custody, analysis and results;
- Complaints received and corrective actions taken; and
- Copy of the EPL, development consent and other relevant approvals.

The monitoring data is used to review and identify any exceedances and to assess the change in water levels compared to the water table over time, against the adapted goals with the appropriate corrective actions applied as discussed below.

5.3 Exceedances and Corrective Actions

All incidents are reported and investigated, and corrective actions assigned to prevent future occurrences.

An incident may involve any action or activity deemed to be in non-compliance with this SWMP, other management plans as well as actual or potential Material or Serious Environmental Harm, or *Pollution of Waters* pursuant to section 120 of the *Protection of the Environment Operations Act 1997*.

All incident reporting will be recorded in RIVO, which forms part of Veolia's National Integrated Management System (NIMS).

5.4 Publishing of Data

Where required, Veolia publishes the results of any environmental monitoring required under the EPL on the following website: https://www.veolia.com/anz/media/media/reports

Section 6 Soil and Water Monitoring and Reporting

In line with regulatory requirements, a response plan has been prepared detailing the measures to be implemented in response to any excess capacity of the ED3N, ED3S and ED3S-S during operation of the Woodlawn Bioreactor. Protocols for the investigation, notification and mitigation of any exceedances to respective trigger levels are also detailed in this section. **Table 6.1** describes the triggers and actions to be taken in the event that there is an exceedance of the trigger levels listed below.

Table 6.1 Triggers and Actions

Location	Pollutant	Performance Measure/Trigger	Action	Responsibility
Groundwater Wells	As per the Eco Project Site analytes testing regime	Existing groundwater network performance against baseline	Review Eco Project Site groundwater monitoring results; Identify exceedance, consider resampling and/or continue periodic monitoring to gauge any upward trends; Where applicable, report exceedance to DPE, EPA, Goulburn Mulwaree Council and any other relevant government agencies	Quarterly
ED3N (1,2,3 & 4) and ED3S-S ED1 Coffer Dam(s)	Treated leachate	0.5 m freeboard space Visual inspections for spills, leaks, level exceedances	In the event that a treated leachate dam approaches maximum storage capacity, water will be transferred to alternative leachate dams with suitable storage capacity. If all dams are approaching maximum storage volume, additional pumping capacity will be made available to return the treated leachate to the Bioreactor and the Leachate Treatment System will be disabled preventing	Facility Manager and/or operational personnel

			further discharge into dams. Follow incident processes for spills, containment etc.(refer **Figures 6.1** and **6.2**). Where applicable, report exceedance to DPE, EPA,Goulburn Mulwaree Council and any other relevant government agencies	

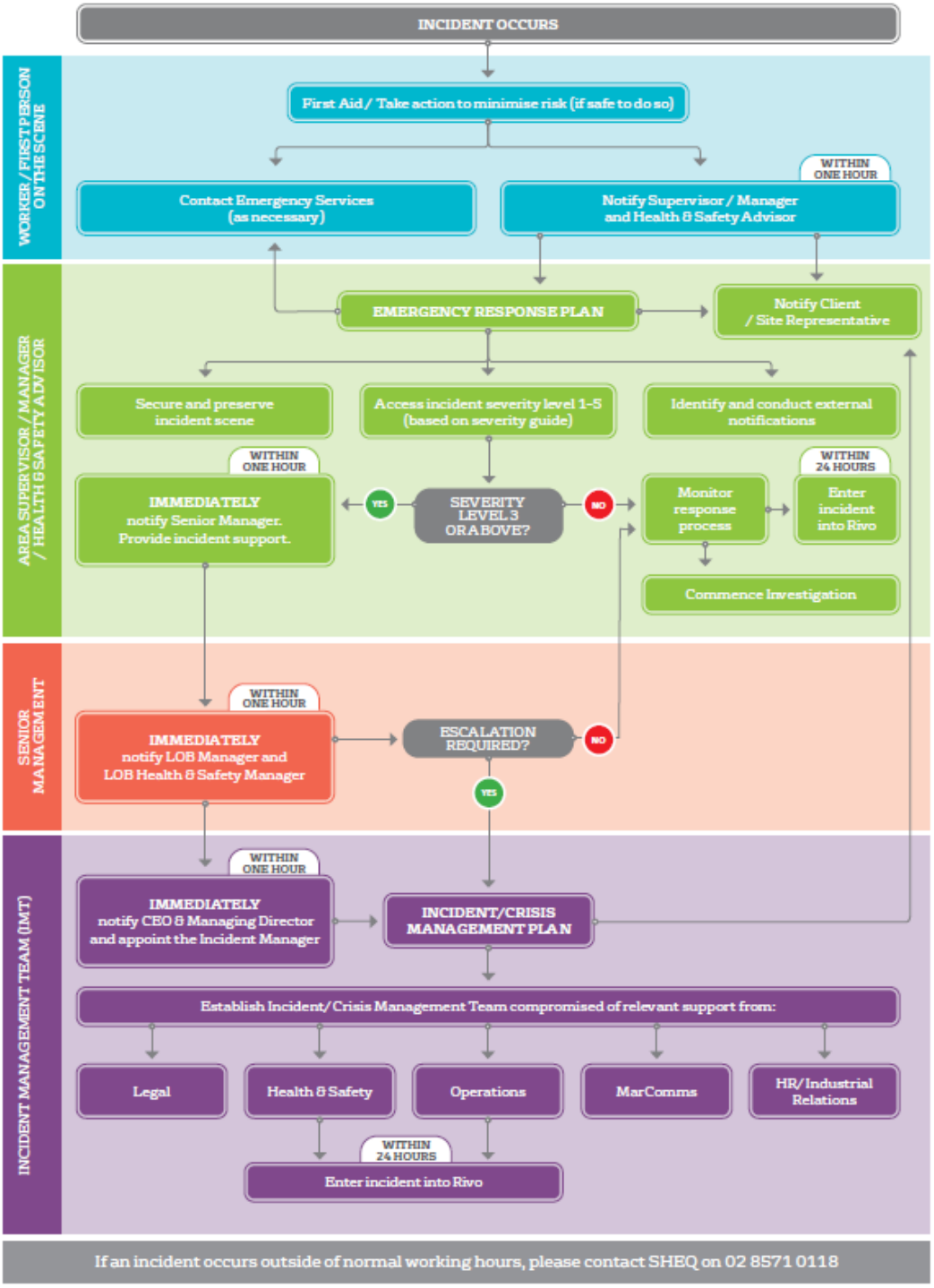
Handling of any soil and water related incidents will be managed in accordance with the process outlined in **Section 4.4** of the LEMP. The Facility Manager, or their site nominee, will record and manage all complaints in accordance with Veolia's complaints handling, notification and reporting procedures.

Incidents will be managed in accordance with Veolia's Incident Management Standard. Investigations, where required, will be undertaken as per the same standard or on a case by case basis depending on the severity of the incident as described in **Section 5.1.1** of the LEMP.

At completion of any investigation, any corrective actions required will be recorded in Veolia's online incident and audit management system, Rivo, and managed in accordance with the Continual Improvement Procedure (PRO-151) in a timely manner as described in **Section 5.1.1** of LEMP.

An Emergency Response Plan (ERP) has been updated for the Woodlawn Bioreactor Facility and is appended to the LEMP. The ERP identifies the procedures to be followed in the event of an emergency and is to be used as protocol in the event of an exceedance. The process for dealing with potential incidents and emergencies at the Woodlawn Bioreactor Facility is summarised in **Figure 6.1** below.

Figure 6.1 Incident Response Process Map



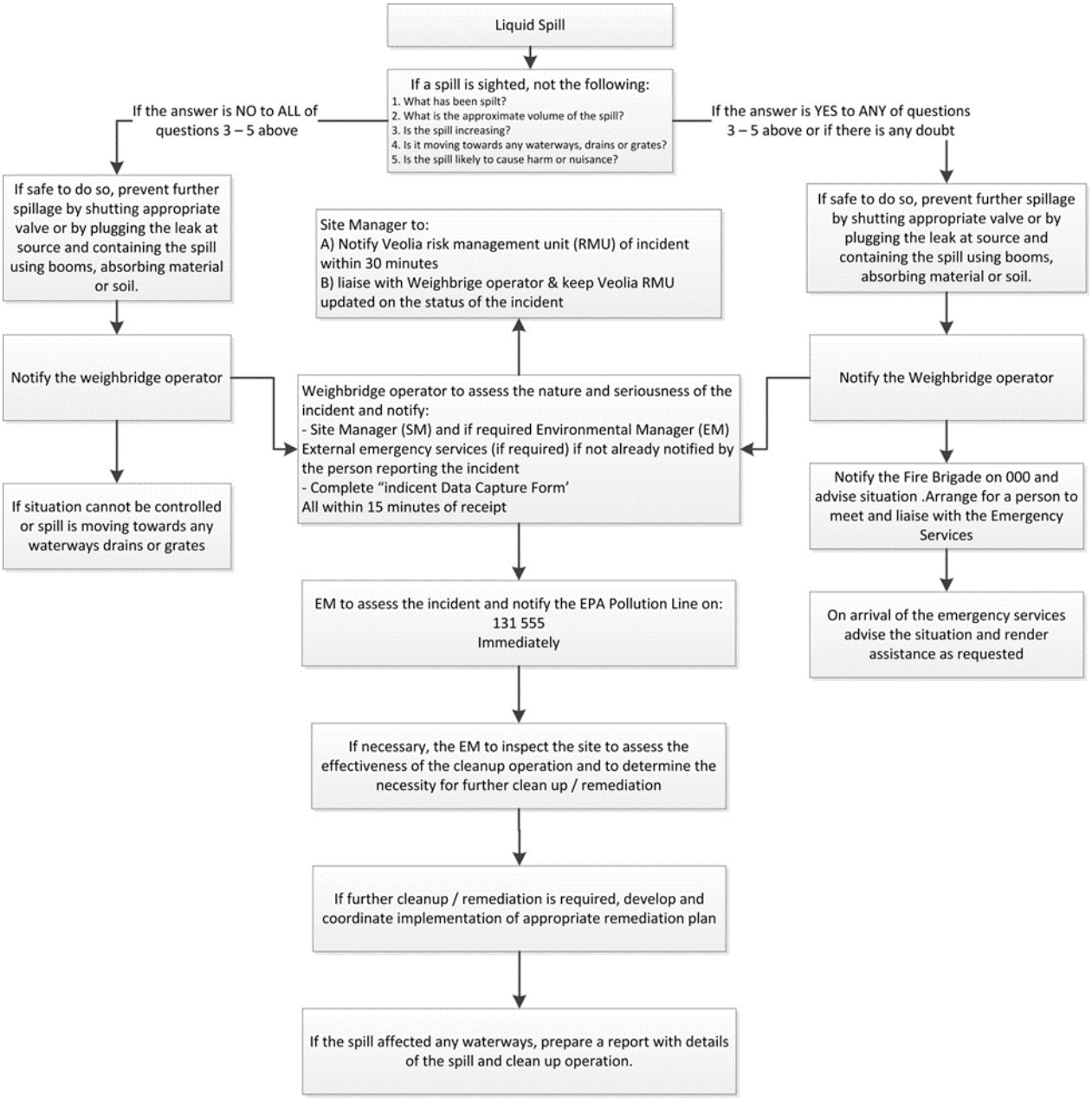
In addition to the emergency and environmental incident response process described previously, the following process provides additional guidance for the response to water quality contamination through incidents such as spills or overflows.

Containment may include the use of absorbent material to contain the spill/discharge. Spill kits are available onsite at all times and training in their use is to be provided to all personnel at the Woodlawn Bioreactor.

Any fuel, lubricant, or hydraulic fluid spillages is contained through the design of site bunding, and any excess material may also be collected using absorbent material, with contaminated material disposed of to a licensed waste facility.

A typical spill response procedure to be followed by Veolia personnel is summarised in **Figure 6.2** below.

Figure 6.2 Typical Spill Response Flow Chart



Reference and Related Documents

Document Name
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Appendices

Appendix A Surface Water Management Map

Appendix B Construction Quality Control Assurance for Lining Evaporation Dam (ED3SS)

Appendix C Surface water and Groundwater Monitoring Points

Appendix D WSP Approved Water Balance (2017)

Appendix E Water Management Simulation for Woodlawn Bioreactor

Appendix F Groundwater Monitoring Bore Details

MGA

COLLECTOR ROAD

FROM TARAGO / CANBERRA / GOULBURN / INTERMODAL

MAIN ENTRANCE

ED3 NORTH GROUNDWATER

ED3N2

ED3N3

ED3N1

ED3 SOUTH STORMWATER

TO EVAPORATION DAMS

LEACHATE TREATMENT DAM

3 x 280mm HDPE PN12.5

PUMPING STATION 3 x 132kW PUMPS

3 x 250mm HDPE PN12.5

POND 3 3 x 120kW PUMPS

715

2kW PUMP XYLEM SUBMERSIBLE

110mm HDPE PN12.5

80,000L HOLDING TANK FOR WASHBAY WATER

TRUCK WASHDOWN & CONTAINER WASH AREA

EMERGENCY ASSEMBLY POINT

VISITORS CARPARK

VISITORS ENTRANCE

SEWAGE TREATMENT AREA

RECEPTION

POWER STATION

GATE HOUSE

MAIN OFFICE

SUB-STATION

PLANT DAM

LABORATORY

MESSING ROOM

FLARE

PLANT AREA SILT TRAPS FOR SURFACE WATER RUNOFF

LOAD OUT AREA

WORKSHOP

FLOTATION

DEWATERING

REAGENT SHED

ZINC THICKENER

LEAD & COPPER THICKENER

COPPER LEAD

PROCESS ZINC

PROCESS WATER

TAILINGS THICKENER

TAILINGS THICKENER

SMALL DAM

AREA OF STOCKPILES (VARIOUS MATERIALS)

GRAVEL AREA (VARIOUS SMALL STOCKPILES)

WHEEL WASH LOCATION

TO TAILINGS DAMS

NOTE: REFER ALSO TO LANDTEAM DRAWING No. 201146-CAT1 FOR VOID SURFACE WATER SUB-CATCHMENT DETAILS

File Name: J:\Surveyors\Jobs\Veolia\16800 Engineering\CAD\16800-451 Surface Water Management Plan.dwg

VEOLIA ENVIRONMENTAL SERVICES

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ISSUE	AMENDMENT	DRAWN	DATE
A	INITIAL ISSUE	MK	13/04/2016

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LandTeam

A1 SHEET

VEOLIA ENVIRONMENTAL SERVICES

WOODLAWN BIOREACTOR
COLLECTOR ROAD, TARAGO

SURFACE WATER MANAGEMENT PLAN
WOODLAWN BIOREACTOR

SURVEYED: N/A
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Veolia Australia & NZ Pty Ltd

Woodlawn Bioreactor; Construction Quality Control Assurance for Lining Evaporation Dam (ED3SS), November 2015 to July 2016.

Report E2W-0243 (R001–V2)

5 September 2016

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TABLE OF CONTENTS

1.0 Introduction....2

2 Background & Environmental Setting....2

3. Liner System - ED3SS....3

4. Technical Designs- ED3SS....4

5. Geotechnical Testing Results - ED3SS....5

6. Conclusions....5

Figure

Landteam Pty Ltd, 12 April 2016. Drawing (16800-442) of ED3SS (completed)

Tables

Table 1 E2W Preliminary Geotechnical Investigation Results (2015 to 2016)
Table 2 Woodlawn Bioreactor: ED3SS Evaporation Dam Liner System

Appendices

Appendix A Figure 1: Site Layout & Testing Locations at Evaporation Dam (15 Dec 2015), Plates 1-11 (15 December 2015), & Geotechnical Testing Results
Appendix A1 Figure 1A: Site Layout & Testing Locations at Evaporation Dam (E2W, 12 January 2016). Plates 1 to 5 (12 January 2016)
Appendix A2 Geotechnical Testing Results of MBT Clays (15 Dec 2015, 12 Jan 2016, 5 Feb 2016)
Appendix A3 Figure 1C: Site Layout & ED3SS Testing Locations (10 March 2016), Plates 1-4 (10 March 2016), Geotechnical Testing Results
Appendix B Table B-1: Summary of Geotehnical Testing by Veolia/Testcrete Pty Ltd
Site Testing Map (Testcrete Pty Ltd, 9 August 2016)

Appendix C1 Pre-Construction Plates (ED3SS during 2007)
Appendix C2 Initial Survey of ED3ss (pre construction, August 2015)
Appendix C3 Early Construction Plates of ED3SS (November 2015)

Appendix D1 Veolia Dam Lining Specifications (December 2015) & Design Plans for ED3SS (2015).
Appendix D2 Veolia Construction Design Plans for ED3SS (2016). Works as Executed (top of clay)
Appendix D3 Plates 1-4 (March 2016, Practical liner completion)
Appendix D4 Plates 1-3 (July 2016, completion with gravel layer)

Appendix E Earth2Water Pty Ltd, 2 March 2016. Lining Specification (Evaporation Dam ED3SS)-Woodlawn Bioreactor.
Appendix F Monitoring location Plan
Appendix G Limitations

1.0 Introduction

Earth2Water Pty Ltd (E2W) was engaged by Veolia Australia & NZ Pty Ltd (Veolia) to provide independent professional advice, and construction quality control assurance (CQA) for the Evaporation Dam (ED3SS) liner system, located at the Woodlawn Bioreactor (Figure-Drawing 16800-437, and Appendix D1). Veolia's engaged three contractors including Divalls Bulk Haulage & Earthmoving Pty Ltd (civil/bulk earth works), Testcrete Pty Ltd (geotechnical and compaction testing), and Landteam Pty Ltd (surveyors) to construct and facilitate the construction and testing works from November 2015 to July 2016.

E2W undertook four site inspections (15 December 2015, 12 January 2016, 2 February 2016, 10 March 2016) and included independent geotechnical testing works (permeability testing via GHD Testing Pty Ltd) of the ED3SS liner (insitu/reworked silty clays) and also of the exsitu capping material (i.e. MBT clay stockpiled at Woodlawn Bioreactor) to verify material specifications, construction works and compliance with the NSW EPA published guidelines for liner systems (NSWEPA 1996. Environmental Guidelines- Solid Waste Landfills) and NSWEPA December 2015: Draft Environmental Guidelines- Solid Waste Landfills).

E2W outlined the liner specification for ED3SS (in consultation with Veolia) in a report entitled "Re: Lining Specification (Evaporation Dam ED3SS)-Woodlawn Bioreactor" dated 2 March 2016 (Appendix E). The location, geometrical design, capacity of the dam and testing parameters (compaction, permeability) for ED3SS was outlined by Veolia (Appendix D-1). The construction of ED3SS was undertaken by Divalls Bulk Haulage & Earthmoving Pty Ltd from approximately November 2015 to July 2016 under supervision provided by Veolia and E2W (Dino Parisotto).

The purpose of this report by E2W is to provide construction quality control assurance (CQA) and verify the suitability of the proposed liner system and compliance with current published guidelines (NSWEPA 1996. Environmental Guidelines- Solid Waste Landfills) and NSWEPA December 2015: Draft Environmental Guidelines- Solid Waste Landfills).

This CQA report by E2W includes a compilation of relevant maps, testing data and drawings of ED3SS to support compliance with NSW EPA guidelines. The CQA includes the technical construction designs of ED3SS (pre works and works as executed drawings), liner/capping system & material properties, environmental information, site inspection and photographic records of construction works, geotechnical results (permeability, compaction) by Testcrete Pty Ltd and independently by E2W (GHD geotechnical laboratory) and the site survey details (testing locations).

2 Background & Environmental Setting

Veolia is seeking to increase the capacity to store treated leachate onsite by utilizing the ED3SS. Currently, stormwater from the landfill void is pumped into existing evaporation dam at ED3 South and treated leachate is pumped to ED3 North. Following lining of ED3SS dam, Veolia intend to store treated leachate in ED3SS and transfer stormwater from the Void to ED2.

E2W (Dino Parisotto) has previously provided environmental and water assessment studies for the Woodlawn Bioreactor since 2006 (i.e. comprehensive groundwater and surface water monitoring status reports in November 2007, groundwater training workshops in January 2007,

assessment of Evaporation Dam (ED3) and Monitoring Issues (June 2007), supervised well installation programs around the Void and evaporation dams, previous EPL & SML technical reports @ 2007 to 2011, and a hydrogeological study at Woodlawn @2015 & 2016).

The location of ED3SS is within a group of existing evaporation dams (unlined) associated with current landfill operations and past mining activities. Veolia currently require an increase in water storage capacity to manage landfill leachate associated with the bioreactor/void. ED3SS is approximately 3 ha in area and sited within low permeability bedrock (siltstone/tuff) and silty clays (Table 1). The ED3SS is situated a few meters above the local water table, and has no water ingress from the neighbouring unlined evaporation dams (ED3 lagoons) due to the thickness of the batter wall (>10m).

E2W (Dino Parisotto) conducted a site inspection at ED3SS in consultation with Veolia (Stephen Bernhart) on 19 November 2015, 12 January and 5 February 2016. The insitu material excavated at the site mainly comprises silty-clays and gravelly-clays associated with the reworking and leveling of the natural clay soils and weathered bedrock (siltstone/tuff with low permeability ~E-08 m/sec). Recent excavation at the nearby MBT construction site has generated approximately 10,000 m3 of silty clays with very low permeability (E-11 m/sec, refer to Table 2) which was utilized for capping over the insitu materials.

3. Liner System - ED3SS

The details of ED3SS liner system and preferred cap design are summarised in Tables 1 & 2, and Appendix D& E. The construction of the liner system was integrated with a construction quality control system (E2W) to ensure the suitability of the foundation materials, material properties (permeability, compaction) thickness and quality of the sealing/barrier layers (Appendix D-1).

Existing monitoring wells (e.g. WM5 and ED3B) and surface water testing locations are available for monitoring leakage and impacts to water ways (Appendix F).

The integrity of the ED3SS liner system relies on the impervious nature of existing silty-clay/gravelly-clay soils and siltstone/tuff bedrock (permeability estimated at K= E-08 to E-09 m/sec) and imported clays (MBT stockpile, approximately K= E-11 m/sec). The location of the dam is in a low risk setting situated alongside other evaporation dams associated with landfill and previous mine operations. ED3SS is greater than 250 m from the site boundary and at least 2 m above the groundwater table.

Photographic records of the ED3SS at various stages of development are provided in Appendix A, A-1, A-2, Appendix C-3, Appendix D-3 and D-4. The uniformity and consistency of the reworked insitu materials (floor and walls) was assessed and inspected by testpit excavations (8 locations on 15 December 2015), soil logging (Appendix A) and observing the construction works (including use of water cart) and machinery used (e.g. 7 passes with sheep foot roller).

The construction works of ED3SS is summarized as follows:

- Technical specifications and designs by Veolia and checked by E2W (Appendix C-2 and Appendix D-1).
- Excavation and reworking of existing bedrock and clay soils to desired geometry using excavators and dozers. Survey provided by Landteam Pty Ltd.

- Reconstruction of dam liner on walls and floors using silty clay materials and crushed weathered siltstone by spreading into thin layers (~0.3m) using excavator and dozer (D-8). Application of water and compaction of layers using sheep foot roller (14 t).
- Inspection by E2W/Veolia and ongoing testing (Testcrete) to assess material consistency (compaction, soil type) and geotechnical properties (permeability, Appendix A, A1, A2, A3).
- Survey of constructed layers and final levels (placement of temporary survey points for guidance).
- Compaction of final surfaces (walls and floor) using sheep foot compactor to prepare for clay cap layer.
- Placement of clay liner (0.3m) over floor and walls of ED3SS (i.e. MBT source E-011 m/sec permeability)
- Compaction of final surface (walls) cover using sheep foot and smooth drum roller for protective gravel layer.
- Install (approximately 0.10m) thick gravel layer (10-40 mm dolerite) over walls of ED3SS (including access road) to protect clay liner from dessication and erosion.

4. Technical Designs- ED3SS

Work as executed drawings are provided in Appendix D-2. The specifications are provided in Appendix D-1. The final plans are in accordance with initial designs. The initial design and layout of ED3SS is presented in Appendix C (plates and survey).

The construction of ED3SS shows a relatively thick floor (~1.5m thick) and batter walls (~2.5 m) constructed using local materials derived from a weathered siltstone bedrock source (clay/soft bedrock).

The design of the ED3SS is as follows (Appendix D-2):

- Surface area of floor (base of wall)= Approximately 1 Ha
- Surface area at full capacity = Approximately 2.3 Ha
- Surface area with 0.5m freeboard = Approximately 2.2 Ha
- Capacity = 122.58 ML
- Capacity with 0.5m freeboard = 111.44 ML

The construction works were undertaken by Divalls contractors with appropriate machinery (D8 dozer, 22 t excavators, 14 t sheep foot compactors). The process of excavation, material reworking and compacting in thin layers was considered adequate to construct the impervious liner. The silt clay and weathered siltstone bedrock was amenable to excavation and crushing, and reworking into a material suitable for compaction and sealing of the wall and floor of ED3SS. Areas where hard bedrock could not be easily reworked (approximately 15% of the floor area) the material was removed from the dam by use of truck transport. Areas of where hard siltstone bedrock was removed on the dam floor (i.e. 1m depth, near ramp and south east corner) the backfill comprised impervious clay from MBT area (E-11 m/sec), thereby creating a better impervious seal.

5. Geotechnical Testing Results - ED3SS

The geotechnical results provided by Testcrete Pty Ltd are provided in Appendix B (summary provided in Table B-1). In summary, 49 compaction tests (Wall 1 to Wall 8, Floor 1 to Floor 7) over 20 locations within the insitu reworked material floor and walls at three depth levels (0.2m, 0.5m, and 0.9/1m) and at 0.15m depth on the imported MBT clay layer (0.3m thick, Clay 1 to Clay 10). Compaction test were conducted over a 0.15m thick soil profile. Testcrete conducted eight permeability tests over floor and wall locations (Appendix B, map)

Based on the dam area (2.63 ha), the sampling rate is approximately 1 per 536 m2 (Testcrete Pty Ltd). Earth2Water conducted additional geotechnical testing of the reworked insitu material (12 locations) and of the MBT clay stockpile (4 samples). Testing results are summarised in Table 1, and Appendices; A, A1, A2, A3. The independent geotechnical results (focused on permeability using bulk samples and u50 insitu sample tubes) indicate that the material properties are suitable for a liner system. The insitu material properties have been supplemented by importing impervious clay material (MBT stockpiled clay) to address the environmental performance and liner requirements (i.e. equivalent to or exceeding 1 m thick at E-09 m/sec).

The geotechnical results of the liner material indicate adequate permeability, compaction and a consistent construction approach:

- Bedrock siltstone (estimated at E-08 to E-09 m/sec floor of dam)
- Insitu Silty clay (floor and walls): 1.2m thick at approximately E-08 to E-09 m/sec
- Imported MBT Silty Clay (floor and wall): Approximately 0.3m thick at E-011 m/sec (some areas on floor are >1m thick due to removal of hard bedrock)

In summary, three compaction results from (0.9 to 1m) depth locations were marginally below the specification of 95% compaction density (ranging from 91 to 94%). The results are considered satisfactory.

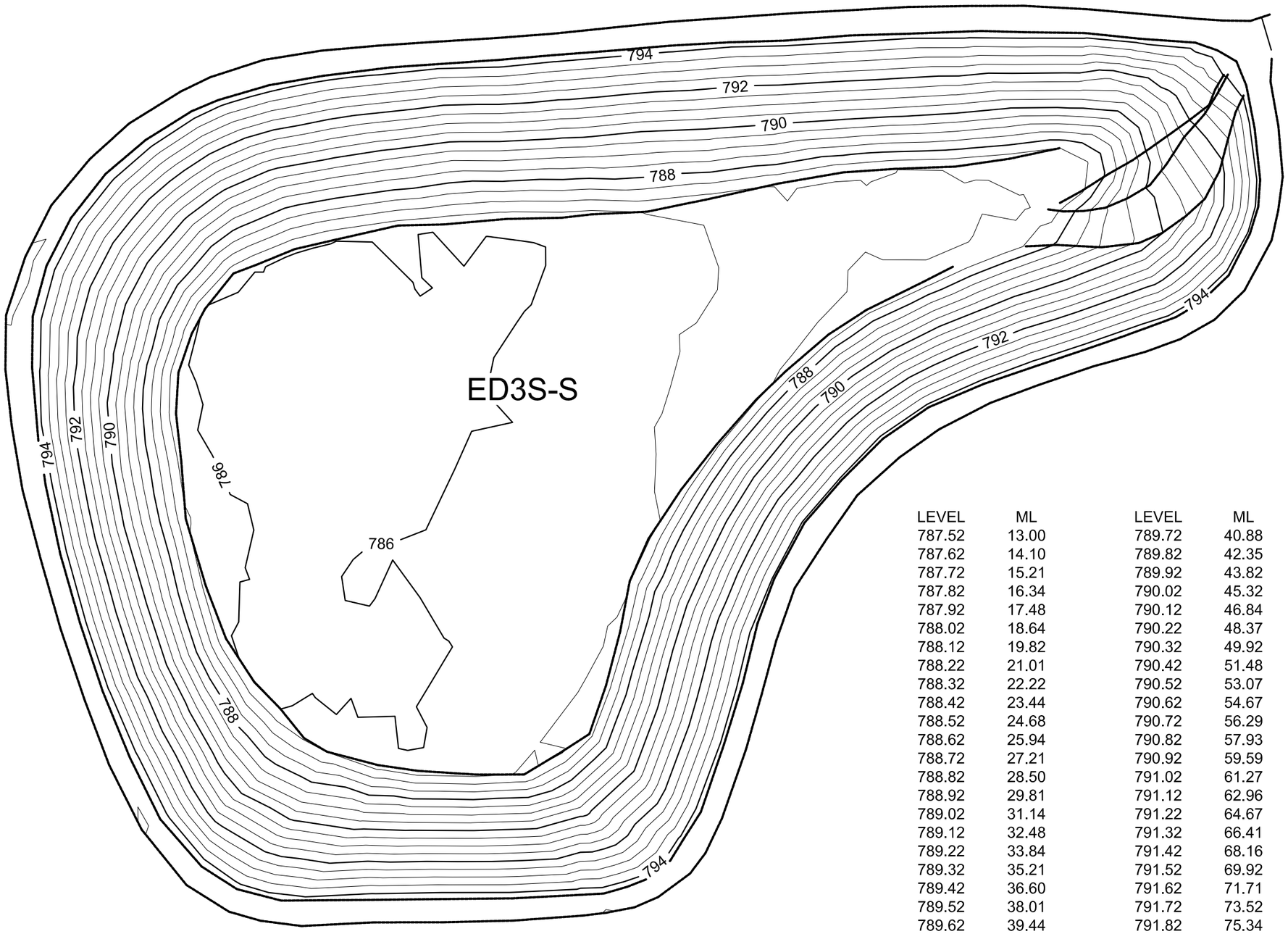
6. Conclusions

Based on the site inspections, technical designs, geotechnical testing results and testpit logging, E2W offer the following conclusions regarding the ED3SS liner system:

- The liner system design is suitable for the site given the environmental setting and low risk. The dam liner system comprises engineered bulk earthworks over low permeability and unsaturated siltstone bedrock, and a 1.5 m thick dual clay liner system (i.e. reworked silty clay of K=E-08 and 1.2 m thick, MBT clays of K=E-11 m/sec and 0.3 m thick). The liner is expected to achieve a similar or greater environmental performance relative to EPA guidelines (2015). A gravel (~0.1m) layer was installed to cover the clay capping to protect against desiccation and erosion.

A site inspection program is recommended at 6 monthly intervals (2 years) at ED3SS to assess the integrity of walls/floors and any erosion or seepage issues (including a review of monitoring data). Any erosion scars or erosion points associated with stormwater or water jetting are to be repaired using low permeability clays (MBT) and associated gravel covering.

Figure



LEVEL	ML	LEVEL	ML	LEVEL	ML
787.52	13.00	789.72	40.88	791.92	77.19
787.62	14.10	789.82	42.35	792.02	79.05
787.72	15.21	789.92	43.82	792.12	80.93
787.82	16.34	790.02	45.32	792.22	82.83
787.92	17.48	790.12	46.84	792.32	84.75
788.02	18.64	790.22	48.37	792.42	86.69
788.12	19.82	790.32	49.92	792.52	88.65
788.22	21.01	790.42	51.48	792.62	90.62
788.32	22.22	790.52	53.07	792.72	92.62
788.42	23.44	790.62	54.67	792.82	94.63
788.52	24.68	790.72	56.29	792.92	96.67
788.62	25.94	790.82	57.93	793.02	98.72
788.72	27.21	790.92	59.59	793.12	100.79
788.82	28.50	791.02	61.27	793.22	102.88
788.92	29.81	791.12	62.96	793.32	104.99
789.02	31.14	791.22	64.67	793.42	107.12
789.12	32.48	791.32	66.41	793.52	109.27
789.22	33.84	791.42	68.16	793.62	111.44 (0.50m FREEBOARD)
789.32	35.21	791.52	69.92	794.12	122,58 (FULL)
789.42	36.60	791.62	71.71		
789.52	38.01	791.72	73.52	SURFACE AREA AT FULL CAPACITY: 2·317ha	
789.62	39.44	791.82	75.34	SURFACE AREA AT BASE OF WALL: 0·943ha	

File Name: J:\Surveyors\Jobs\Veolia\16800 Engineering\CAD\16800-437 ED3S-South Volumes Issue B.dwg

ISSUE	AMENDMENT	DATE
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VEOLIA ENVIRONMENTAL SERVICES

PLAN SHOWING STORAGE INFORMATION
EVAPORATION DAM 3 - SOUTH (SOUTHERN PARTITION)
WOODLAWN BIOREACTOR

DATUM AHD | CONTOUR INTERVAL 0.5m

DATE: 12/04/2016
SURVEYED: VAR
DRAWN: MK
CHECKED: JK
ISSUE B

DRAWING No. 16800-437

Tables

Table 1 - E2W Preliminary Geotechnical Investigation Results (2015 to 2016)

Woodlawn Bioreactor - Evaporation Dam ED3SS

Sample ID	Date	Sample Depth	Sample Description	Inferred Cap Quality (E2W interpretation from logging)	Permeability (m/sec)	Sampling Area	Comments
Floor of Evaporation Dam (section completed area of 0.9m thick , 2500 m2)							
FFK-1 @0.9m	**12/01/2016**	**0-0.18m**	Silty clay with fine gravel (tuff ~10%)- light brown (u50 tube)	**B**	**4.0 E-08**	Floor completed with 0.9m reworked insitu	not meeting criteria for clay liner (E-9 m/sec)
FFK-2 @0.9m	**12/01/2016**	**0.05-0.15m**	Silty clay with fine gravel (tuff ~10%)- light brown (u50 tube)	**B**	**2.0 E-08**	Floor completed with 0.9m reworked insitu	not meeting criteria for clay liner (E-9 m/sec)
FFK-3 @0.9m	**12/01/2016**	**0.05-0.15m**	Silty clay with fine gravel (tuff ~10%)- light brown (u50 tube)	**B**	**5.0 E-08**	Floor completed with 0.9m reworked insitu	not meeting criteria for clay liner (E-9 m/sec)
Floor of Evaporation Dam (in progress- 1 to 2m higher)							
NFK-1	**15/12/2015**	**0-0.15m**	Silty clay with fine gravel (tuff ~10%)- light brown	**A**	**3.2 E-09**	Floor not completed within ~1m of final level	meets criteria for clay liner (E-9 m/sec)
SFK-2	**15/12/2015**	**0-0.15m**	Silty clay with fine gravel (tuff ~10%)- light brown	**B**	**1.3 E-08**	Floor not completed within ~1m of final level	not meeting criteria for clay liner (E-9 m/sec)
SFK-2 Rock	**15/12/2015**	**0-0.3m**	Tuff- light brown, fine grained, massive- clay matrix, poorly cemented, weathered.	**B**	**2.0 E-08**	Floor not completed within ~1m of final level	not meeting criteria for clay liner (E-9 m/sec)
SFK-3	**15/12/2015**	**BH-6 (0.1-0.6m)**	Silty clay with fine gravel (tuff ~10%)- light grey/white	**B**	**1.0 E-08**	Floor not completed within ~1m of final level	not meeting criteria for clay liner (E-9 m/sec)
MSFK-4	**15/12/2015**	**BH9B (0.2-0.8m)**	Silty clay with fine gravel (tuff ~10%)- light brown	**B**	**1.7 E-08**	Floor not completed within ~1m of final level. Predominant material type at centre of liner	not meeting criteria for clay liner (E-9 m/sec)
Floor & Walls of Evaporation Dam (completed layers with insitu 1.2m & 0.3m clay cap -MBT stockpile)							
ED3SS- Fl	**10/03/2016**	**0-0.15m**	Silty clay with fine gravel (siltstone)- medium brown	**A+**	**5.2 E-11**	Floor completed with 1.2m reworked insitu & capped with 0.3m MBT clay.	meets criteria for clay liner (E-9 m/sec).
ED3SS- Wl	**10/03/2016**	**0-0.15m**	Silty clay with fine gravel (siltstone)- medium brown	**A+**	**2.4 E-11**	Walls completed with ~2m reworked insitu & capped with 0.3m MBT clay. Gravel layer not installed as yet	meets criteria for clay liner (E-9 m/sec). Needs to be covered by gravel for protection
Batter Slope of Evaporation Dam (completed)							
u50TP-5 @0.2m	**15/12/2015**	**0.2-0.35m**	Silty clay with fine gravel (tuff ~10%)- light brown	**B**	**2.0 E-08**	sample collected from batter slope. Testpit excavated to 0.2m depth. Sample collected with steel u50 tube for insitu sample. Slopes completed and compacted	not meeting criteria for clay liner (E-9 m/sec)
u50TPx @0.5m	**15/12/2015**	**0.5-0.65m**	Silty clay with fine gravel (tuff ~10%)- light brown	**B**	**5.0 E-08**	sample collected from batter slope. Testpit excavated to 0.5m depth. Sample collected with steel u50 tube for insitu sample.Slopes completed and compacted	not meeting criteria for clay liner (E-9 m/sec)
MBT Stockpile (adjacent haul road)- Source of Clay cap (0.3m)							
Lipmans Exacavated Material	**16/10/2015**	**Grab**	Silty clay with fine gravel (siltstone)- medium brown	**A+**	**4.0 E-11**	material collected at source	meets criteria for clay liner (E-9 m/sec)
Top Of Void	**17/10/2015**	**Grab**	Silty clay with fine gravel (siltstone)- medium brown	**A+**	**4.0 E-11**	material collected at stockpile area (top of void)	meets criteria for clay liner (E-9 m/sec)
MBT SP-2	**12/01/2016**	**0.1-0.4m**	Silty clay with fine gravel (siltstone)- medium brown	**A+**	**7.0 E-11**	Large stockpile situated next to Void-	meets criteria for clay liner (E-9 m/sec)
MBT SP	**15/12/2015**	**0-0.2m**	Silty clay with fine gravel (siltstone)- medium brown	**A+**	**7.0 E-11**	Large stockpile situated next to Void- other samples collected by Testright	meets criteria for clay liner (E-9 m/sec)

Notes:

A= Material properties good for clay barrier (high clay content, plasticity, impervious and meets or exceeds criteria A+)

B= Material properties are marginal for clay barrier (low moderate clay content, low plasticity and needs additional measures or capping to meet criteria)

Table 2: Woodlawn Bioreactor: ED3SS Evaporation Dam Liner System

Compliance Assessment

Layer Type	Compliance	NSW EPA 1996 Guidelines	NSW EPA 2015 Guidelines	Proposed & Implemented Liner Design	Comments and Justification for Changes to NSW EPA (2015)
Foundation Material & Sub-base Layer	Yes	Engineered Foundation Material & Layer (performance based)	Engineered Foundation Material & Layer- 0.2m thick	Minimum 0.2m of blended & compacted fine grained materials & similar to clay cap (~E-08 m/sec). Inspection & CQA of liner floor recommended to assess fractures/preferential pathways	Weathered to fresh Siltstone/Schist bedrock basement at evaporation dam- low permeability (estimated K= E-8 m/sec to E-10m/sec). Sealing of any fractured materials with compact clays to address localised seepage
Environmental Risks; Boundary & Depth to Groundwater	Yes	low risk environment	low risk environment	Evaporation Basin is >250m from site boundary. Water table >2 m below floor of evaporation dam. Average groundwater level of ~4m below floor liner	Monitoring data available to indicate general water level (RL 784). No groundwater relief layer required. Low yielding and saline fractured rock aquifer present in ore body area (groundwater is poor quality). ED3SS is a Low risk area- away from creeks or groundwater resource area. Raw water dam and Void are potential receptors (>250m distance)
Leachate Collection System	No (site specific)	leachate collection drains and sumps	leachate collection drains and sumps	Not required due to impervious metamorphic rocks (Silurian) with low permeability & porosity, and depth to water table >2m'	Flow in natural clay soils and rock is through diffusion or secondary porosity (fractures- sealed by reworking/compaction). Leachate migration is anticipated via very slow rates of diffusion. Existing dams (ED1& 2) show no evidence of leackage (impervious basement and fine silts sealing layer). Permeability testing of basement = (TBA, K= m/s). Climate of area shows that evaporation greatly exceeds rainfall (1400 mm vs 690mm)
Basin Gradients	NA (site specific)	liner gradients > 3% transversely and > 1% longitudinally.	liner gradients > 3% transversely and > 1% longitudinally.	1% to assist with optimum evaporation	1% proposed - as shown in technical survey drawings. Basin is to aid evaporation of water and the gentler slopes promote greater evaporation potential
Impermeable Barrier	Yes	Minimum Clay Permeability @ E-09 m/sec, 0.9m thick	1m Minimum Permeability @ E-09 m/sec	2 Layer system=1.5m thick. Base Insitu Clay liner @ 1.2m thick with E-08 m/sec, & Overlain by 0.3m clay cap at permeability @ approx E-11 m/sec	MBT clay (0.3m) has high plasticity and suitable particle size distribution. Construction quality control to be implemented (compaction, thickness, protective gravellayer). Exisiting insitu clays have permeability below EPA requirements therefore capping with MBT material (0.3m imported) is recommended. Clay capping to be covered by blue metal gravel (~0.1m thick) to address desication/erosion on batter slopes and above water line. Proposed liner system is considered to achieve a similar or greater environmental performance relative to the EPA guidelines.
Battered Slopes	Yes	Maximum '3H:1V Minimum 5% to drainage points	The elements of leachate barrier systems installed on slopes must have adequate slope stability.	VES design parameters complies with slope stability and requirements	Slope of gradients achieved without instability - compacted (>95%) fine grained soil and rock

Notes:

WM5 swl= 784 - 786 mRL (ave 784 mRL)

ED3B swl= 784 - 786m RL (ave 784 mRL)

Base of evaporation dam approximately 788m RL

The Woodlam deposit is hosted by a sequence of Late Silurian shales, cherts and pyroclastics intruded by dolerite sills. Site geology indicates sequence of volcanic tuff & siltstone bedrock

Appendices

Appendix A
Figure 1: Site Layout & Testing Locations at Evaporation Dam (15 Dec 2015), Plates 1-11 (15 December 2015), & Geotechnical Testing Results

Plate 1 (15 December 2015) Viewing south west over the construction of ED3SS (left of frame). Batter slopes nearly complete and construction of the floor levels and liner still in progress. Existing evaporation dam (No3 lagoons- south & north) are full and right of ED3SS.

Plates 2 & 3 (15 December 2015) View of over the construction of ED3SS showing batter slopes, water cart (moisture control during reworking and compaction), roller (14 t sheep foot) on southern batter, and excavator (20 t) used to excavate & load materials (light brown weathered tuff and silty clay, D8 used to rip & spread materials in 150mm layers). Batter slopes nearly complete whilst floor levels are still in progress showing excess stockpiled materials.

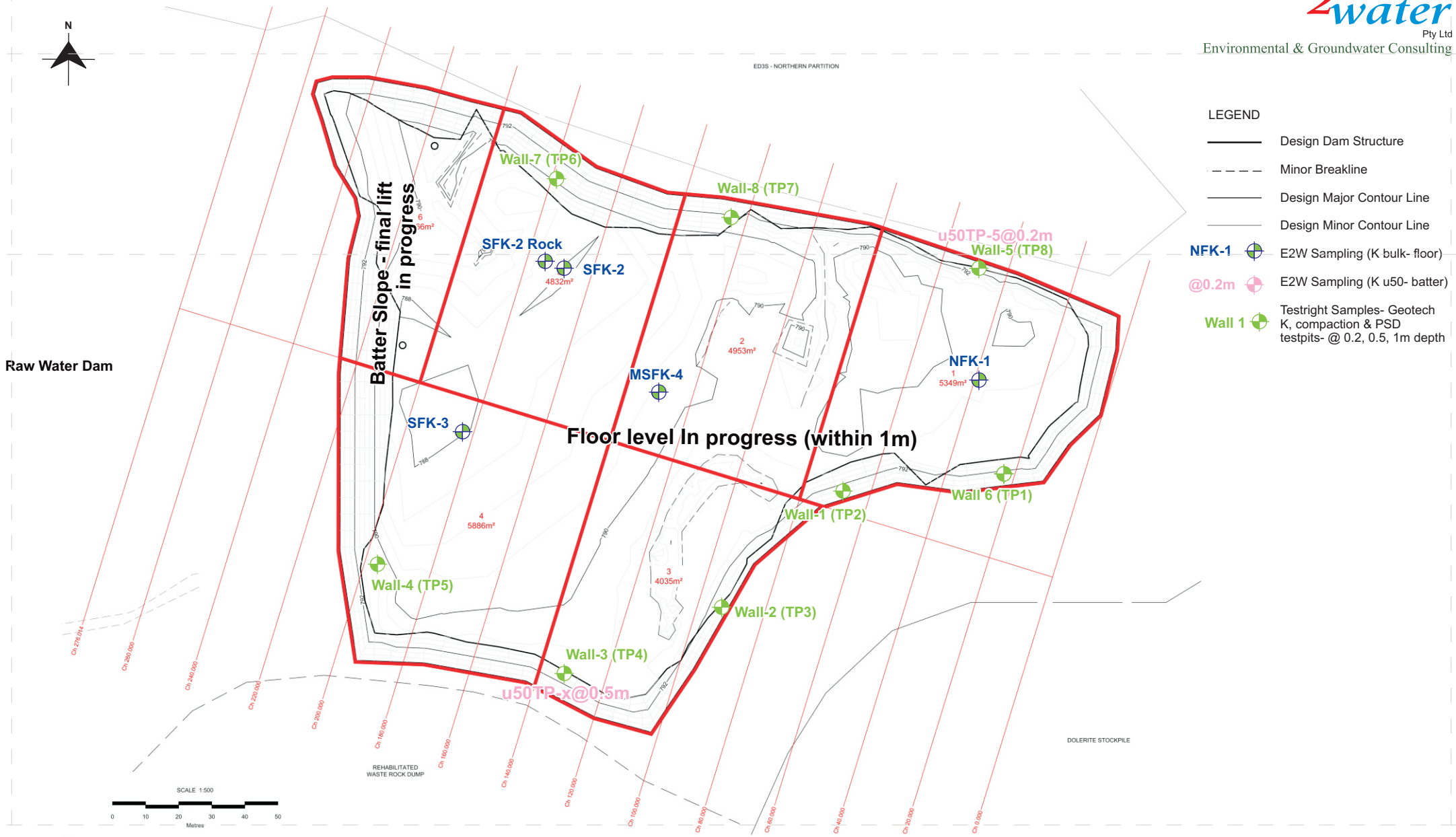
Plates 4 & 5 (15 December 2015) Testpits -1& 2 (battered slope). Compacted light brown silty clay with gravel (tuffaceous weathered rock <10 %). (K Test=Wall 6 &1).

Plates 6 & 7 (15 December 2015) Testpits -3& 4 (battered slope). Compacted light brown silty clay with gravel (tuffaceous weathered rock <10%). (K Test=Wall 2 & 3).

Plates 8 & 9 (15 December 2015) Testpits -5 & 6 (battered slope). Compacted light brown silty clay with gravel (tuffaceous weathered rock <10%). (K Test=Wall 4 & 7).

Plates 10 & 11 (15 December 2015) Testpits -7 & 8 (battered slope). Compacted light brown silty clay with gravel (tuffaceous weathered rock <5%). (K Test=Wall 8 & 5).

earth2water Pty Ltd
Environmental & Groundwater Consulting



Raw Water Dam

Source: LandTeam Australia Pty Ltd

Site Layout & Testing Locations at Evaporation Dam (15 Dec 2015)

Woodlawn Bioreactor - ED3SS CQA

Date: *16 December 2015*

Reference: *E2W_243_01.cdr*

Figure 1

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Aggregate/Soil Test Report

Report No: SYD1502270

Client:
Earth 2 Water Pty Ltd
Material Evaluation
Gerringong NSW 2534

Project: 2124279

Sample Details

GHD Sample No	SYD15L-0459-08
Date Sampled	15/12/2015
Sampled By	Sampled By Client
Location	Woodlawn
BH / TP No.	MBT-SP
Depth (m)	Stockpile
Soil Description	CLAY with sand; brown with trace gravel

Other Test Results

Description	Method	Result	Limits
Coef of Permeability (m/sec)	AS 1289.6.7.3	7 E-11	
Mean Stress Level (kPa)		30	
Permeant Used		Syd Tap Water	
Length (mm)		72.2	
Diameter (mm)		70.0	
Length/Diameter Ratio		1.03	
Laboratory Moisture Ratio (%)		0.0	
Laboratory Density Ratio (%)		0.0	
CompactiveEffort		approx. 100% std	
Method of Compaction		tamped	
Surcharge Applied (Kg)		0.0	
Pressure Applied (Kpa)		10	
Oversize Sieve (mm)		13.2	
Percentage Oversize (%)		4.0	
Moisture Content (%)		0.0	

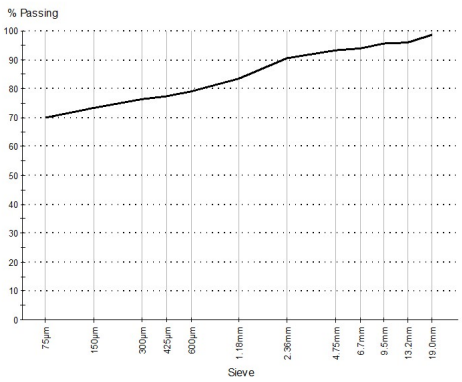
Particle Size Distribution

Method: AS 1289.3.6.1

Date Tested: 7/01/2016
Note: Sample Washed

Sieve Size	% Passing	Limits
19.0mm	99	
13.2mm	96	
9.5mm	96	
6.7mm	94	
4.75mm	93	
2.36mm	91	
1.18mm	83	
600µm	79	
425µm	77	
300µm	76	
150µm	73	
75µm	70	

Chart



Comments

Moisture and Density Ratio's not applicable.
Permeability- At client request, specimen compacted to approximately 100% compactive effort at estimated Optimum Moisture Content

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Aggregate/Soil Test Report

Report No: SYD1502267
Issue No: 1
This report replaces all previous issues of report no 'SYD1502267'.

Client:
Earth 2 Water Pty Ltd
Material Evaluation
Gerringong NSW 2534

Project: 2124279

Accredited for compliance with ISO / IEC 17025

NATA Accredited Laboratory Number: 679

Approved Signatory: G J Vukovic (Senior Laboratory Technician)

Date of Issue: 13/01/2016

Sample Details

GHD Sample No	SYD15L-0459-05
Date Sampled	15/12/2015
Sampled By	Sampled By Client
Location	Woodlawn
BH / TP No.	MSFK-4
Depth (m)	floor
Soil Description	SILT; yellow/brown with sand

Other Test Results

Description	Method	Result	Limits
Coef of Permeability (m/sec)	AS 1289.6.7.3	3 E-08	
Mean Stress Level (kPa)		30	
Permeant Used		Syd Tap Water	
Length (mm)		62.6	
Diameter (mm)		50.3	
Length/Diameter Ratio		1.24	
Laboratory Moisture Ratio (%)		0.0	
Laboratory Density Ratio (%)		0.0	
CompactiveEffort		approx. 95% std	
Method of Compaction		tamped	
Surcharge Applied (Kg)		0.0	
Pressure Applied (Kpa)		10	
Oversize Sieve (mm)		9.5	
Percentage Oversize (%)		2.0	
Moisture Content (%)		24.3	
Date Tested		5/01/2016	

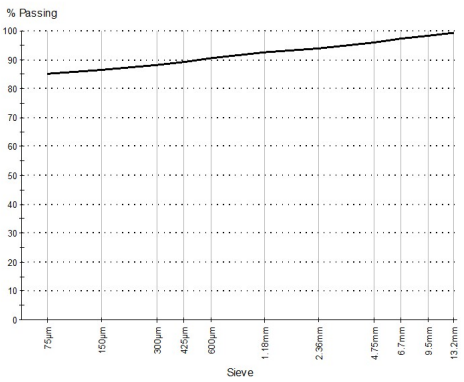
Particle Size Distribution

Method: AS 1289.3.6.1

Date Tested: 7/01/2016
Note: Sample Washed

Sieve Size	% Passing	Limits
13.2mm	99	
9.5mm	98	
6.7mm	97	
4.75mm	96	
2.36mm	94	
1.18mm	93	
600µm	90	
425µm	89	
300µm	88	
150µm	86	
75µm	85	

Chart



Comments

Moisture and Density Ratio's not applicable.
Permeability- At client request, specimen compacted to approximately 95% compactive effort at estimated Optimum Moisture Content.
Remoulded Dry Density = 1.70 t/m³, Remoulded Moisture Content = 16.9 %.

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Aggregate/Soil Test Report

Report No: SYD1502267

Client:
Earth 2 Water Pty Ltd
Material Evaluation
Gerringong NSW 2534

Project: 2124279

Sample Details

GHD Sample No	SYD15L-0459-05
Date Sampled	15/12/2015
Sampled By	Sampled By Client
Location	Woodlawn
BH / TP No.	MSFK-4
Depth (m)	floor
Soil Description	SILT; yellow/brown with sand

Other Test Results

Description	Method	Result	Limits
Coef of Permeability (m/sec)	AS 1289.6.7.3	1.7 E-08	
Mean Stress Level (kPa)		30	
Permeant Used		Syd Tap Water	
Length (mm)		62.2	
Diameter (mm)		50.0	
Length/Diameter Ratio		1.24	
Laboratory Moisture Ratio (%)		0.0	
Laboratory Density Ratio (%)		0.0	
CompactiveEffort		approx. 95% std	
Method of Compaction		tamped	
Surcharge Applied (Kg)		0.0	
Pressure Applied (Kpa)		10	
Oversize Sieve (mm)		9.5	
Percentage Oversize (%)		2.0	
Moisture Content (%)		0.0	
Date Tested		5/01/2016	

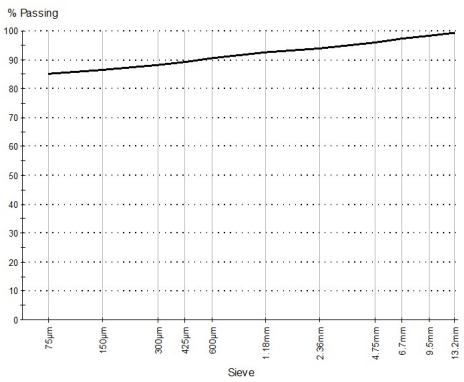
Particle Size Distribution

Method: AS 1289.3.6.1

Date Tested: 7/01/2016
Note: Sample Washed

Sieve Size	% Passing	Limits
13.2mm	99	
9.5mm	98	
6.7mm	97	
4.75mm	96	
2.36mm	94	
1.18mm	93	
600µm	90	
425µm	89	
300µm	88	
150µm	86	
75µm	85	

Chart



Comments

Moisture and Density Ratio's not applicable.
Permeability- At client request, specimen compacted to approximately 95% compactive effort at estimated Optimum Moisture Content

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Aggregate/Soil Test Report

Report No: SYD1502263

Client: Earth 2 Water Pty Ltd
Material Evaluation
Salt Pan Creek Landfill

Project: 2124279

Sample Details

GHD Sample No	SYD15L-0459-01
Date Sampled	15/12/2015
Sampled By	Sampled By Client
Location	Woodlawn
BH / TP No.	NFK-1
Depth (m)	floor
Soil Description	SILT / CLAY: yellow brown with sand & gravel

Other Test Results

Description	Method	Result	Limits
Coef of Permeability (m/sec)	AS 1289.6.7.3	3.2 E -09	
Mean Stress Level (kPa)		30	
Permeant Used		tap water	
Length (mm)		92.3	
Diameter (mm)		102.0	
Length/Diameter Ratio		0.90	
Laboratory Moisture Ratio (%)		0.0	
Laboratory Density Ratio (%)		0.0	
CompactiveEffort	approximately 95% standard		
Method of Compaction		tamped	
Surcharge Applied (Kg)		0.0	
Pressure Applied (Kpa)		10	
Oversize Sieve (mm)		13.2	
Percentage Oversize (%)		0.0	
Moisture Content (%)		15.1	
Date Tested		21/12/2015	

Particle Size Distribution

Method: AS 1289.3.6.1

Date Tested:

Note: Sample Not Washed

Sieve Size	% Passing	Limits

Chart

Comments

Permeability - At client request, specimen compacted at approximately 95% compactive effort at estimated Optimum Moisture Content

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Aggregate/Soil Test Report

Report No: SYD1502263
Issue No: 1
This report replaces all previous issues of report no 'SYD1502263'.

Client:
Earth 2 Water Pty Ltd
Material Evaluation
Gerringong NSW 2534

Project: 2124279

Accredited for compliance with ISO / IEC 17025

NATA Accredited Laboratory Number: 679

Approved Signatory: G J Vukovic (Senior Laboratory Technician)

Date of Issue: 8/01/2016

Sample Details

GHD Sample No	SYD15L-0459-01
Date Sampled	15/12/2015
Sampled By	Sampled By Client
Location	Woodlawn
BH / TP No.	NFK-1
Depth (m)	floor
Soil Description	Silty Clayey GRAVEL: yellow brown with sand.

Other Test Results

Description	Method	Result	Limits
Coef of Permeability (m/sec)	AS 1289.6.7.3	3.2 E -09	
Mean Stress Level (kPa)		30	
Permeant Used		tap water	
Length (mm)		92.3	
Diameter (mm)		102.0	
Length/Diameter Ratio		0.90	
Laboratory Moisture Ratio (%)		0.0	
Laboratory Density Ratio (%)		0.0	
CompactiveEffort		approximately 95% standard	
Method of Compaction		tamped	
Surcharge Applied (Kg)		0.0	
Pressure Applied (Kpa)		10	
Oversize Sieve (mm)		13.2	
Percentage Oversize (%)		0.0	
Moisture Content (%)		15.1	
Date Tested		21/12/2015	

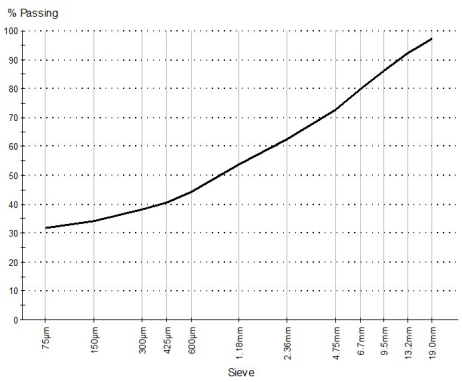
Particle Size Distribution

Method: AS 1289.3.6.1

Date Tested: 7/01/2016
Note: Sample Washed

Sieve Size	% Passing	Limits
19.0mm	97	
13.2mm	92	
9.5mm	86	
6.7mm	80	
4.75mm	73	
2.36mm	62	
1.18mm	54	
600µm	44	
425µm	41	
300µm	38	
150µm	34	
75µm	32	

Chart



Comments

Permeability - At client request, specimen compacted to approximately 95% compactive effort at estimated Optimum Moisture Content

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Aggregate/Soil Test Report

Report No: SYD1502264
Issue No: 1
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Client:
Earth 2 Water Pty Ltd
Material Evaluation
Gerringong NSW 2534

Project: 2124279

Accredited for compliance with ISO / IEC 17025

NATA Accredited Laboratory Number: 679

Approved Signatory: G J Vukovic (Senior Laboratory Technician)

Date of Issue: 13/01/2016

Sample Details

GHD Sample No	SYD15L-0459-02
Date Sampled	15/12/2015
Sampled By	Sampled By Client
Location	Woodlawn
BH / TP No.	SFK-2
Depth (m)	floor
Soil Description	SILT; yellow/brown

Other Test Results

Description	Method	Result	Limits
Coef of Permeability (m/sec)	AS 1289.6.7.3	2 E-08	
Mean Stress Level (kPa)		30	
Permeant Used		Syd Tap Water	
Length (mm)		66.6	
Diameter (mm)		50.3	
Length/Diameter Ratio		1.32	
Laboratory Moisture Ratio (%)		0.0	
Laboratory Density Ratio (%)		0.0	
CompactiveEffort		approx 95% Std	
Method of Compaction		tamped	
Surcharge Applied (Kg)		0.0	
Pressure Applied (Kpa)		10	
Oversize Sieve (mm)		9.5	
Percentage Oversize (%)		4.0	
Moisture Content (%)		23.1	
Date Tested		5/01/2016	

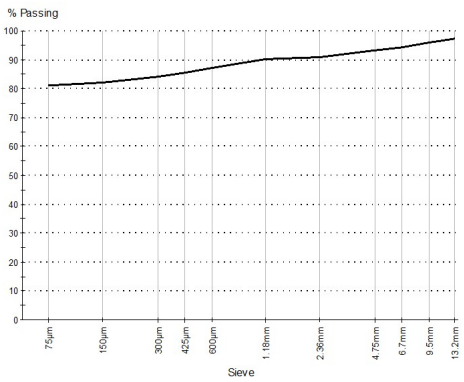
Particle Size Distribution

Method: AS 1289.3.6.1

Date Tested: 7/01/2016
Note: Sample Washed

Sieve Size	% Passing	Limits
13.2mm	97	
9.5mm	96	
6.7mm	94	
4.75mm	93	
2.36mm	91	
1.18mm	90	
600µm	87	
425µm	86	
300µm	84	
150µm	82	
75µm	81	

Chart



Comments

Moisture and Density Ratio's not applicable.
Permeability- At client request, specimen compacted to approximately 95% compactive effort at estimated Optimum Moisture Content.
Remoulded Dry Density = 1.71 t/m³, Remoulded Moisture Content = 19.9 %.

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Aggregate/Soil Test Report

Report No: SYD1502264

Client:
Earth 2 Water Pty Ltd
Material Evaluation
Gerringong NSW 2534

Project: 2124279

Sample Details

GHD Sample No	SYD15L-0459-02
Date Sampled	15/12/2015
Sampled By	Sampled By Client
Location	Woodlawn
BH / TP No.	SFK-2
Depth (m)	floor
Soil Description	SILT; yellow/brown

Other Test Results

Description	Method	Result	Limits
Coef of Permeability (m/sec)	AS 1289.6.7.3	1.3 E-08	
Mean Stress Level (kPa)		30	
Permeant Used		Syd Tap Water	
Length (mm)		66.2	
Diameter (mm)		50.1	
Length/Diameter Ratio		1.32	
Laboratory Moisture Ratio (%)		0.0	
Laboratory Density Ratio (%)		0.0	
CompactiveEffort		approx 95% Std	
Method of Compaction		tamped	
Surcharge Applied (Kg)		0.0	
Pressure Applied (Kpa)		10	
Oversize Sieve (mm)		9.5	
Percentage Oversize (%)		4.0	
Moisture Content (%)		0.0	
Date Tested		5/01/2016	

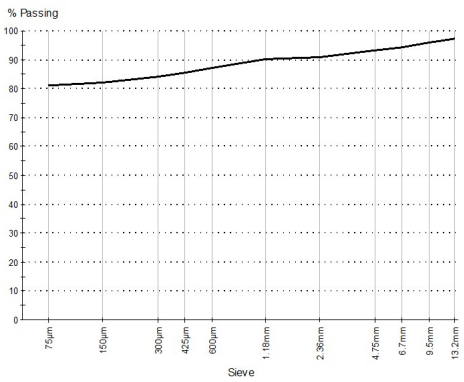
Particle Size Distribution

Method: AS 1289.3.6.1

Date Tested: 7/01/2016
Note: Sample Washed

Sieve Size	% Passing	Limits
13.2mm	97	
9.5mm	96	
6.7mm	94	
4.75mm	93	
2.36mm	91	
1.18mm	90	
600µm	87	
425µm	86	
300µm	84	
150µm	82	
75µm	81	

Chart



Comments

Moisture and Density Ratio's not applicable.
Permeability- At client request, specimen compacted to approximately 95% compactive effort at estimated Optimum Moisture Content

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Aggregate/Soil Test Report

Report No: SYD1502265
Issue No: 1
This report replaces all previous issues of report no 'SYD1502265'.

Client:
Earth 2 Water Pty Ltd
Material Evaluation
Gerringong NSW 2534

Project: 2124279

Accredited for compliance with ISO / IEC 17025

NATA Accredited Laboratory Number: 679

Approved Signatory: D.P Brooke (Sydney Laboratory Manager)

Date of Issue: 11/01/2016

Sample Details

GHD Sample No	SYD15L-0459-03
Date Sampled	15/12/2015
Sampled By	Sampled By Client
Location	Woodlawn
BH / TP No.	SFK-2 rock
Depth (m)	floor
Soil Description	SILT; yellow/brown trace sand & gravel

Test Results

Description	Method	Result	Limits
Coef of Permeability (m/sec)	AS 1289.6.7.3	2 E -08	
Mean Stress Level (kPa)		30	
Permeant Used		Syd Tap Water	
Length (mm)		67.9	
Diameter (mm)		50.0	
Length/Diameter Ratio		1.35	
Laboratory Moisture Ratio (%)		0.0	
Laboratory Density Ratio (%)		0.0	
CompactiveEffort		approx 100% std	
Method of Compaction		tamped	
Surcharge Applied (Kg)		0.0	
Pressure Applied (Kpa)		10	
Oversize Sieve (mm)		9.5	
Percentage Oversize (%)		0.0	
Moisture Content (%)		22.6	
Date Tested		5/01/2016	

Comments

Moisture and Density Ratio's not applicable.
Permeability- At client request, specimen compacted to approximately 100% compactive effort at estimated Optimum Moisture Content remoulded Dry density = 1.723 t/m³ , remoulded moisture content = 19.4%

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Aggregate/Soil Test Report

Report No: SYD1502265

Client:
Earth 2 Water Pty Ltd
Material Evaluation
Gerringong NSW 2534

Project: 2124279

Sample Details

GHD Sample No	SYD15L-0459-03
Date Sampled	15/12/2015
Sampled By	Sampled By Client
Location	Woodlawn
BH / TP No.	SFK-2 rock
Depth (m)	floor
Soil Description	SILT; yellow/brown

Test Results

Description	Method	Result	Limits
Coef of Permeability (m/sec)	AS 1289.6.7.3	2.1 E-08	
Mean Stress Level (kPa)		30	
Permeant Used		Syd Tap Water	
Length (mm)		67.9	
Diameter (mm)		50.0	
Length/Diameter Ratio		1.35	
Laboratory Moisture Ratio (%)		0.0	
Laboratory Density Ratio (%)		0.0	
CompactiveEffort		approx 100% std	
Method of Compaction		tamped	
Surcharge Applied (Kg)		0.0	
Pressure Applied (Kpa)		10	
Oversize Sieve (mm)		9.5	
Percentage Oversize (%)		0.0	
Moisture Content (%)		0.0	

Comments

N/A

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Aggregate/Soil Test Report

Report No: SYD1502266

Client:
Earth 2 Water Pty Ltd
Material Evaluation
Gerringong NSW 2534

Project: 2124279

Sample Details

GHD Sample No	SYD15L-0459-04
Date Sampled	15/12/2015
Sampled By	Sampled By Client
Location	Woodlawn
BH / TP No.	SFK-3
Depth (m)	floor
Soil Description	Sandy SILT; yelow/brown

Other Test Results

Description	Method	Result	Limits
Coef of Permeability (m/sec)	AS 1289.6.7.3	2.1 E-08	
Mean Stress Level (kPa)		30	
Permeant Used		Syd Tap water	
Length (mm)		68.0	
Diameter (mm)		70.4	
Length/Diameter Ratio		0.97	
Laboratory Moisture Ratio (%)		0.0	
Laboratory Density Ratio (%)		0.0	
CompactiveEffort		approx. 95% std	
Method of Compaction		tamped	
Surcharge Applied (Kg)		0.0	
Pressure Applied (Kpa)		10	
Oversize Sieve (mm)		13.2	
Percentage Oversize (%)		1.0	
Moisture Content (%)		0.0	
Date Tested		18/12/2015	

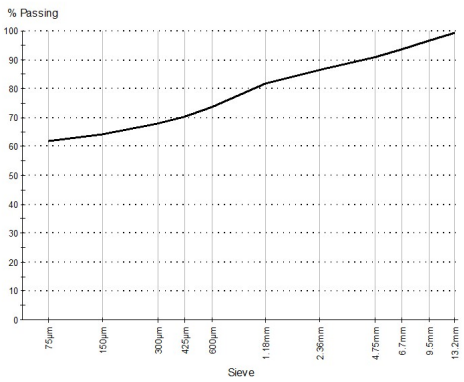
Particle Size Distribution

Method: AS 1289.3.6.1

Date Tested: 7/01/2016
Note: Sample Washed

Sieve Size	% Passing	Limits
13.2mm	99	
9.5mm	97	
6.7mm	94	
4.75mm	91	
2.36mm	87	
1.18mm	82	
600µm	74	
425µm	70	
300µm	68	
150µm	64	
75µm	62	

Chart



Comments

Moisture and Density Ratio's not applicable.
Permeability- At client request, specimen compacted to approximately 95% compactive effort at estimated Optimum Moisture Content

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Aggregate/Soil Test Report

Report No: SYD1502266
Issue No: 2
This report replaces all previous issues of report no 'SYD1502266'.

Client:
Earth 2 Water Pty Ltd
Material Evaluation
Gerringong NSW 2534

Project: 2124279

Accredited for compliance with ISO / IEC 17025

NATA Accredited Laboratory Number: 679

Approved Signatory: D.P Brooke (Sydney Laboratory Manager)

Date of Issue: 11/01/2016

Sample Details

GHD Sample No	SYD15L-0459-04
Date Sampled	15/12/2015
Sampled By	Sampled By Client
Location	Woodlawn
BH / TP No.	SFK-3
Depth (m)	floor
Soil Description	Sandy SILT; yellow/brown some gravel

Other Test Results

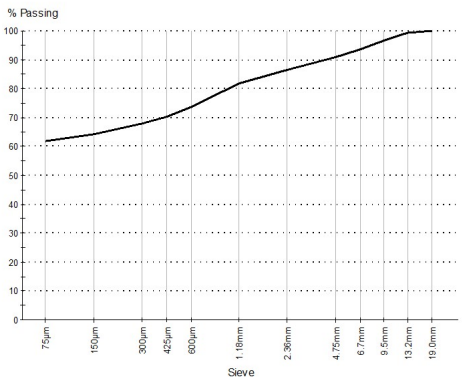
Description	Method	Result	Limits
Coef of Permeability (m/sec)	AS 1289.6.7.3	1 E -08	
Mean Stress Level (kPa)		30	
Permeant Used		Syd Tap water	
Length (mm)		68.0	
Diameter (mm)		70.4	
Length/Diameter Ratio		0.97	
Laboratory Moisture Ratio (%)		0.0	
Laboratory Density Ratio (%)		0.0	
CompactiveEffort		approx. 95% std	
Method of Compaction		tamped	
Surcharge Applied (Kg)		0.0	
Pressure Applied (Kpa)		10	
Oversize Sieve (mm)		13.2	
Percentage Oversize (%)		1.0	
Moisture Content (%)		19.2	
Date Tested		18/12/2015	

Particle Size Distribution

Method:	AS 1289.3.6.1
Drying by:	Oven
Date Tested:	7/01/2016
Note:	Sample Washed

Sieve Size	% Passing	Limits
19.0mm	100	
13.2mm	99	
9.5mm	97	
6.7mm	94	
4.75mm	91	
2.36mm	87	
1.18mm	82	
600µm	74	
425µm	70	
300µm	68	
150µm	64	
75µm	62	

Chart



Comments

Moisture and Density Ratio's not applicable.
Permeability- At client request, specimen compacted to approximately 95% compactive effort at estimated Optimum Moisture Content
Remoulded Dry Density = 1.765 t/m³ , Remoulded moisture content = 16.9%

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Aggregate/Soil Test Report

Report No: SYD1502268
Issue No: 1
This report replaces all previous issues of report no 'SYD1502268'.

Client:
Earth 2 Water Pty Ltd
Material Evaluation
Salt Pan Creek Landfill

Project: 2124279

Sample Details

GHD Sample No	SYD15L-0459-06
Date Sampled	15/12/2015
Sampled By	Sampled By Client
Location	Woodlawn
Client Location	Batter W
BH / TP No.	TP5 Batter W
Depth (m)	0.2
Soil Description	SILT : light brown some sand & gravel

Other Test Results

Description	Method	Result	Limits
Coef of Permeability (m/sec)	AS 1289.6.7.3	2 E -08	
Mean Stress Level (kPa)		30	
Permeant Used		tap water	
Length (mm)		68.4	
Diameter (mm)		51.4	
Length/Diameter Ratio		1.30	
Laboratory Moisture Ratio (%)		0.0	
Laboratory Density Ratio (%)		0.0	
CompactiveEffort		approx 95% standard	
Method of Compaction		tamped	
Surcharge Applied (Kg)		0.0	
Pressure Applied (Kpa)		10	
Oversize Sieve (mm)		6.3	
Percentage Oversize (%)		5.0	
Moisture Content (%)		19.7	
Date Tested		21/12/2015	

Particle Size Distribution

Method: AS 1289.3.6.1

Date Tested:
Note: Sample Not Washed

Sieve Size	% Passing	Limits

Chart

Comments

Permeability - At client request, specimen compacted to approximately 95% compactive effort at estimated Optimum Moisture Content

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Aggregate/Soil Test Report

Report No: SYD1502268
Issue No: 2
This report replaces all previous issues of report no 'SYD1502268'.

Client:
Earth 2 Water Pty Ltd
Material Evaluation
Gerringong NSW 2534

Project: 2124279

Accredited for compliance with ISO / IEC 17025

NATA Accredited Laboratory Number: 679

Approved Signatory: G J Vukovic (Senior Laboratory Technician)

Date of Issue: 8/01/2016

Sample Details

GHD Sample No	SYD15L-0459-06
Date Sampled	15/12/2015
Sampled By	Sampled By Client
Location	Woodlawn
Client Location	Batter W
BH / TP No.	TP5 Batter W
Depth (m)	0.2
Soil Description	SILT : light brown some sand & gravel

Test Results

Description	Method	Result	Limits
Coef of Permeability (m/sec)	AS 1289.6.7.3	2 E -08	
Mean Stress Level (kPa)		30	
Permeant Used		syd tap water	
Length (mm)		68.4	
Diameter (mm)		51.4	
Length/Diameter Ratio		1.30	
Laboratory Moisture Ratio (%)		0.0	
Laboratory Density Ratio (%)		0.0	
CompactiveEffort		approx 95% standard	
Method of Compaction		tamped	
Surcharge Applied (Kg)		0.0	
Pressure Applied (Kpa)		10	
Oversize Sieve (mm)		6.3	
Percentage Oversize (%)		5.0	
Moisture Content (%)		19.7	
Date Tested		21/12/2015	

Comments

Permeability - At client request, specimen compacted to approximately 95% compactive effort at estimated Optimum Moisture Content
Moisture and Density Ratio's not applicable.

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Aggregate/Soil Test Report

Report No: SYD1502269

Client:
Earth 2 Water Pty Ltd
Material Evaluation
Salt Pan Creek Landfill

Project: 2124279

Sample Details

GHD Sample No	SYD15L-0459-07
Date Sampled	15/12/2015
Sampled By	Sampled By Client
Location	Woodlawn
BH / TP No.	TPx Batter E
Depth (m)	0.5
Soil Description	SILT: light yellow brown brown & grey trace sand & gravel

Other Test Results

Description	Method	Result	Limits
Coef of Permeability (m/sec)	AS 1289.6.7.3	5 E -08	
Mean Stress Level (kPa)		30	
Permeant Used		tap water	
Length (mm)		67.0	
Diameter (mm)		50.4	
Length/Diameter Ratio		1.30	
Laboratory Moisture Ratio (%)		0.0	
Laboratory Density Ratio (%)		0.0	
CompactiveEffort		approx 95% standard	
Method of Compaction		tamped	
Surcharge Applied (Kg)		0.0	
Pressure Applied (Kpa)		10	
Oversize Sieve (mm)		6.7	
Percentage Oversize (%)		0.0	
Moisture Content (%)		23.9	
Date Tested		18/12/2015	

Particle Size Distribution

Method: AS 1289.3.6.1

Date Tested:
Note: Sample Not Washed

Sieve Size	% Passing	Limits

Chart

Comments

Permeability - At client request, specimen compacted at approximately 95% compactive effort at estimated Optimum Moisture Content

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Aggregate/Soil Test Report

Report No: SYD1502269
Issue No: 1
This report replaces all previous issues of report no 'SYD1502269'.

Client:
Earth 2 Water Pty Ltd
Material Evaluation
Gerringong NSW 2534

Project: 2124279

Accredited for compliance with ISO / IEC 17025

NATA Accredited Laboratory Number: 679

Approved Signatory: G J Vukovic (Senior Laboratory Technician)

Date of Issue: 8/01/2016

Sample Details

GHD Sample No	SYD15L-0459-07
Date Sampled	15/12/2015
Sampled By	Sampled By Client
Location	Woodlawn
BH / TP No.	TPx Batter E
Depth (m)	0.5
Soil Description	SILT: light yellow brown brown & grey trace sand & gravel

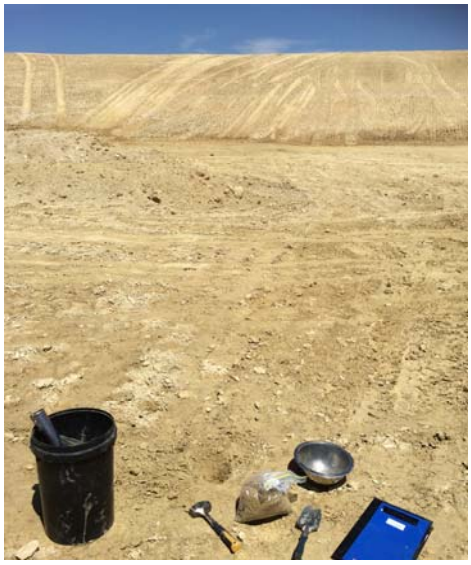
Test Results

Description	Method	Result	Limits
Coef of Permeability (m/sec)	AS 1289.6.7.3	5 E -08	
Mean Stress Level (kPa)		30	
Permeant Used		syd tap water	
Length (mm)		67.0	
Diameter (mm)		50.4	
Length/Diameter Ratio		1.30	
Laboratory Moisture Ratio (%)		0.0	
Laboratory Density Ratio (%)		0.0	
CompactiveEffort		approx 95% standard	
Method of Compaction		tamped	
Surcharge Applied (Kg)		0.0	
Pressure Applied (Kpa)		10	
Oversize Sieve (mm)		6.7	
Percentage Oversize (%)		0.0	
Moisture Content (%)		23.9	
Date Tested		18/12/2015	

Comments

Permeability - At client request, specimen compacted to approximately 95% compactive effort at estimated Optimum Moisture Content
Moisture and Density Ratio's not applicable.

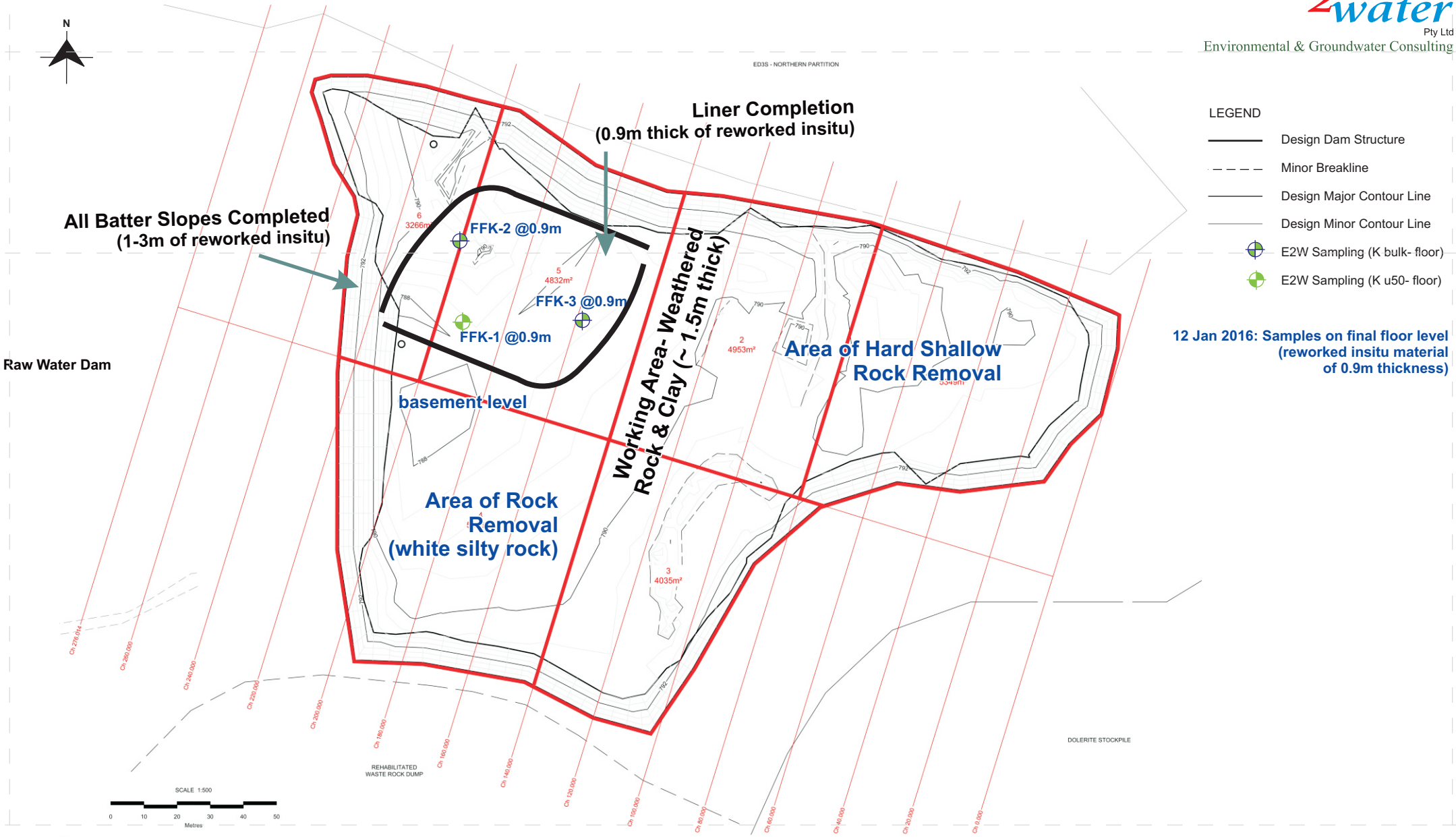
Appendix A1
Figure 1A: Site Layout & Testing Locations at Evaporation Dam (E2W, 12 January 2016).
Plates 1 to 5 (12 January 2016)



Plates 1 to 5 (12 January 2016) Viewing north over liner construction works at ED3SS (use of D8, roller, excavator, water cart). An area of approximately 2500m2 completed on SW corner to 0.9m thickness using re-worked and compacted weathered bedrock (siltstone) and clayey silt. Batter slopes completed using reworked insitu material (few meters thick). Two areas on the floor comprise hard rock which is removed and reused in the VOID.

Woodlawn Bioreactor- ED3SS liner construction (1 of 1)

earth2water Pty Ltd
Environmental & Groundwater Consulting



Source: LandTeam Australia Pty Ltd

Site Layout & Testing Locations at Evaporation Dam (12 January 2016)

Date: *13 January 2016*

Reference: *E2W_243_01.cdr*

Woodlawn Bioreactor - ED3SS CQA

Figure 1A

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Aggregate/Soil Test Report

Report No: SYD1600033
Issue No: 1
This report replaces all previous issues of report no 'SYD1600033'.

Client:
Earth 2 Water Pty Ltd
Material Evaluation
Gerringong NSW 2534

Project: 2124279

Accredited for compliance with ISO / IEC 17025

NATA Accredited Laboratory Number: 679

Approved Signatory: D.P Brooke (Sydney Laboratory Manager)

Date of Issue: 22/01/2016

Sample Details

GHD Sample No	SYD16-0012-01
Date Sampled	12/01/2016
Sampled By	Sampled By Client
Location	Woodlawn
BH / TP No.	FFK-1
Depth (m)	0.9
Soil Description	SILT with sand; light brown trace gravel

Other Test Results

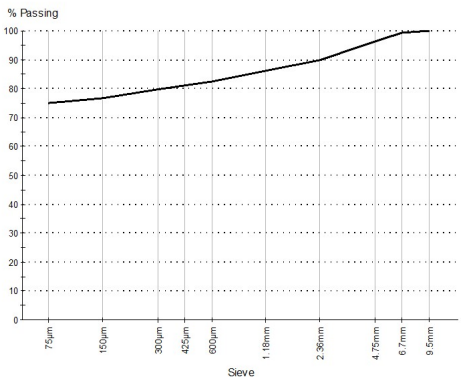
Description	Method	Result	Limits
Coef of Permeability (m/sec)	AS 1289.6.7.3	4 E -08	
Mean Stress Level (kPa)		30	
Permeant Used		Tap Water	
Length (mm)		65.1	
Diameter (mm)		50.7	
Length/Diameter Ratio		1.30	
Laboratory Moisture Ratio (%)		0.0	
Laboratory Density Ratio (%)		0.0	
CompactiveEffort		n/a	
Method of Compaction		Undisturbed Sample	
Surcharge Applied (Kg)		0.0	
Pressure Applied (Kpa)		10	
Oversize Sieve (mm)		6.7	
Percentage Oversize (%)		1.0	
Moisture Content (%)		22.9	
Date Tested		14/01/2016	

Particle Size Distribution

Method:	AS 1289.3.6.1
Drying by:	Oven
Date Tested:	14/01/2016
Note:	Sample Washed

Sieve Size	% Passing	Limits
9.5mm	100	
6.7mm	99	
4.75mm	96	
2.36mm	90	
1.18mm	86	
600µm	83	
425µm	81	
300µm	80	
150µm	77	
75µm	75	

Chart



Comments

Moisture and Density Ratio's not applicable. Undisturbed sample.
Natural Moisture Content = 15.8 % , Natural Dry Density = 1.683 t/m ^{3}

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Aggregate/Soil Test Report

Report No: SYD1600034
Issue No: 1
This report replaces all previous issues of report no 'SYD1600034'.

Client:
Earth 2 Water Pty Ltd
Material Evaluation
Gerringong NSW 2534

Project: 2124279

Accredited for compliance with ISO / IEC 17025

NATA Accredited Laboratory Number: 679

Approved Signatory: D.P Brooke (Sydney Laboratory Manager)

Date of Issue: 22/01/2016

Sample Details

GHD Sample No	SYD16-0012-02
Date Sampled	12/01/2016
Sampled By	Sampled By Client
Location	Woodlawn
BH / TP No.	FFK-2
Depth (m)	0.9
Soil Description	Gravelly SILT with sand light brown

Other Test Results

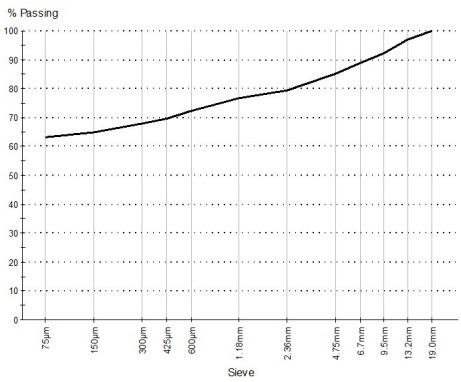
Description	Method	Result	Limits
Coef of Permeability (m/sec)	AS 1289.6.7.3	2 E -08	
Mean Stress Level (kPa)		30	
Permeant Used		Tap Water	
Length (mm)		66.1	
Diameter (mm)		50.0	
Length/Diameter Ratio		1.30	
Laboratory Moisture Ratio (%)		0.0	
Laboratory Density Ratio (%)		0.0	
CompactiveEffort		Approx 100% Standard	
Method of Compaction		Tamped	
Surcharge Applied (Kg)		0.0	
Pressure Applied (Kpa)		10	
Oversize Sieve (mm)		6.7	
Percentage Oversize (%)		11.0	
Moisture Content (%)		23.7	
Date Tested		14/01/2016	

Particle Size Distribution

Method:	AS 1289.3.6.1
Drying by:	Oven
Date Tested:	14/01/2016
Note:	Sample Washed

Sieve Size	% Passing	Limits
19.0mm	100	
13.2mm	97	
9.5mm	92	
6.7mm	89	
4.75mm	85	
2.36mm	79	
1.18mm	77	
600µm	72	
425µm	70	
300µm	68	
150µm	65	
75µm	63	

Chart



Comments

At clients request specimens remoulded to approximately 100% standard compactive & approximately OMC. Moisture and Density Ratio's not applicable.
Remoulded moisture content = 15.7% , Remoulded dry density = 1.680 t/m³

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Aggregate/Soil Test Report

Report No: SYD1600035
Issue No: 1
This report replaces all previous issues of report no 'SYD1600035'.

Client:
Earth 2 Water Pty Ltd
Material Evaluation
Gerringong NSW 2534

Project: 2124279

Accredited for compliance with ISO / IEC 17025

NATA Accredited Laboratory Number: 679

Approved Signatory: D.P Brooke (Sydney Laboratory Manager)

Date of Issue: 22/01/2016

Sample Details

GHD Sample No	SYD16-0012-03
Date Sampled	12/01/2016
Sampled By	Sampled By Client
Location	Woodlawn
BH / TP No.	FFK-3
Depth (m)	0.9
Soil Description	SILT with sand; light brown trace gravel

Other Test Results

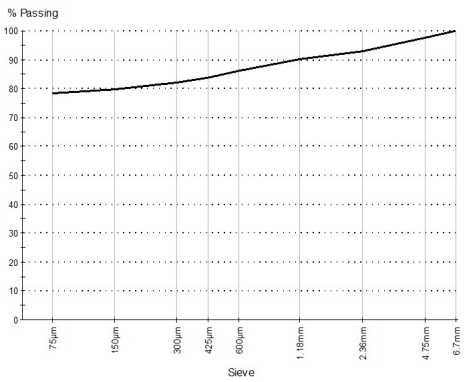
Description	Method	Result	Limits
Coef of Permeability (m/sec)	AS 1289.6.7.3	5 E -08	
Mean Stress Level (kPa)		30	
Permeant Used		Tap Water	
Length (mm)		67.6	
Diameter (mm)		50.1	
Length/Diameter Ratio		1.35	
Laboratory Moisture Ratio (%)		0.0	
Laboratory Density Ratio (%)		0.0	
CompactiveEffort		Approx 100% standard	
Method of Compaction		Tamped	
Surcharge Applied (Kg)		0.0	
Pressure Applied (Kpa)		10	
Oversize Sieve (mm)		6.7	
Percentage Oversize (%)		0.0	
Moisture Content (%)		23.8	
Date Tested		14/01/2016	

Particle Size Distribution

Method:	AS 1289.3.6.1
Drying by:	Oven
Date Tested:	14/01/2016
Note:	Sample Washed

Sieve Size	% Passing	Limits
6.7mm	100	
4.75mm	98	
2.36mm	93	
1.18mm	90	
600µm	86	
425µm	84	
300µm	82	
150µm	80	
75µm	78	

Chart



Comments

At clients request specimens remoulded to approximately 100% standard compactive & approximately OMC. Moisture and Density Ratio's not applicable.
Remoulded moisture content = 15.6% , Remoulded dry density = 1.680 t/m³

Appendix A2
Geotechnical Testing Results of MBT Clays (15 Dec 2015, 12 Jan 2016, 5 Feb 2016)

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Aggregate/Soil Test Report

Report No: SYD1502270

Client:
Earth 2 Water Pty Ltd
Material Evaluation
Gerringong NSW 2534

Project: 2124279

Sample Details

GHD Sample No	SYD15L-0459-08
Date Sampled	15/12/2015
Sampled By	Sampled By Client
Location	Woodlawn
BH / TP No.	MBT-SP
Depth (m)	Stockpile
Soil Description	CLAY with sand; brown with trace gravel

Other Test Results

Description	Method	Result	Limits
Coef of Permeability (m/sec)	AS 1289.6.7.3	7 E-11	
Mean Stress Level (kPa)		30	
Permeant Used		Syd Tap Water	
Length (mm)		72.2	
Diameter (mm)		70.0	
Length/Diameter Ratio		1.03	
Laboratory Moisture Ratio (%)		0.0	
Laboratory Density Ratio (%)		0.0	
CompactiveEffort		approx. 100% std	
Method of Compaction		tamped	
Surcharge Applied (Kg)		0.0	
Pressure Applied (Kpa)		10	
Oversize Sieve (mm)		13.2	
Percentage Oversize (%)		4.0	
Moisture Content (%)		0.0	

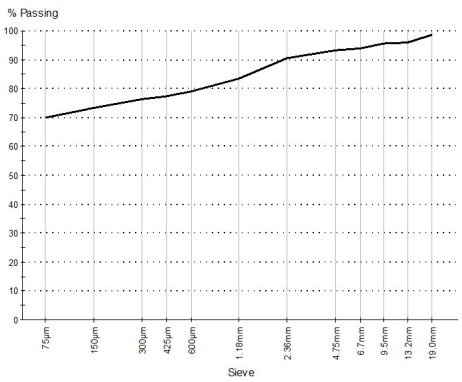
Particle Size Distribution

Method: AS 1289.3.6.1

Date Tested: 7/01/2016
Note: Sample Washed

Sieve Size	% Passing	Limits
19.0mm	99	
13.2mm	96	
9.5mm	96	
6.7mm	94	
4.75mm	93	
2.36mm	91	
1.18mm	83	
600µm	79	
425µm	77	
300µm	76	
150µm	73	
75µm	70	

Chart



Comments

Moisture and Density Ratio's not applicable.
Permeability- At client request, specimen compacted to approximately 100% compactive effort at estimated Optimum Moisture Content

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Aggregate/Soil Test Report

Report No: SYD1600036
Issue No: 1
This report replaces all previous issues of report no 'SYD1600036'.

Client:
Earth 2 Water Pty Ltd
Material Evaluation
Gerringong NSW 2534

Project: 2124279

Accredited for compliance with ISO / IEC 17025

NATA Accredited Laboratory Number: 679

Approved Signatory: D.P Brooke (Sydney Laboratory Manager)

Date of Issue: 22/01/2016

Sample Details

GHD Sample No	SYD16-0012-04
Date Sampled	12/01/2016
Sampled By	Sampled By Client
Location	Woodlawn
BH / TP No.	MBT SP2
Soil Description	CLAY with sand; Brown

Other Test Results

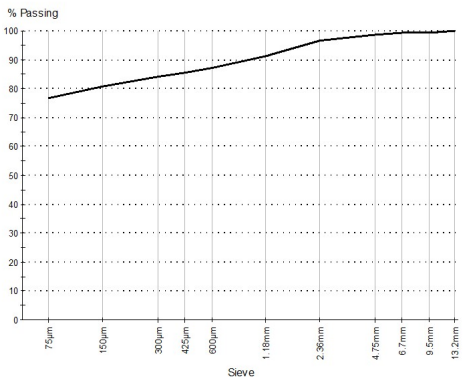
Description	Method	Result	Limits
Coef of Permeability (m/sec)	AS 1289.6.7.3	7 E -11	
Mean Stress Level (kPa)		30	
Permeant Used		Tap Water	
Length (mm)		64.3	
Diameter (mm)		50.4	
Length/Diameter Ratio		1.30	
Laboratory Moisture Ratio (%)		0.0	
Laboratory Density Ratio (%)		0.0	
CompactiveEffort		Approx 100% standard	
Method of Compaction		tamped	
Surcharge Applied (Kg)		0.0	
Pressure Applied (Kpa)		10	
Oversize Sieve (mm)		6.7	
Percentage Oversize (%)		1.0	
Moisture Content (%)		25.8	
Date Tested		14/01/2016	

Particle Size Distribution

Method:	AS 1289.3.6.1
Drying by:	Oven
Date Tested:	14/01/2016
Note:	Sample Washed

Sieve Size	% Passing	Limits
13.2mm	100	
9.5mm	99	
6.7mm	99	
4.75mm	99	
2.36mm	97	
1.18mm	91	
600µm	87	
425µm	85	
300µm	84	
150µm	81	
75µm	77	

Chart



Comments

At clients request specimens remoulded to approximately 100% standard compactive & approximately OMC. Moisture and Density Ratio's not applicable.
Remoulded moisture content = 19.3 % , Remoulded dry density = 1.635 t/m³

Sydney Laboratory
57 Herbert St
Artarmon NSW 2064
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web: www.ghd.com.au/ghdgeotechnics
Tel: (02) 9462 4860
Fax:(02) 9462 4710

Aggregate/Soil Test Report

Report No: SYD1600230
Issue No: 1
This report replaces all previous issues of report no 'SYD1600230'.

Client:
Earth 2 Water Pty Ltd
Material Evaluation
Gerringong NSW 2534

Project: 2124279

Accredited for compliance with ISO / IEC 17025

NATA Accredited Laboratory Number: 679

Approved Signatory: D.P Brooke (Sydney Laboratory Manager)

Date of Issue: 17/02/2016

Sample Details

GHD Sample No	SYD16-0043-01
Client Sample ID	MBT-SP3
Date Sampled	05/02/2016
Sampled By	Supplied by Client
Location	Woodlawn
Soil Description	CLAY: brown, Grey, Red, mottled with gravel

Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	13.0	
Mould Length (mm)		125	
Crumbling		No	
Curling		No	
Cracking		No	
Liquid Limit (%)	AS 1289.3.1.1	66	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	20	
Plasticity Index (%)	AS 1289.3.3.1	46	
Date Tested		17/02/2016	
Emerson Class Number	AS 1289.3.8.1	1	
Soil Description		CLAY	
Type of Water		Distilled	
Temperature of Water (°C)		25	
Date Tested		15/02/2016	

Comments

N/A

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SGS Australia Pty Ltd
PO Box 6432 Alexandria NSW 2015
Unit 15, 33 Maddox Street
Alexandria NSW 2015

Client:	VEOLIA ENVIRONMENTAL SERVICES (AUSTRALIA) PTY LTD	Client Job No:	
Order No:	4503277234	Project:	Woodlawn Bioreactor
Tested Date:	14/10/2015	Location:	
SGS Job Number:	15-32-282	Sample No:	15-AC-2109
Lab:	Alexandria CMT	Sample ID:	Lipmans Excavated Material

Atterberg Limits (4 Point Casagrande Method with Linear Shrinkage)

AS 1289.3.1.1, 3.2.1, 3.3.1, 3.4.1

Sample Description:	Silty Clay : Brown
Liquid Limit:	72%
Plastic Limit:	16%
Plasticity Index:	56%
History of Sample:	Oven-Dried
Method of Preparation:	Dry-Sieved
Linear Shrinkage:	16.0%
Length of Mould:	125MM
Dry State:	Linear

Note: Sample supplied by client.

Approved Signatory: (Aaron.Lacey, Business Manager) Date: 16/10/2015

Accredited for compliance with ISO/IEC 17025

Accreditation No.: 2418

Site No.: 1452
Cert No.: 15-AC-2109-AN012
Form No.PF-AU-INDCMT-GEN-AN-012

Client Address: NSW WOODLAWN BIOREACTOR COLLECTOR ROAD TARAGO NSW 2580

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Client:	VEOLIA ENVIRONMENTAL SERVICES (AUSTRALIA) PTY LTD	Client Job No:	
Order No:	4503277234	Project:	Woodlawn Bioreactor
Tested Date:	16/10/2015	Location:	
SGS Job Number:	15-32-282	Sample No:	15-AC-2109
Lab:	Alexandria CMT	Sample ID:	Lipmans Excavated Material

Emerson Class Number of a Soil

AS 1289.3.8.1

Emerson Class Number:	**6**
Soil Description:	Silty Clay : Brown
Type of Water Used:	Distilled water at 20°C

Note: Sample supplied by client.

Approved Signatory: (Aaron.Lacey, Business Manager) Date: 16/10/2015

Accredited for compliance with ISO/IEC 17025

Site No.: 1452
Cert No.: 15-AC-2109-AN018
Form No.

Accreditation No.: 2418
Client Address: NSW WOODLAWN BIOREACTOR COLLECTOR ROAD TARAGO NSW 2580

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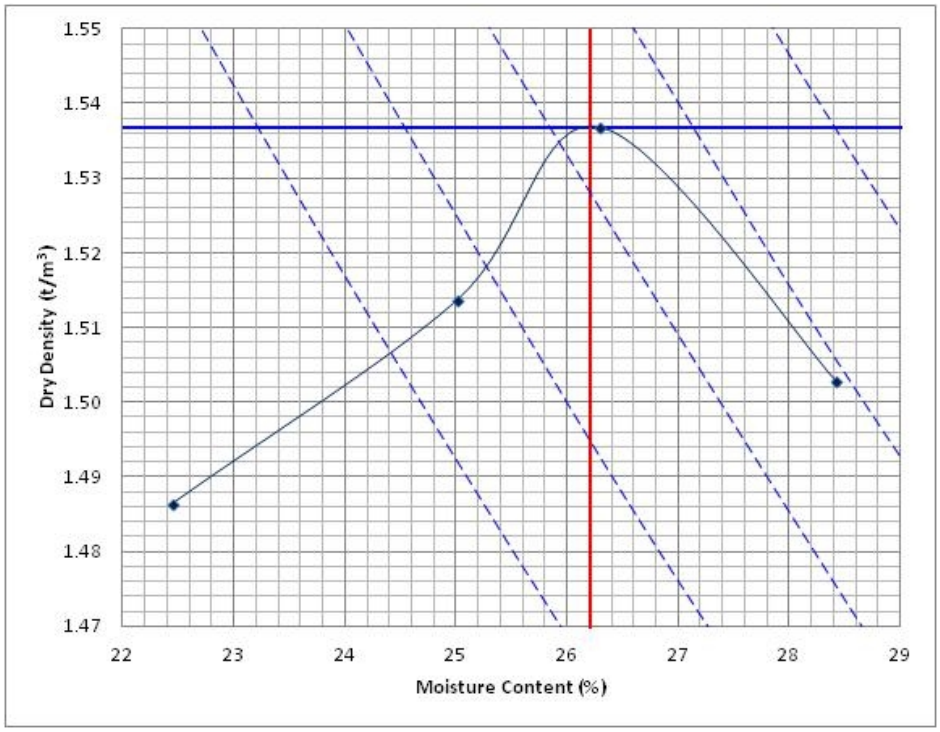
Client:	VEOLIA ENVIRONMENTAL SERVICES (AUSTRALIA) PTY LTD	Client Job No:	
Order No:	4503277234	Project:	Woodlawn Bioreactor
Tested Date:	16/10/2015	Location:	
SGS Job Number:	15-32-282	Sample No:	15-AC-2109
Lab:	Alexandria CMT	Sample ID:	Lipmans Excavated Material

Dry Density / Moisture Content Relation of a Soil

AS 1289.5.1.1 - Standard Compactive Effort



Sample Description:	Silty Clay : Brown
Maximum Dry Density:	1.54t/m³
Optimum Moisture Content:	26.0%
Percent Oversize:	0%
Sieve Size:	19.0mm

Note: Sample supplied by client.

Approved Signatory: (Aaron.Lacey, Business Manager) Date: 16/10/2015

Accredited for compliance with ISO/IEC 17025

Site No.: 1452
Cert No.: 15-AC-2109-AN027.1
Form No.PF-AU-INDCMT-GEN-AN-027

Accreditation No.: 2418
Client Address: NSW WOODLAWN BIOREACTOR COLLECTOR ROAD TARAGO NSW 2580

TEST CERTIFICATE

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SGS Australia Pty Ltd
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(PO Box 6432)
Alexandria NSW 2015
Australia

CONSTANT HEAD PERMEABILITY USING A FLEXIBLE WALL PERMEAMETER

CLIENT: **VEOLIA ENVIRONMENTAL SERVICES (AUSTRALIA) PTY LTD**
NSW WOODLAWN BIOREACTORCOLLECTOR ROADTARAGO NSW 2580

PROJECT: **Woodlawn Bioreactor**

LOCATION:

Job Number: 15-32-282

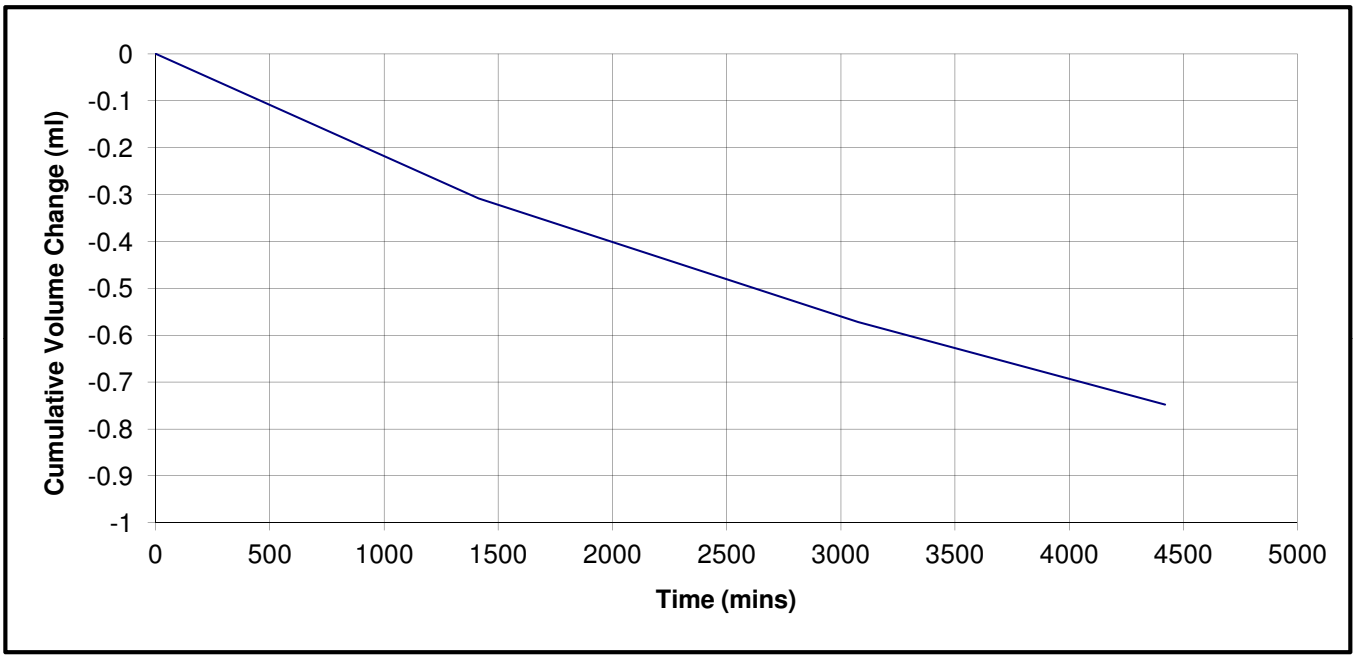
Date Tested: 17/10/2015

Laboratory Number: 15-AC-2109

Sampled By: Client

Sample Source: Lipmans Excavated Material

Sample Description: Silty Clay : Brown



Coefficient of Permeability	4E-11	(metres/second)
Mean Effective Stress	100	(kPa)
Permeant Used	Sydney Tap Water	
SAMPLE DETAILS		
Diameter of Specimen	50.0	(mm)
Height of Specimen	50.0	(mm)
REMOULD DATA		
Laboratory Moisture Ratio	100.1	(%)
Laboratory Density Ratio	100.0	(%)
Retained on 19mm Sieve	0	(%)
Compactive Effort	Standard	

Test Method: Constant head method using a flexible wall permeameter AS1289.6.7.3

Comments:

Approved Signatory: Corey Papu-Gread **Date:** 22/10/2015

Accredited for Compliance with ISO/IEC 17025

Accreditation No. 2418

TEST CERTIFICATE

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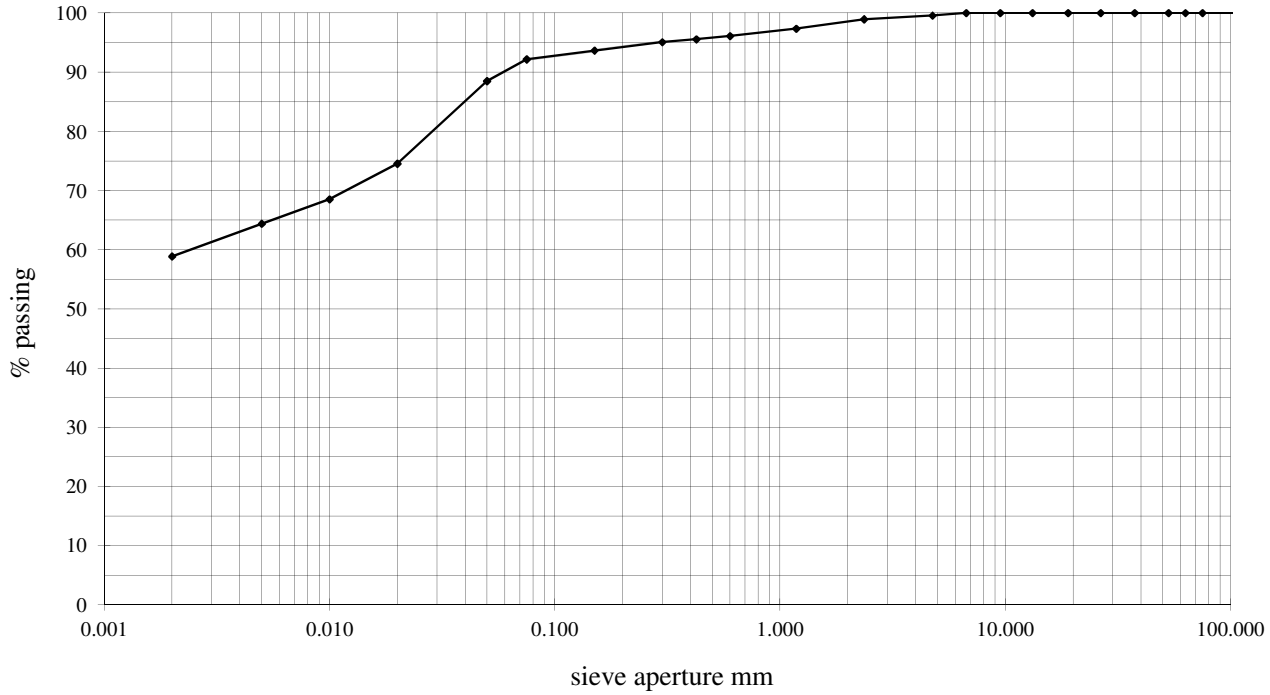
SGS Australia Pty Ltd
Unit 15, 33 Maddox Street
(PO Box 6432)
Alexandria NSW 2015
Australia

PARTICLE SIZE DISTRIBUTION

Client: VEOLIA ENVIRONMENTAL SERVICES (AUSTRALIA) PTY LTD
Address: NSW WOODLAWN BIOREACTORCOLLECTOR ROADTARAGO NSW 2580
Project: Woodlawn Bioreactor
Location:

Test Method: **AS 1289 3.6.1 / 3**
Job Number: 15-32-282
Sample Source: Lipmans Excavated Material
Sampled By: Client

Lab Number: 15-AC-2109
Date Tested: 8/10/2015
Checked By: ME



Clay	Silt	Sand	Gravel

Sample Description: Silty Clay : Brown

Sieve Size (mm)	% Passing	Sieve Size (mm)	% Passing
150.0		1.18	**97**
75.0		0.600	**96**
63.0		0.425	**96**
53.0		0.300	**95**
37.5		0.150	**94**
26.5		0.075	**92**
19.0		0.050	**88**
13.2		0.020	**75**
9.5		0.010	**69**
6.7		0.005	**64**
4.75	**100**	0.002	**59**
2.36	**99**		

Hydrometer Type: **ASTM 152H**
Dispersant Type: **Sodium Hexametaphosphate**
Pretreatment: **None**
Loss on Pretreatment: **None**
Remarks:

Approved Signatory: Aaron Lacey Date: 16/10/2015

Accredited for Compliance with ISO/IEC 17025

Accreditation No. 2418

TEST CERTIFICATE

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Alexandria NSW 2015

Client:	VEOLIA ENVIRONMENTAL SERVICES (AUSTRALIA) PTY LTD	Client Job No:	
Order No:	4503277234	Project:	Woodlawn Bioreactor
Tested Date:	16/10/2015	Location:	
SGS Job Number:	15-32-282	Sample No:	15-AC-2110
Lab:	Alexandria CMT	Sample ID:	Lipmans Top of Void

Atterberg Limits (4 Point Casagrande Method with Linear Shrinkage)

AS 1289.3.1.1, 3.2.1, 3.3.1, 3.4.1

Sample Description:	Silty Clay : Brown
Liquid Limit:	78%
Plastic Limit:	17%
Plasticity Index:	61%
History of Sample:	Oven-Dried
Method of Preparation:	Dry-Sieved
Linear Shrinkage:	15.5%
Length of Mould:	255MM
Dry State:	Curling

Note: Sample supplied by client.

Approved Signatory: (Aaron.Lacey, Business Manager) Date: 16/10/2015

Accredited for compliance with ISO/IEC 17025

Accreditation No.: 2418

Site No.: 1452
Cert No.: 15-AC-2110-AN012
Form No.PF-AU-INDCMT-GEN-AN-012

Client Address: NSW WOODLAWN BIOREACTOR COLLECTOR ROAD TARAGO NSW 2580

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Alexandria NSW 2015

Client:	VEOLIA ENVIRONMENTAL SERVICES (AUSTRALIA) PTY LTD	Client Job No:	
Order No:	4503277234	Project:	Woodlawn Bioreactor
Tested Date:	16/10/2015	Location:	
SGS Job Number:	15-32-282	Sample No:	15-AC-2110
Lab:	Alexandria CMT	Sample ID:	Lipmans Top of Void

Emerson Class Number of a Soil

AS 1289.3.8.1

Emerson Class Number:	**5**
Soil Description:	Silty Clay : Brown
Type of Water Used:	Distilled water at 20°C

Note: Sample supplied by client.

Approved Signatory: (Aaron.Lacey, Business Manager) Date: 16/10/2015

Accredited for compliance with ISO/IEC 17025

Site No.: 1452
Cert No.: 15-AC-2110-AN018
Form No.

Accreditation No.: 2418
Client Address: NSW WOODLAWN BIOREACTOR COLLECTOR ROAD TARAGO NSW 2580

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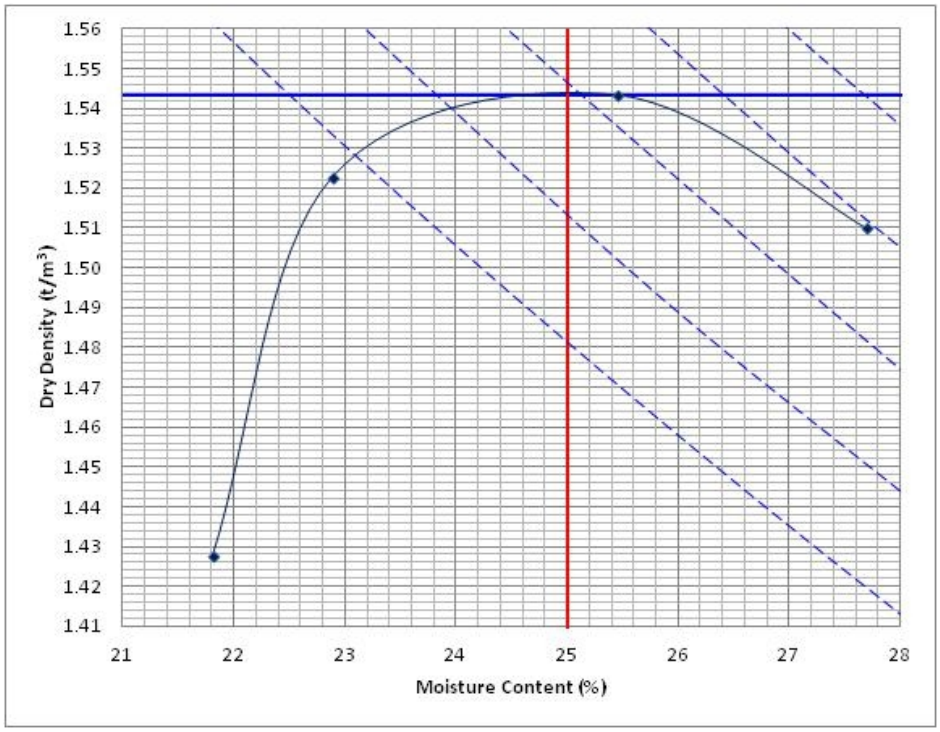
Alexandria NSW 2015

Client:	VEOLIA ENVIRONMENTAL SERVICES (AUSTRALIA) PTY LTD	Client Job No:	
Order No:	4503277234	Project:	Woodlawn Bioreactor
Tested Date:	16/10/2015	Location:	
SGS Job Number:	15-32-282	Sample No:	15-AC-2110
Lab:	Alexandria CMT	Sample ID:	Lipmans Top of Void

Dry Density / Moisture Content Relation of a Soil

AS 1289.5.1.1 - Standard Compactive Effort



Sample Description:	Silty Clay : Brown
Maximum Dry Density:	1.54t/m³
Optimum Moisture Content:	25.0%
Percent Oversize:	0%
Sieve Size:	19.0mm

Note: Sample supplied by client.

Approved Signatory: (Aaron.Lacey, Business Manager) Date: 16/10/2015

Accredited for compliance with ISO/IEC 17025

Site No.: 1452
Cert No.: 15-AC-2110-AN027.1
Form No.PF-AU-INDCMT-GEN-AN-027

Accreditation No.: 2418
Client Address: NSW WOODLAWN BIOREACTOR COLLECTOR ROAD TARAGO NSW 2580

TEST CERTIFICATE

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SGS Australia Pty Ltd
Unit 15, 33 Maddox Street
(PO Box 6432)
Alexandria NSW 2015
Australia

CONSTANT HEAD PERMEABILITY USING A FLEXIBLE WALL PERMEAMETER

CLIENT: **VEOLIA ENVIRONMENTAL SERVICES (AUSTRALIA) PTY LTD**
NSW WOODLAWN BIOREACTORCOLLECTOR ROADTARAGO NSW 2580

PROJECT: **Woodlawn Bioreactor**

LOCATION:

Job Number: 15-32-282

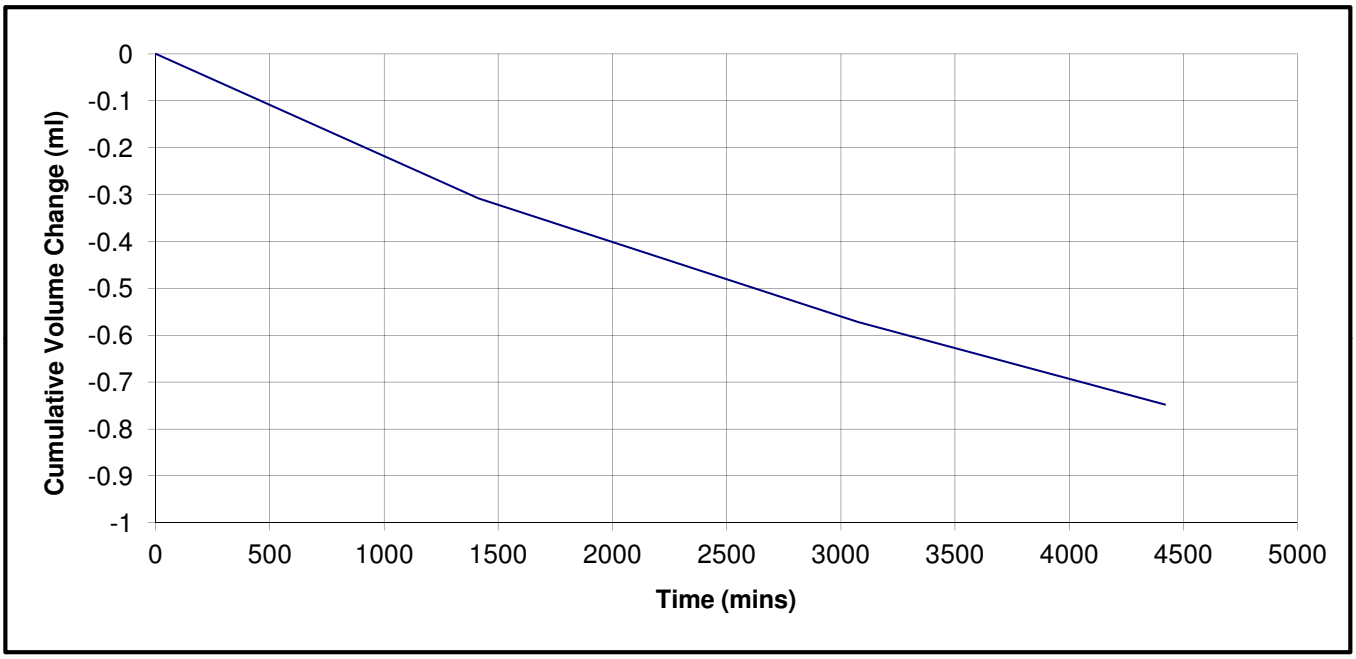
Date Tested: 17/10/2015

Laboratory Number: 15-AC-2110

Sampled By: Client

Sample Source: Lipmans Top of Void

Sample Description: Silty Clay : Brown



Coefficient of Permeability	4E-11	(metres/second)
Mean Effective Stress	100	(kPa)
Permeant Used	Sydney Tap Water	
SAMPLE DETAILS		
Diameter of Specimen	50.0	(mm)
Height of Specimen	50.0	(mm)
REMOULD DATA		
Laboratory Moisture Ratio	100.1	(%)
Laboratory Density Ratio	100.2	(%)
Retained on 19mm Sieve	0	(%)
Compactive Effort	Standard	

Test Method: Constant head method using a flexible wall permeameter AS1289.6.7.3

Comments:

Approved Signatory: Corey Papu-Gread **Date:** 31/10/2015

Accredited for Compliance with ISO/IEC 17025

Accreditation No. 2418

TEST CERTIFICATE

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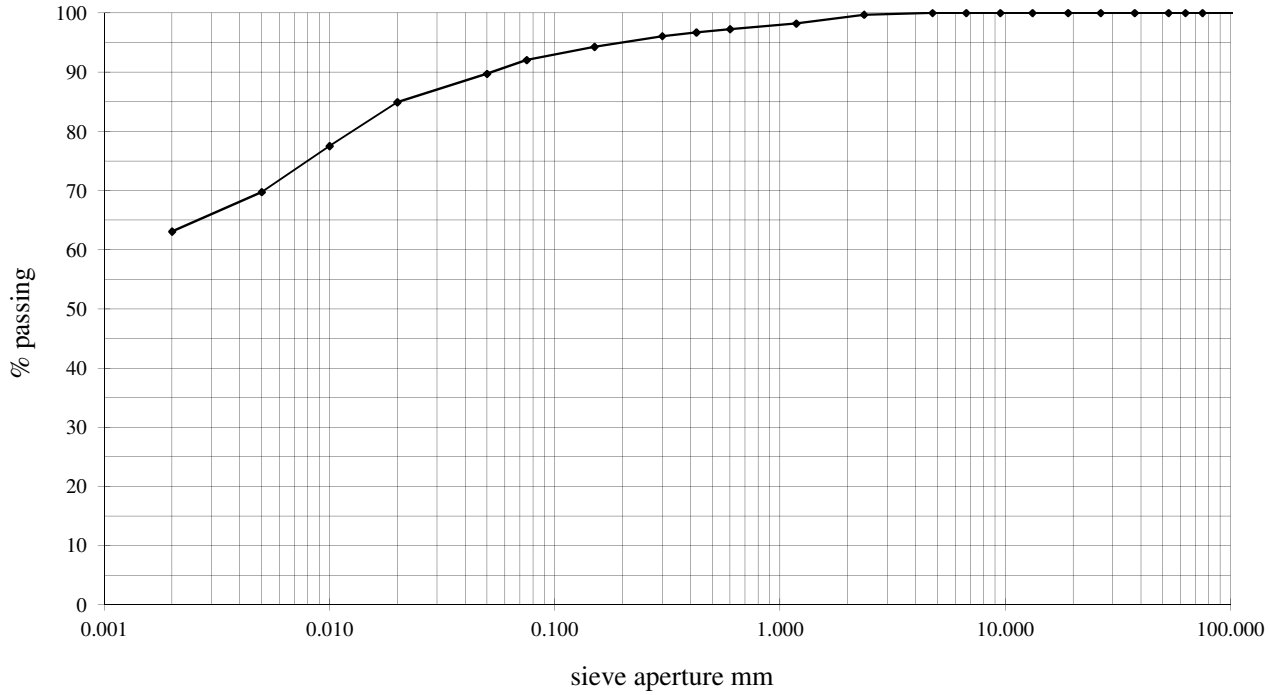
SGS Australia Pty Ltd
Unit 15, 33 Maddox Street
(PO Box 6432)
Alexandria NSW 2015
Australia

PARTICLE SIZE DISTRIBUTION

Client: VEOLIA ENVIRONMENTAL SERVICES (AUSTRALIA) PTY LTD
Address: NSW WOODLAWN BIOREACTORCOLLECTOR ROADTARAGO NSW 2580
Project: Woodlawn Bioreactor
Location:
Test Method: **AS 1289 3.6.1 / 3**
Job Number: 15-32-282
Sample Source: Lipmans Top of Void
Sampled By: CP
Lab Number: 15-AC-2110
Date Tested: 8/10/2015
Checked By: ME



Clay	Silt	Sand	Gravel

Sample Description: Silty Clay : Brown

Sieve Size (mm)	% Passing	Sieve Size (mm)	% Passing
150.0		1.18	**98**
75.0		0.600	**97**
63.0		0.425	**97**
53.0		0.300	**96**
37.5		0.150	**94**
26.5		0.075	**92**
19.0		0.050	**90**
13.2		0.020	**85**
9.5		0.010	**78**
6.7		0.005	**70**
4.75		0.002	**63**
2.36	**100**		

Hydrometer Type: **ASTM 152H**
Dispersant Type: **Sodium Hexametaphosphate**
Pretreatment: **None**
Loss on Pretreatment: **None**
Remarks:

Approved Signatory: Aaron Lacey Date: 16/10/2015

Accredited for Compliance with ISO/IEC 17025

TEST CERTIFICATE

Aaron.Lacey@sgs.com
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SGS Australia Pty Ltd
PO Box 6432 Alexandria NSW 2015
Unit 15, 33 Maddox Street
Alexandria NSW 2015

Client:	VEOLIA ENVIRONMENTAL SERVICES (AUSTRALIA) PTY LTD	Client Job No:	
Order No:	4503277234	Project:	Woodlawn Bioreactor
Tested Date:	16/10/2015	Location:	
SGS Job Number:	15-32-282	Sample No:	15-AC-2111
Lab:	Alexandria CMT	Sample ID:	ED1A

Atterberg Limits (4 Point Casagrande Method with Linear Shrinkage)

AS 1289.3.1.1, 3.2.1, 3.3.1, 3.4.1

Sample Description:	Clay : Brown
Liquid Limit:	70%
Plastic Limit:	16%
Plasticity Index:	54%
History of Sample:	Oven-Dried
Method of Preparation:	Dry-Sieved
Linear Shrinkage:	16.5%
Length of Mould:	255MM
Dry State:	Curling

Note: Sample supplied by client.

Approved Signatory: (Aaron.Lacey, Business Manager) Date: 16/10/2015

Accredited for compliance with ISO/IEC 17025

Site No.: 1452
Cert No.: 15-AC-2111-AN012
Form No.PF-AU-INDCMT-GEN-AN-012

Accreditation No.: 2418
Client Address: NSW WOODLAWN BIOREACTOR COLLECTOR ROAD TARAGO NSW 2580

TEST CERTIFICATE

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Unit 15, 33 Maddox Street
Alexandria NSW 2015

Client:	VEOLIA ENVIRONMENTAL SERVICES (AUSTRALIA) PTY LTD	Client Job No:	
Order No:	4503277234	Project:	Woodlawn Bioreactor
Tested Date:	16/10/2015	Location:	
SGS Job Number:	15-32-282	Sample No:	15-AC-2111
Lab:	Alexandria CMT	Sample ID:	ED1A

Emerson Class Number of a Soil

AS 1289.3.8.1

Emerson Class Number:	**6**
Soil Description:	Clay : Brown
Type of Water Used:	Distilled water at 20°C

Note: Sample supplied by client.

Approved Signatory: (Aaron.Lacey, Business Manager) Date: 16/10/2015

Accredited for compliance with ISO/IEC 17025

Site No.: 1452
Cert No.: 15-AC-2111-AN018
Form No.

Accreditation No.: 2418
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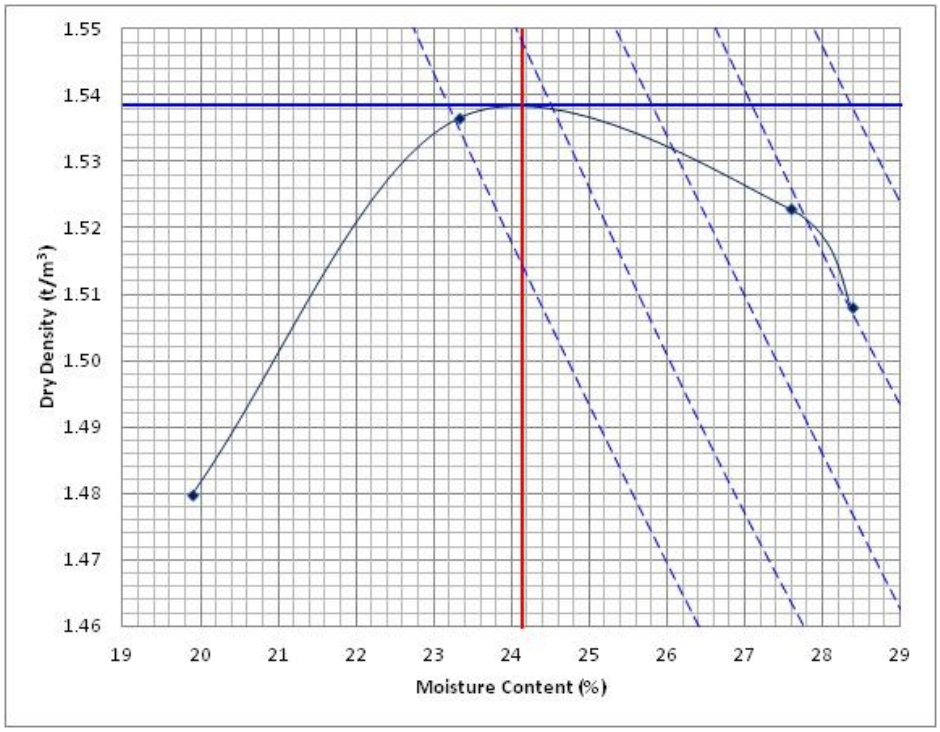
Alexandria NSW 2015

Client:	VEOLIA ENVIRONMENTAL SERVICES (AUSTRALIA) PTY LTD	Client Job No:	
Order No:	4503277234	Project:	Woodlawn Bioreactor
Tested Date:	16/10/2015	Location:	
SGS Job Number:	15-32-282	Sample No:	15-AC-2111
Lab:	Alexandria CMT	Sample ID:	ED1A

Dry Density / Moisture Content Relation of a Soil

AS 1289.5.1.1 - Standard Compactive Effort



Sample Description:	Clay : Brown
Maximum Dry Density:	1.54t/m³
Optimum Moisture Content:	24.0%
Percent Oversize:	0%
Sieve Size:	19.0mm

Note: Sample supplied by client.

Approved Signatory: (Aaron.Lacey, Business Manager) Date: 16/10/2015

Accredited for compliance with ISO/IEC 17025

Accreditation No.: 2418

Site No.: 1452
Cert No.: 15-AC-2111-AN027.1
Form No.PF-AU-INDCMT-GEN-AN-027

Client Address: NSW WOODLAWN BIOREACTOR COLLECTOR ROAD TARAGO NSW 2580

TEST CERTIFICATE

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SGS Australia Pty Ltd
Unit 15, 33 Maddox Street
(PO Box 6432)
Alexandria NSW 2015
Australia

CONSTANT HEAD PERMEABILITY USING A FLEXIBLE WALL PERMEAMETER

CLIENT: **VEOLIA ENVIRONMENTAL SERVICES (AUSTRALIA) PTY LTD**
NSW WOODLAWN BIOREACTORCOLLECTOR ROADTARAGO NSW 2580

PROJECT: **Woodlawn Bioreactor**

LOCATION:

Job Number: 15-32-282

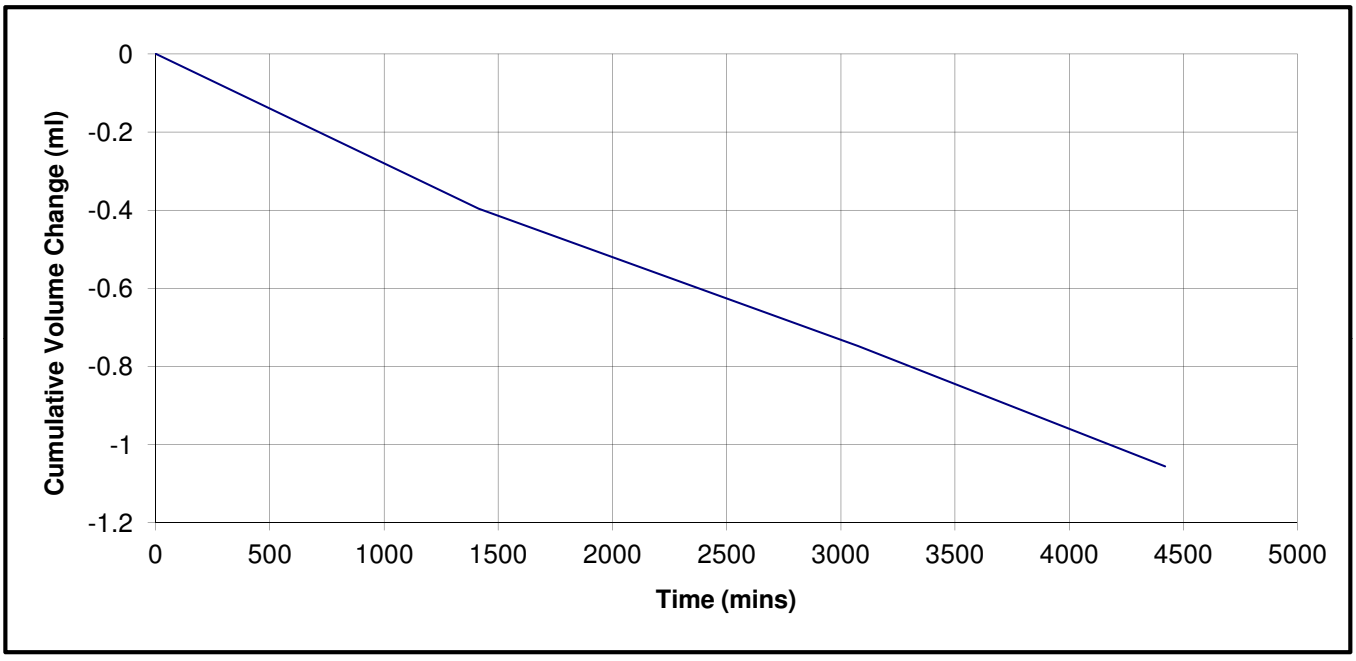
Date Tested: 17/10/2015

Laboratory Number: 15-AC-2111

Sampled By: Client

Sample Source: ED1A

Sample Description: Clay : Brown



Coefficient of Permeability	5E-11	(metres/second)
Mean Effective Stress	100	(kPa)
Permeant Used	Sydney Tap Water	
SAMPLE DETAILS		
Diameter of Specimen	50.0	(mm)
Height of Specimen	50.0	(mm)
REMOULD DATA		
Laboratory Moisture Ratio	100.0	(%)
Laboratory Density Ratio	100.0	(%)
Retained on 19mm Sieve	0	(%)
Compactive Effort	Standard	

Test Method: Constant head method using a flexible wall permeameter AS1289.6.7.3

Comments:

Approved Signatory: Corey Papu-Gread **Date:** 22/10/2015

Accredited for Compliance with ISO/IEC 17025

Accreditation No. 2418

TEST CERTIFICATE

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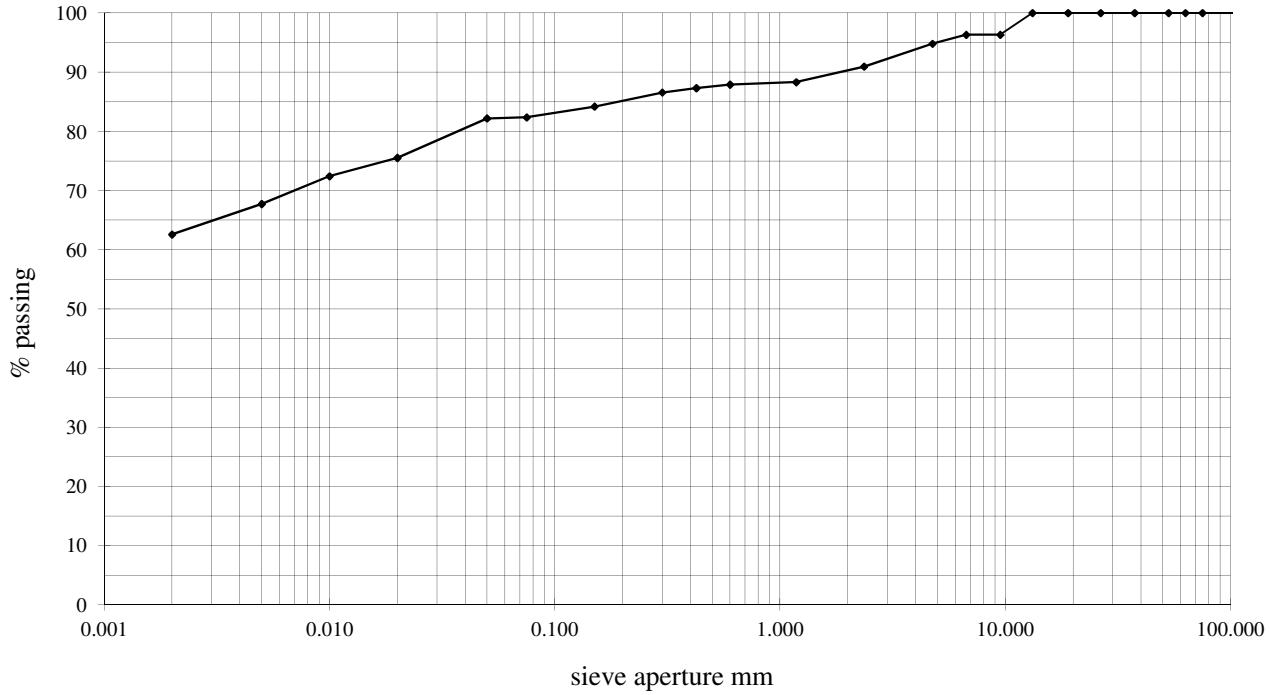
Alexandria NSW 2015
Australia

PARTICLE SIZE DISTRIBUTION

Client: VEOLIA ENVIRONMENTAL SERVICES (AUSTRALIA) PTY LTD
Address: NSW WOODLAWN BIOREACTORCOLLECTOR ROADTARAGO NSW 2580
Project: Woodlawn Bioreactor
Location:
Test Method: **AS 1289 3.6.1 / 3**
Job Number: 15-32-282
Sample Source: ED1A
Sampled By: CP
Lab Number: 15-AC-2111
Date Tested: 8/10/2015
Checked By: ME



Clay	Silt	Sand	Gravel

Sample Description: Clay : Brown

Sieve Size (mm)	% Passing	Sieve Size (mm)	% Passing
150.0		1.18	**88**
75.0		0.600	**88**
63.0		0.425	**87**
53.0		0.300	**87**
37.5		0.150	**84**
26.5		0.075	**82**
19.0		0.050	**82**
13.2	**100**	0.020	**76**
9.5	**96**	0.010	**72**
6.7	**96**	0.005	**68**
4.75	**95**	0.002	**63**
2.36	**91**		

Hydrometer Type: **ASTM 152H**
Dispersant Type: **Sodium Hexametaphosphate**
Pretreatment: **None**
Loss on Pretreatment: **None**
Remarks:

Approved Signatory: Aaron Lacey Date: 16/10/2015

Accredited for Compliance with ISO/IEC 17025

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SGS Australia Pty Ltd
PO Box 6432 Alexandria NSW 2015
Unit 15, 33 Maddox Street
Alexandria NSW 2015

Client:	VEOLIA ENVIRONMENTAL SERVICES (AUSTRALIA) PTY LTD	Client Job No:	
Order No:	4503277234	Project:	Woodlawn Bioreactor
Tested Date:	31/10/2015	Location:	
SGS Job Number:	15-32-282	Sample No:	15-AC-2112
Lab:	Alexandria CMT	Sample ID:	ED1B

Atterberg Limits (4 Point Casagrande Method with Linear Shrinkage)

AS 1289.3.1.1, 3.2.1, 3.3.1, 3.4.1

Sample Description:	Silty Clay : Brown
Liquid Limit:	84%
Plastic Limit:	19%
Plasticity Index:	65%
History of Sample:	Air-Dried
Method of Preparation:	Dry-Sieved
Linear Shrinkage:	16.0%
Length of Mould:	127MM
Dry State:	Curling

Note: Sample supplied by client.

Approved Signatory: (Aaron.Lacey, Business Manager) Date: 31/10/2015

Accredited for compliance with ISO/IEC 17025

Accreditation No.: 2418

Site No.: 1452
Cert No.: 15-AC-2112-AN012
Form No.PF-AU-INDCMT-GEN-AN-012

Client Address: NSW WOODLAWN BIOREACTOR COLLECTOR ROAD TARAGO NSW 2580

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Client:	VEOLIA ENVIRONMENTAL SERVICES (AUSTRALIA) PTY LTD	Client Job No:	
Order No:	4503277234	Project:	Woodlawn Bioreactor
Tested Date:	16/10/2015	Location:	
SGS Job Number:	15-32-282	Sample No:	15-AC-2112
Lab:	Alexandria CMT	Sample ID:	ED1B

Emerson Class Number of a Soil

AS 1289.3.8.1

Emerson Class Number:	**5**
Soil Description:	Silty Clay : Brown
Type of Water Used:	Distilled water at 20°C

Note: Sample supplied by client.

Approved Signatory: (Aaron.Lacey, Business Manager) Date: 16/10/2015

Accredited for compliance with ISO/IEC 17025

Site No.: 1452
Cert No.: 15-AC-2112-AN018
Form No.

Accreditation No.: 2418
Client Address: NSW WOODLAWN BIOREACTOR COLLECTOR ROAD TARAGO NSW 2580

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PO Box 6432 Alexandria NSW 2015
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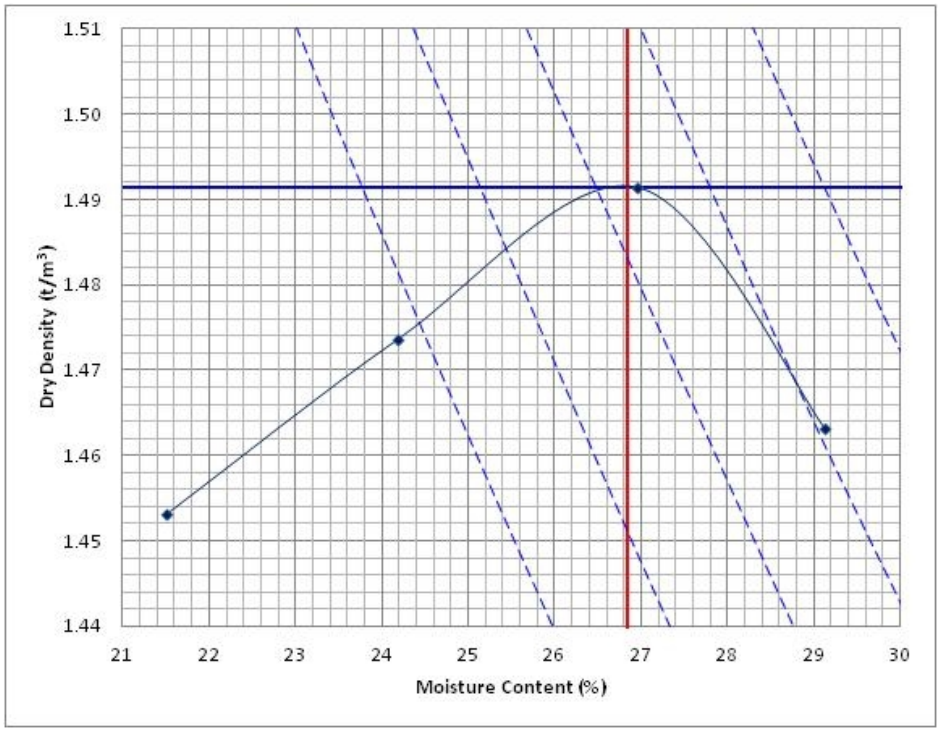
Alexandria NSW 2015

Client:	VEOLIA ENVIRONMENTAL SERVICES (AUSTRALIA) PTY LTD	Client Job No:	
Order No:	4503277234	Project:	Woodlawn Bioreactor
Tested Date:	20/10/2015	Location:	
SGS Job Number:	15-32-282	Sample No:	15-AC-2112
Lab:	Alexandria CMT	Sample ID:	ED1B

Dry Density / Moisture Content Relation of a Soil

AS 1289.5.1.1 - Standard Compactive Effort



Sample Description:	Silty Clay : Brown
Maximum Dry Density:	1.49t/m³
Optimum Moisture Content:	27.0%
Percent Oversize:	0%
Sieve Size:	19.0mm

Note: Sample supplied by client.

Approved Signatory: (Aaron.Lacey, Business Manager) Date: 31/10/2015

Accredited for compliance with ISO/IEC 17025

Accreditation No.: 2418

Site No.: 1452
Cert No.: 15-AC-2112-AN027.1
Form No.PF-AU-INDCMT-GEN-AN-027

Client Address: NSW WOODLAWN BIOREACTOR COLLECTOR ROAD TARAGO NSW 2580

TEST CERTIFICATE

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SGS Australia Pty Ltd
PO Box 6432 Alexandria NSW 2015
Unit 15, 33 Maddox Street
Alexandria NSW 2015

Client:	VEOLIA ENVIRONMENTAL SERVICES (AUSTRALIA) PTY LTD	Client Job No:	
Order No:	4503277234	Project:	Woodlawn Bioreactor
Tested Date:	16/10/2015	Location:	
SGS Job Number:	15-32-282	Sample No:	15-AC-2109
Lab:	Alexandria CMT	Sample ID:	Lipmans Excavated Material

Emerson Class Number of a Soil

AS 1289.3.8.1

Emerson Class Number:	**6**
Soil Description:	Silty Clay : Brown
Type of Water Used:	Distilled water at 20°C

Note: Sample supplied by client.

Approved Signatory: (Aaron.Lacey, Business Manager) Date: 16/10/2015

Accredited for compliance with ISO/IEC 17025

Site No.: 1452
Cert No.: 15-AC-2109-AN018
Form No.

Accreditation No.: 2418
Client Address: NSW WOODLAWN BIOREACTOR COLLECTOR ROAD TARAGO NSW 2580

TEST CERTIFICATE

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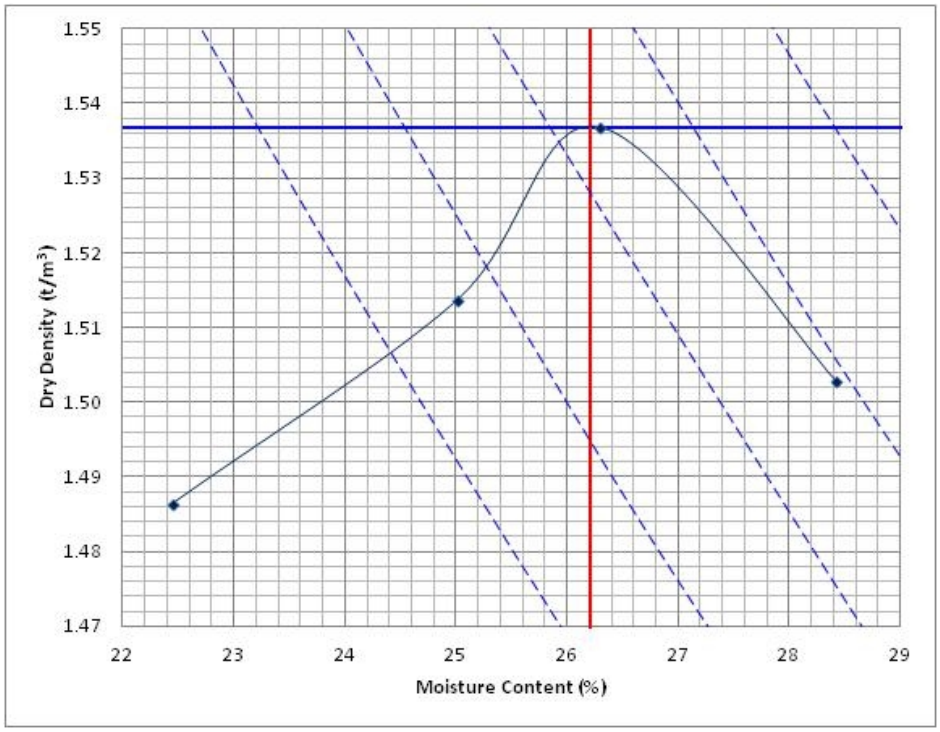
SGS Australia Pty Ltd
PO Box 6432 Alexandria NSW 2015
Unit 15, 33 Maddox Street
Alexandria NSW 2015

Client:	VEOLIA ENVIRONMENTAL SERVICES (AUSTRALIA) PTY LTD	Client Job No:	
Order No:	4503277234	Project:	Woodlawn Bioreactor
Tested Date:	16/10/2015	Location:	
SGS Job Number:	15-32-282	Sample No:	15-AC-2109
Lab:	Alexandria CMT	Sample ID:	Lipmans Excavated Material

Dry Density / Moisture Content Relation of a Soil

AS 1289.5.1.1 - Standard Compactive Effort



Sample Description:	Silty Clay : Brown
Maximum Dry Density:	1.54t/m³
Optimum Moisture Content:	26.0%
Percent Oversize:	0%
Sieve Size:	19.0mm

Note: Sample supplied by client.

Approved Signatory: (Aaron.Lacey, Business Manager) Date: 16/10/2015

Accredited for compliance with ISO/IEC 17025

Site No.: 1452
Cert No.: 15-AC-2109-AN027.1
Form No.PF-AU-INDCMT-GEN-AN-027

Accreditation No.: 2418
Client Address: NSW WOODLAWN BIOREACTOR COLLECTOR ROAD TARAGO NSW 2580

TEST CERTIFICATE

ABN 44 000 964 278
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SGS Australia Pty Ltd
Unit 15, 33 Maddox Street
(PO Box 6432)
Alexandria NSW 2015
Australia

CONSTANT HEAD PERMEABILITY USING A FLEXIBLE WALL PERMEAMETER

CLIENT: **VEOLIA ENVIRONMENTAL SERVICES (AUSTRALIA) PTY LTD**
NSW WOODLAWN BIOREACTORCOLLECTOR ROADTARAGO NSW 2580

PROJECT: **Woodlawn Bioreactor**

LOCATION:

Job Number: 15-32-282

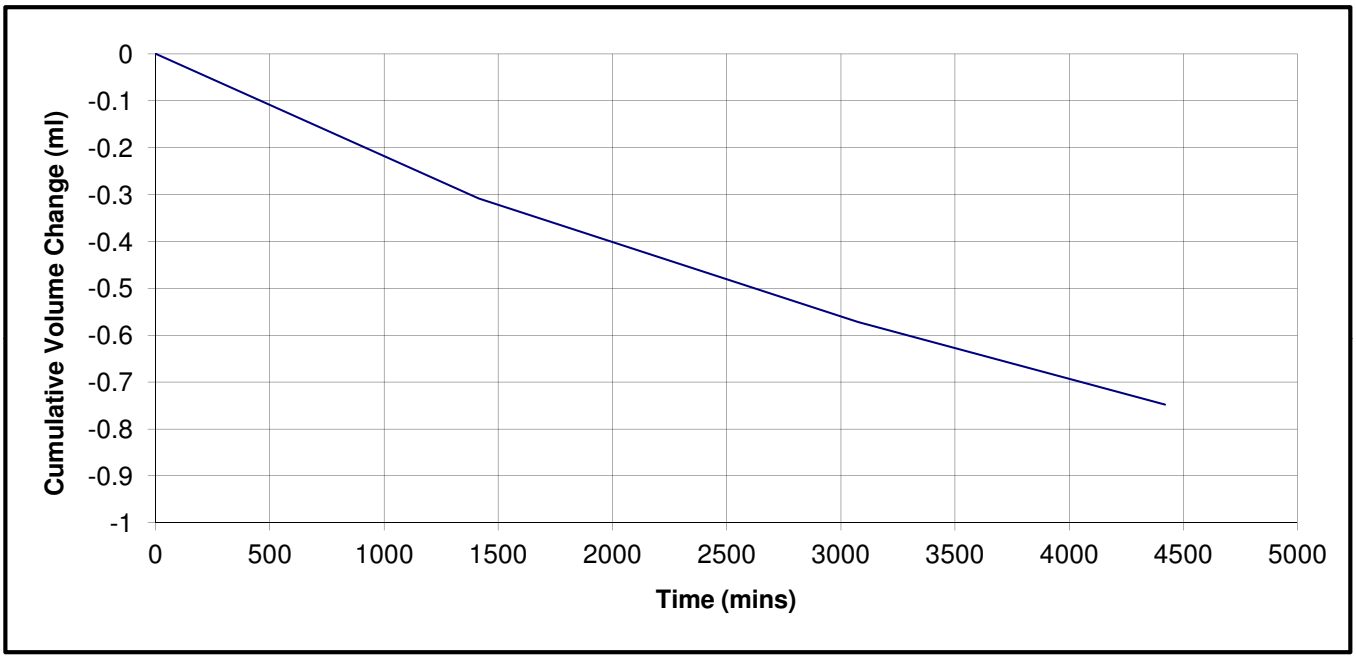
Date Tested: 17/10/2015

Laboratory Number: 15-AC-2109

Sampled By: Client

Sample Source: Lipmans Excavated Material

Sample Description: Silty Clay : Brown



Coefficient of Permeability	4E-11	(metres/second)
Mean Effective Stress	100	(kPa)
Permeant Used	Sydney Tap Water	
SAMPLE DETAILS		
Diameter of Specimen	50.0	(mm)
Height of Specimen	50.0	(mm)
REMOULD DATA		
Laboratory Moisture Ratio	100.1	(%)
Laboratory Density Ratio	100.0	(%)
Retained on 19mm Sieve	0	(%)
Compactive Effort	Standard	

Test Method: Constant head method using a flexible wall permeameter AS1289.6.7.3

Comments:

Approved Signatory: Corey Papu-Gread **Date:** 22/10/2015

Accredited for Compliance with ISO/IEC 17025

Accreditation No. 2418

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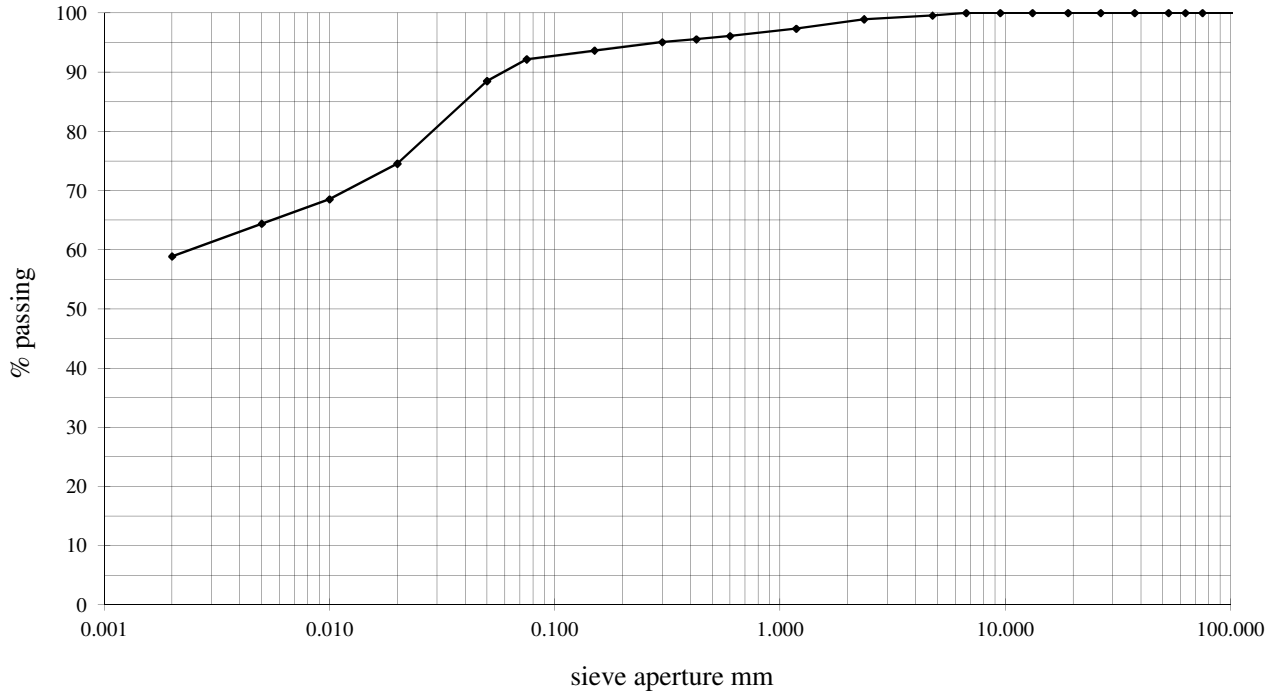
Alexandria NSW 2015
Australia

PARTICLE SIZE DISTRIBUTION

Client: VEOLIA ENVIRONMENTAL SERVICES (AUSTRALIA) PTY LTD
Address: NSW WOODLAWN BIOREACTORCOLLECTOR ROADTARAGO NSW 2580
Project: Woodlawn Bioreactor
Location:

Test Method: **AS 1289 3.6.1 / 3**
Job Number: 15-32-282
Sample Source: Lipmans Excavated Material
Sampled By: Client

Lab Number: 15-AC-2109
Date Tested: 8/10/2015
Checked By: ME



Clay	Silt	Sand	Gravel

Sample Description: Silty Clay : Brown

Sieve Size (mm)	% Passing	Sieve Size (mm)	% Passing
150.0		1.18	**97**
75.0		0.600	**96**
63.0		0.425	**96**
53.0		0.300	**95**
37.5		0.150	**94**
26.5		0.075	**92**
19.0		0.050	**88**
13.2		0.020	**75**
9.5		0.010	**69**
6.7		0.005	**64**
4.75	**100**	0.002	**59**
2.36	**99**		

Hydrometer Type: **ASTM 152H**
Dispersant Type: **Sodium Hexametaphosphate**
Pretreatment: **None**
Loss on Pretreatment: **None**
Remarks:

Approved Signatory: Aaron Lacey Date: 16/10/2015

Accredited for Compliance with ISO/IEC 17025

Accreditation No. 2418

TEST CERTIFICATE

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SGS Australia Pty Ltd
PO Box 6432 Alexandria NSW 2015
Unit 15, 33 Maddox Street
Alexandria NSW 2015

Client:	VEOLIA ENVIRONMENTAL SERVICES (AUSTRALIA) PTY LTD	Client Job No:	
Order No:	4503277234	Project:	Woodlawn Bioreactor
Tested Date:	16/10/2015	Location:	
SGS Job Number:	15-32-282	Sample No:	15-AC-2110
Lab:	Alexandria CMT	Sample ID:	Lipmans Top of Void

Atterberg Limits (4 Point Casagrande Method with Linear Shrinkage)

AS 1289.3.1.1, 3.2.1, 3.3.1, 3.4.1

Sample Description:	Silty Clay : Brown
Liquid Limit:	78%
Plastic Limit:	17%
Plasticity Index:	61%
History of Sample:	Oven-Dried
Method of Preparation:	Dry-Sieved
Linear Shrinkage:	15.5%
Length of Mould:	255MM
Dry State:	Curling

Note: Sample supplied by client.

Approved Signatory: (Aaron.Lacey, Business Manager) Date: 16/10/2015

Accredited for compliance with ISO/IEC 17025

Accreditation No.: 2418

Site No.: 1452
Cert No.: 15-AC-2110-AN012
Form No.PF-AU-INDCMT-GEN-AN-012

Client Address: NSW WOODLAWN BIOREACTOR COLLECTOR ROAD TARAGO NSW 2580

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PO Box 6432 Alexandria NSW 2015
Unit 15, 33 Maddox Street
Alexandria NSW 2015

Client:	VEOLIA ENVIRONMENTAL SERVICES (AUSTRALIA) PTY LTD	Client Job No:	
Order No:	4503277234	Project:	Woodlawn Bioreactor
Tested Date:	16/10/2015	Location:	
SGS Job Number:	15-32-282	Sample No:	15-AC-2110
Lab:	Alexandria CMT	Sample ID:	Lipmans Top of Void

Emerson Class Number of a Soil

AS 1289.3.8.1

Emerson Class Number:	**5**
Soil Description:	Silty Clay : Brown
Type of Water Used:	Distilled water at 20°C

Note: Sample supplied by client.

Approved Signatory: (Aaron.Lacey, Business Manager) Date: 16/10/2015

Accredited for compliance with ISO/IEC 17025

Site No.: 1452
Cert No.: 15-AC-2110-AN018
Form No.

Accreditation No.: 2418
Client Address: NSW WOODLAWN BIOREACTOR COLLECTOR ROAD TARAGO NSW 2580

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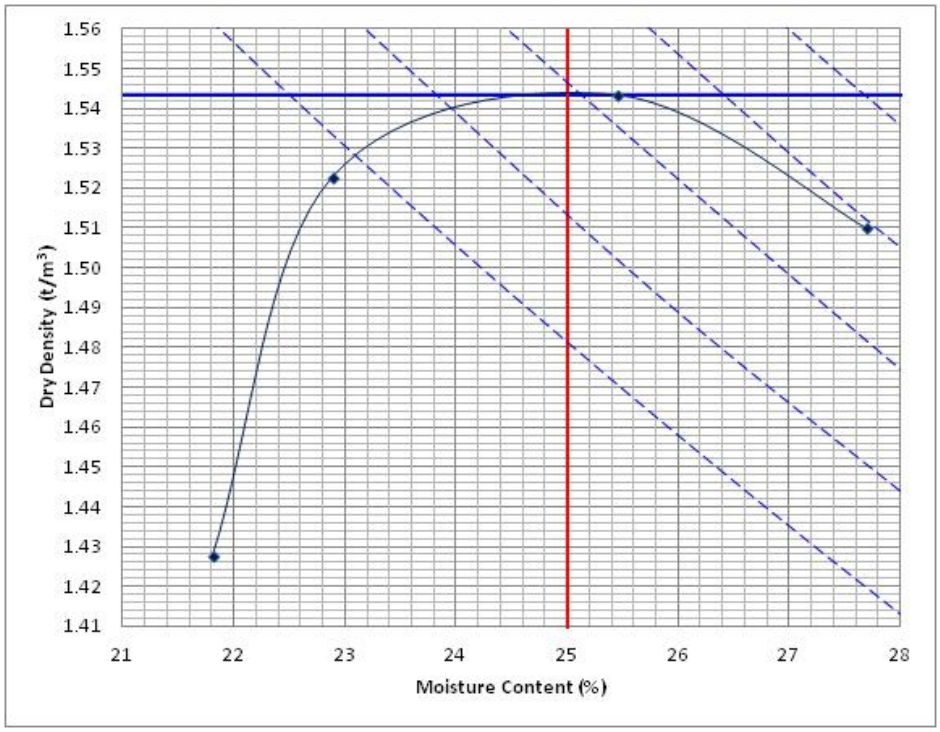
Unit 15, 33 Maddox Street
Alexandria NSW 2015

Client:	VEOLIA ENVIRONMENTAL SERVICES (AUSTRALIA) PTY LTD	Client Job No:	
Order No:	4503277234	Project:	Woodlawn Bioreactor
Tested Date:	16/10/2015	Location:	
SGS Job Number:	15-32-282	Sample No:	15-AC-2110
Lab:	Alexandria CMT	Sample ID:	Lipmans Top of Void

Dry Density / Moisture Content Relation of a Soil

AS 1289.5.1.1 - Standard Compactive Effort



Sample Description:	Silty Clay : Brown
Maximum Dry Density:	1.54t/m³
Optimum Moisture Content:	25.0%
Percent Oversize:	0%
Sieve Size:	19.0mm

Note: Sample supplied by client.

Approved Signatory: (Aaron.Lacey, Business Manager) Date: 16/10/2015

Accredited for compliance with ISO/IEC 17025

Site No.: 1452
Cert No.: 15-AC-2110-AN027.1
Form No.PF-AU-INDCMT-GEN-AN-027

Accreditation No.: 2418
Client Address: NSW WOODLAWN BIOREACTOR COLLECTOR ROAD TARAGO NSW 2580

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SGS Australia Pty Ltd
Unit 15, 33 Maddox Street
(PO Box 6432)
Alexandria NSW 2015
Australia

CONSTANT HEAD PERMEABILITY USING A FLEXIBLE WALL PERMEAMETER

CLIENT: **VEOLIA ENVIRONMENTAL SERVICES (AUSTRALIA) PTY LTD**
NSW WOODLAWN BIOREACTORCOLLECTOR ROADTARAGO NSW 2580

PROJECT: **Woodlawn Bioreactor**

LOCATION:

Job Number: 15-32-282

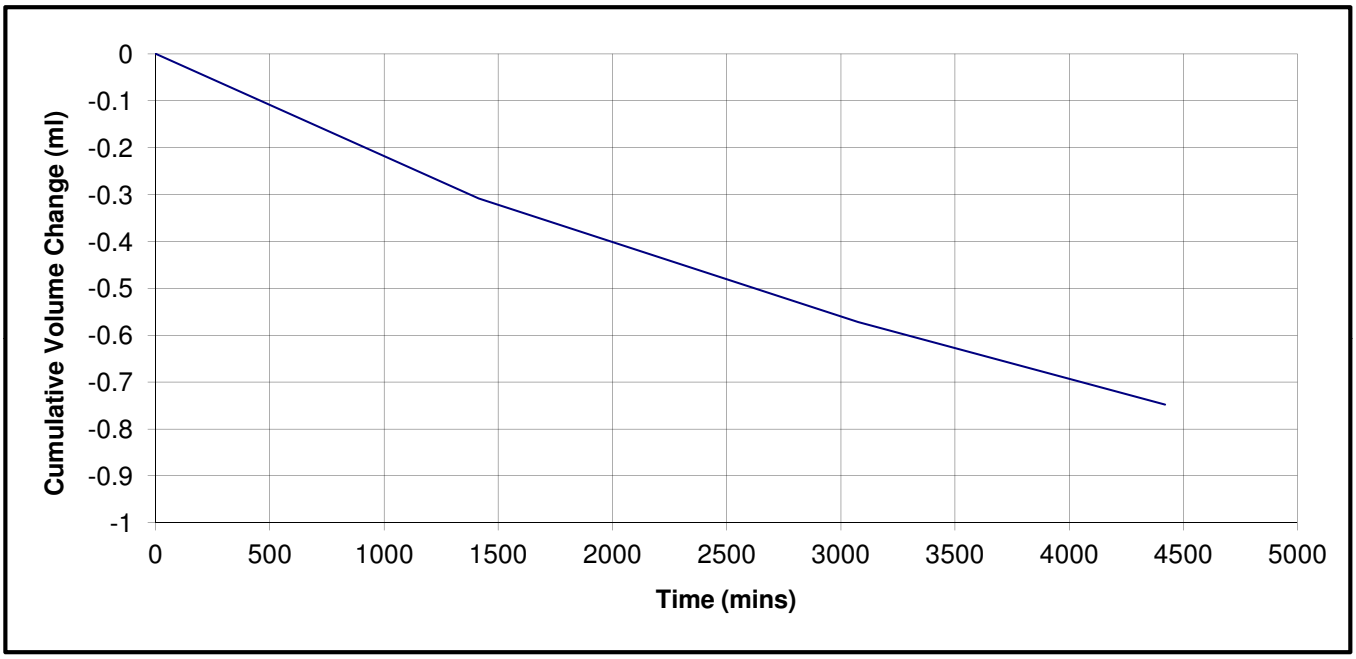
Date Tested: 17/10/2015

Laboratory Number: 15-AC-2110

Sampled By: Client

Sample Source: Lipmans Top of Void

Sample Description: Silty Clay : Brown



Coefficient of Permeability	4E-11	(metres/second)
Mean Effective Stress	100	(kPa)
Permeant Used	Sydney Tap Water	
SAMPLE DETAILS		
Diameter of Specimen	50.0	(mm)
Height of Specimen	50.0	(mm)
REMOULD DATA		
Laboratory Moisture Ratio	100.1	(%)
Laboratory Density Ratio	100.2	(%)
Retained on 19mm Sieve	0	(%)
Compactive Effort	Standard	

Test Method: Constant head method using a flexible wall permeameter AS1289.6.7.3

Comments:

Approved Signatory: Corey Papu-Gread **Date:** 31/10/2015

Accredited for Compliance with ISO/IEC 17025

Accreditation No. 2418

TEST CERTIFICATE

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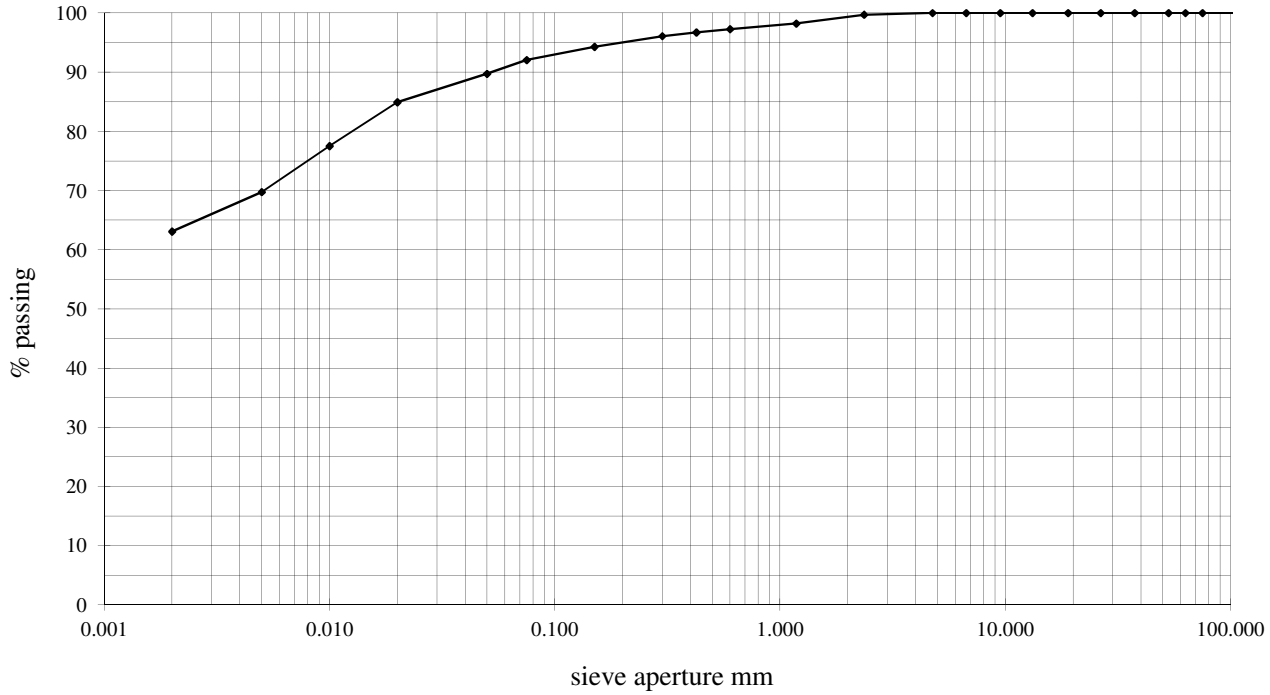
(PO Box 6432)
Alexandria NSW 2015
Australia

PARTICLE SIZE DISTRIBUTION

Client: VEOLIA ENVIRONMENTAL SERVICES (AUSTRALIA) PTY LTD
Address: NSW WOODLAWN BIOREACTORCOLLECTOR ROADTARAGO NSW 2580
Project: Woodlawn Bioreactor
Location:
Test Method: **AS 1289 3.6.1 / 3**
Job Number: 15-32-282
Sample Source: Lipmans Top of Void
Sampled By: CP
Lab Number: 15-AC-2110
Date Tested: 8/10/2015
Checked By: ME



Clay	Silt	Sand	Gravel

Sample Description: Silty Clay : Brown

Sieve Size (mm)	% Passing	Sieve Size (mm)	% Passing
150.0		1.18	**98**
75.0		0.600	**97**
63.0		0.425	**97**
53.0		0.300	**96**
37.5		0.150	**94**
26.5		0.075	**92**
19.0		0.050	**90**
13.2		0.020	**85**
9.5		0.010	**78**
6.7		0.005	**70**
4.75		0.002	**63**
2.36	**100**		

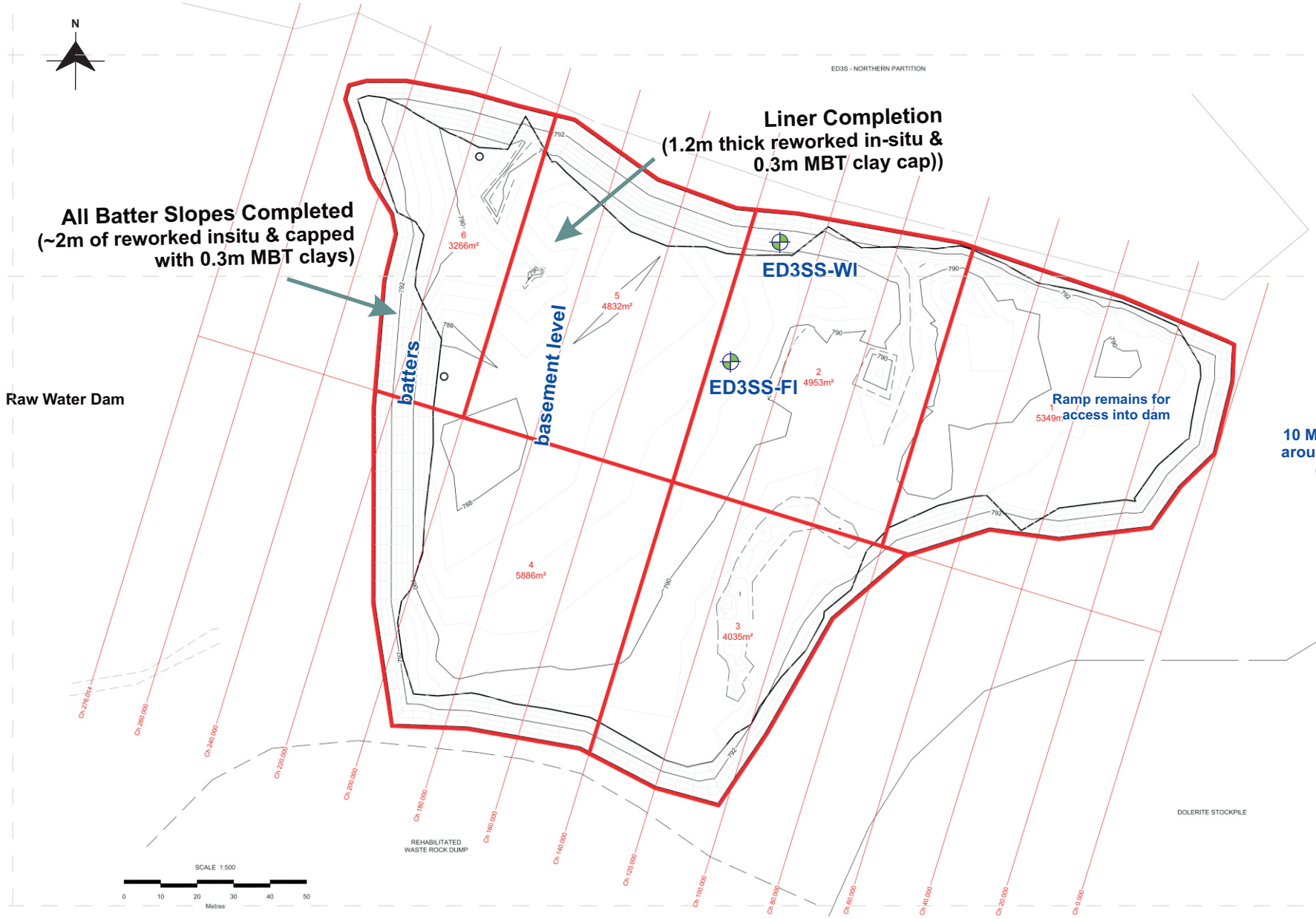
Hydrometer Type: **ASTM 152H**
Dispersant Type: **Sodium Hexametaphosphate**
Pretreatment: **None**
Loss on Pretreatment: **None**
Remarks:

Approved Signatory: Aaron Lacey Date: 16/10/2015

Accredited for Compliance with ISO/IEC 17025

Appendix A3
Figure 1C: Site Layout & ED3SS Testing Locations (10 March 2016), Plates 1-4 (10 March 2016), Geotechnical Testing Results

earth2water Pty Ltd
Environmental & Groundwater Consulting



LEGEND

- Design Dam Structure
- Minor Breakline
- Design Major Contour Line
- Design Minor Contour Line
- E2W Sampling (K bulk- floor & wall) on 10 March 2016 (floor and batters completed with 0.3m MBT clay)

10 March 2016: MBT clays being placed around top of batters to increase height (~0.5m). Gravel layer (0.1m thick) is not installed yet over batters.

Source: LandTeam Australia Pty Ltd

Site Layout & ED3SS Testing Locations (10 March 2016)

Date: *13 January 2016*

Reference: *E2W_243_01.cdr*

Woodlawn Bioreactor - ED3SS CQA

Figure 1C

Plates 1 & 2 (10 March 2016) Viewing south over the construction of ED3SS, showing completed batter slopes and floor levels (capped by 0.3m of MBT clay). Further compaction (smooth drum) and installation of the gravel layer (0.1m) is still in progress. The left plate shows the completed floor and walls and sampling location of ED3ss (Fl= floor, blue bucket) and ED3SS (Wl=wall).

Plates 3 & 4 (10 March 2016 & 5 February 2016). View over the northern end of ED3SS showing the access ramp used to transport clay materials (& remove waste rock) for the liner construction (completed with 0.3m capping of MBT). The completion of the insitu floor liner (i.e. 1.2 m) using reworked insitu clay-silt is shown (5 Feb 2016) before capping by MBT clay (0.3m thick).

Woodlawn Bioreactor- ED3SS CQA (1 of 1)

Sydney Laboratory
57 Herbert St
Artarmon NSW 2064
email: artarmon@ghd.com.au
web: www.ghd.com.au/ghdgeotechnics
Tel: (02) 9462 4860
Fax:(02) 9462 4710

Aggregate/Soil Test Report

Report No: SYD1600429
Issue No: 1
This report replaces all previous issues of report no 'SYD1600429'.

Client:
Earth 2 Water Pty Ltd
Material Evaluation
Gerringong NSW 2534

Project: 2124279

Accredited for compliance with ISO / IEC 17025

NATA Accredited Laboratory Number: 679

Approved Signatory: G J Vukovic (Senior Laboratory Technician)

Date of Issue: 22/03/2016

Sample Details

GHD Sample No	SYD16-0086-01
Client Sample ID	ED3SS-F1
Date Sampled	10/03/2016
Sampled By	Supplied by Client
Location	Woodlawn
Client Location	ED3SS - Site Liner
Soil Description	CLAY; brown

Test Results

Description	Method	Result	Limits
Coef of Permeability (m/sec)	AS 1289.6.7.3	5.2 E-11	
Mean Stress Level (kPa)		30	
Permeant Used		Syd Tap Water	
Length (mm)		70.6	
Diameter (mm)		63.3	
Length/Diameter Ratio		1.12	
Laboratory Moisture Ratio (%)		0.0	
Laboratory Density Ratio (%)		0.0	
CompactiveEffort		Standard	
Method of Compaction		Remoulded	
Surcharge Applied (Kg)		0.0	
Pressure Applied (Kpa)		10	
Oversize Sieve (mm)		6.7	
Percentage Oversize (%)		1.2	
Moisture Content (%)		26.6	
Date Tested		15/03/2016	

Comments

Moisture and Density Ratio's not applicable.
At clients request specimen remoulded to approximately 100% standard compaction and OMC.
Remoulded dry density = 1.61 t/m³, remoulded moisture content = 24.6 %.

Sydney Laboratory
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Artarmon NSW 2064
email: artarmon@ghd.com.au
web: www.ghd.com.au/ghdgeotechnics
Tel: (02) 9462 4860
Fax:(02) 9462 4710

Aggregate/Soil Test Report

Report No: SYD1600430
Issue No: 1
This report replaces all previous issues of report no 'SYD1600430'.

Client:
Earth 2 Water Pty Ltd
Material Evaluation
Gerringong NSW 2534

Project: 2124279

Accredited for compliance with ISO / IEC 17025

NATA Accredited Laboratory Number: 679

Approved Signatory: G J Vukovic (Senior Laboratory Technician)

Date of Issue: 22/03/2016

Sample Details

GHD Sample No	SYD16-0086-02
Client Sample ID	ED3SS-W1
Date Sampled	10/03/2016
Sampled By	Supplied by Client
Location	Woodlawn
Client Location	ED3SS - Site Liner
Soil Description	CLAY; orange/brown brown

Test Results

Description	Method	Result	Limits
Coef of Permeability (m/sec)	AS 1289.6.7.3	2.4 E-11	
Mean Stress Level (kPa)		30	
Permeant Used		Syd Tap Water	
Length (mm)		65.1	
Diameter (mm)		63.3	
Length/Diameter Ratio		1.03	
Laboratory Moisture Ratio (%)		0.0	
Laboratory Density Ratio (%)		0.0	
CompactiveEffort		Standard	
Method of Compaction		Remoulded	
Surcharge Applied (Kg)		0.0	
Pressure Applied (Kpa)		10	
Oversize Sieve (mm)		6.7	
Percentage Oversize (%)		2.6	
Moisture Content (%)		25.6	
Date Tested		15/03/2016	

Comments

Moisture and Density Ratio's not applicable.
At clients request specimen remoulded to approximately 100% standard compaction and OMC.
Remoulded dry density = 1.60 t/m³, remoulded moisture content = 23.0 %.

Appendix B
Table B-1: Summary of Geotechnical Testing by Veolia/Testcrete Pty Ltd
Site Testing Map (Testcrete Pty Ltd, 9 August 2016)

Table B-1: Summary of Geotehnical Testing by Veolia/Testcrete Pty Ltd

Test Point	Easting	Northing	RL	Survey Date	Testcrete	Veolia	Testing Description	Compaction Results (density)	Permeability Results (m/sec)	
Rework & reshape existing insitu material (silty clay/W.siltstone) to form evaporation dam										
WALL1	733696.74	6117020.17	792.40	15-Dec-16	TS038/9 TS038/10 TS038/11	WALL 1 0.2m WALL 1 0.5m WALL 1 1m	Testing of insitu reworked material walls (no MBT clay capping), Refer plates in Appendix A	100.5 % 102 % 100.5%		meets specifications
WALL2	733635.68	6116975.01	789.46	15-Dec-16	TS038/12 TS038/13 TS038/14	WALL 2 0.2m WALL 2 0.5m WALL 2 1m	as above	107% 99% 97%		meets specifications
WALL3	733605.05	6116968.64	791.00	15-Dec-16	TS038/15 TS038/16 TS038/17	WALL 3 0.2m WALL 3 0.5m WALL 3 1m	as above	97 % 98% 101%	0.5m @ 9E-09 1m @ 2E-08	meets specifications
WALL4	733554.39	6116987.05	793.40	15-Dec-16	TS038/18 TS038/19 TS038/20	WALL 4 0.2m WALL 4 0.5m WALL 4 1m	as above	96% 98% **93%**		marginal non compliance with material at depth (1m)
WALL5	733729.27	6117072.40	790.98	15-Dec-16	TS038/21 TS038/22 TS038/23	WALL 5 0.2m WALL 5 0.5m WALL 5 1m	as above	105% 103.5% 103%	0.2m@ 2E-08 . . .	meets specifications
WALL6	733746.31	6117029.05	790.89	15-Dec-16	TS038/24 TS038/25 TS038/26	WALL 6 0.2m WALL 6 0.5m WALL 6 1m	as above	103% 99.5% 103.5%		meets specifications
WALL7	733591.62	6117099.58	790.34	15-Dec-16	TS038/27 TS038/28 TS038/29	WALL 7 0.2m WALL 7 0.5m WALL 7 1m	as above	113% 103% **91%**		marginal non compliance with material at depth (1m)
WALL8	733674.34	6117077.93	788.84	15-Dec-16	TS038/30 TS038/31 TS038/32	WALL 8 0.2m WALL 8 0.5m WALL 8 1m	as above	110.5% 100% 95%	0.5m @ 5E-08 .	meets specifications
FLOOR1	733602.39	6117059.66	785.50	10-Feb-16	TS038/33 TS038/34 TS038/35	WALL 1 0.3m WALL 1 0.6m WALL 1 0.9m	Floor of evap dam-reworked insitu material	101.5% 107.5% 104%		meets specifications
FLOOR2	733640.45	6117056.27	785.83	10-Feb-16	TS038/36 TS038/37 TS038/38	WALL 2 0.3m WALL 2 0.6m WALL 2 0.9m	Floor of evap dam-reworked insitu material	103.5% 105.5% 107.5%		meets specifications
FLOOR3	733671.99	6117048.64	786.32	10-Feb-16	TS038/39 TS038/40 TS038/41	WALL 3 0.3m WALL 3 0.6m WALL 3 0.9m	Floor of evap dam-reworked insitu material	96.5% 100% 100.5%		meets specifications
FLOOR4	733711.33	6117048.92	786.79	10-Feb-16	TS038/42 TS038/43 TS038/44	WALL 4 0.3m WALL 4 0.6m WALL 4 0.9m	Floor of evap dam-reworked insitu material	97% 100% 96%		meets specifications
FLOOR5	733619.46	6117033.52	785.65	10-Feb-16	TS038/45 TS038/46 TS038/47	WALL 5 0.3m WALL 5 0.6m WALL 5 0.9m	Floor of evap dam-reworked insitu material	97.5% 96% **94%**		marginal non compliance with material at depth (0.9m)
FLOOR6	733595.45	6117012.07	785.51	10-Feb-16	TS038/48 TS038/49 TS038/50	WALL 6 0.3m WALL 6 0.6m WALL 6 0.9m	Floor of evap dam-reworked insitu material	108.5% 107% 97.5%		meets specifications
FLOOR7	733629.65	6117001.65	785.95	10-Feb-16	TS038/51 TS038/52 TS038/53	WALL 7 0.3m WALL 7 0.6m WALL 7 0.9m	Floor of evap dam-reworked insitu material	106% 109.5% 101.5%		meets specifications
Additional Clay Cap (0.3m MBT clays installed to supplement reworked insitu material ~1.2m thick)										
CLAY1	733595.18	6117067.70	785.79	16-Mar-16	TS038/57	CLAY1	Floor of evap dam- 0.3m cap of MBT clay	109.50%		meets specifications
CLAY2	733599.10	6117012.22	785.89	16-Mar-16	TS038/58	CLAY2	as above	108%		meets specifications
CLAY3	733712.93	6117052.01	786.88	16-Mar-16	TS038/59	CLAY3	as above	101%		meets specifications
CLAY4	733757.41	6117042.08	790.14	16-Mar-16	TS038/60	CLAY4	Wall of evap dam- 0.3m cap of MBT clay	101%		meets specifications
CLAY5	733650.17	6117006.51	787.79	16-Mar-16	TS038/61	CLAY5	as above	106%		meets specifications
CLAY6	733561.04	6116991.20	791.44	16-Mar-16	TS038/62	CLAY6	as above	104%		meets specifications
CLAY7	733734.41	6117045.41	787.85	12-Jul-16	TS038/S23	CLAY7	Floor of evap dam- 0.3m cap of MBT clay		0.15m @ 2E-10 .	meets specifications
CLAY8	733639.10	6117011.85	786.23	12-Jul-16	TS038/S24	CLAY8	as above		0.15m @ 1E-11 .	meets specifications
CLAY9	733566.91	6117079.53	791.33	12-Jul-16	TS038/S25	CLAY9	Wall of evap dam- 0.3m cap of MBT clay		0.15m @ 1E-11 .	meets specifications
CLAY10	733656.43	6117077.43	787.57	12-Jul-16	TS038/S26	CLAY10	Wall of evap dam- 0.3m cap of MBT clay		0.15m @ 2E-11 .	meets specifications

MGA

ED3S - NORTHERN PARTITION

SCHEDULE OF TEST POINT COORDINATES				
POINT	EASTING	NORTHING	RL	PERMEABILITY (m/s)
WALL1	733696.74	6117020.17	792.40	-----
WALL2	733635.68	6116975.01	789.46	-----
WALL3	733605.05	6116968.64	791.00	9.0×10^{-9} (AT 0.5m) 2.0×10^{-8} (AT 1.0m)
WALL4	733554.39	6116987.05	793.40	-----
WALL5	733729.27	6117072.40	790.98	2.0×10^{-8} (AT 0.2m)
WALL6	733746.31	6117029.05	790.89	-----
WALL7	733591.62	6117099.58	790.34	-----
WALL8	733674.34	6117077.93	788.84	5.0×10^{-8} (AT 0.5m)
FLOOR1	733602.39	6117059.66	785.50	-----
FLOOR2	733640.45	6117056.27	785.83	-----
FLOOR3	733671.99	6117048.64	786.32	-----
FLOOR4	733711.33	6117048.92	786.79	-----
FLOOR5	733619.46	6117033.52	785.65	-----
FLOOR6	733595.45	6117012.07	785.51	-----
FLOOR7	733629.65	6117001.65	785.95	-----
CLAY1	733595.18	6117067.70	785.79	-----
CLAY2	733599.10	6117012.22	785.89	-----
CLAY3	733712.93	6117052.01	786.88	-----
CLAY4	733757.41	6117042.08	790.14	-----
CLAY5	733650.17	6117006.51	787.79	-----
CLAY6	733561.04	6116991.20	791.44	-----
CLAY7	733734.41	6117045.41	787.85	2.0×10^{-10}
CLAY8	733639.10	6117011.85	786.23	1.0×10^{-11}
CLAY9	733566.91	6117079.53	791.33	5.0×10^{-11}
CLAY10	733656.43	6117077.43	787.57	2.0×10^{-11}

LEGEND

FLOOR1	GEOTECHNICAL TEST POINT AND NAME
	SURVEYED DAM BREAKLINES
	FINAL SURFACE CONTOURS

DOLERITE STOCKPILE

REHABILITATED
WASTE ROCK DUMP

Liability limited by a scheme approved under Professional Standards Legislation.

File Name: J:\Surveyors\Jobs\Veolia\16800 Engineering\CAD\16800-445 ED3S-South Geotech Points Issue C.dwg

VEOLIA ENVIRONMENTAL SERVICES

SCALE 1:500

0 10 20 30 40 50
Metres

ISSUE	AMENDMENT	DRAWN	DATE
A	INITIAL ISSUE	MK	24/03/2016
B	TEST POINTS CLAY 7 - CALY 10 ADDED	MK	20/07/2016
C	PERMEABILITY TESTING RESULTS ADDED	MK	9/08/2016

LandTeam Australia Pty Ltd
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www.landteam.au

Integrated Management System

LandTeam

A1 SHEET

VEOLIA ENVIRONMENTAL SERVICES

WOODLAWN BIOREACTOR
COLLECTOR ROAD, TARAGO

EVAPORATION DAM 3 SOUTH - SOUTHERN PARTITION RECONSTRUCTION PROJECT

PLAN SHOWING GEOTECHNICAL TEST POINT LOCATIONS

SURVEYED: MK
DRAWN: MK
CHECKED: JK
ISSUE C

DRAWING No. 16800-445

DATUM	AHD	CONTOUR INTERVAL	0·5m	DATE	9/08/216

TESTCRETE
LABORATORIES PTY LIMITED

16 Kemble Court
MITCHELL ACT 2911
Telephone 02 6241 1322
Fax 02 6241 7593
ABN: 35 102 659 754

Job No.
TS 038

Field Density Test Certificate

Client: ..... Veolia Environmental Services (Australia) Pty Ltd WOODLAWN NSW
Principal: ..... Veolia Environmental Services (Australia) Pty Ltd
Project: ..... Woodlawn Bioreactor
Location: ..... via TARAGO NSW

Test Number	TS 038 / 33	TS 038 / 34	TS 038 / 35	TS 038 / 36
Date and Time Tested	23.02.16 0900hrs			
Test Location	Dam Floor 1	Dam Floor 1	Dam Floor 1	Dam Floor 2
Soil Description	General Fill	General Fill	General Fill	General Fill
Field Remarks	E 733 602.39 N 611 7059.66 0.3 m below final level	E 733 602.39 N 611 7059.66 0.6 m below final level	E 733 602.39 N 611 7059.66 0.9 m below final level	E 733 640.45 N 611 7056.27 0.3 m below final level

TEST RESULTS

Density Ratio	%	**101.5**	**107.5**	**104.0**	**103.5**
Moisture Ratio	%	**104.0**	**110.5**	**97.0**	**106.0**
Optimum Moisture Content	%	15.5	13.5	15.5	12.5
Moisture Variation	%	0.5% WET	1.0% WET	0.5% DRY	0.5% WET

FIELD AND LABORATORY DATA

Depth of Test	mm	150	150	150	150
Field Wet Density	t/m^3	2.12	2.15	2.16	2.10
Field Dry Density	t/m^3	1.83	1.87	1.88	1.85
Maximum Dry Density	t/m^3	1.80	1.74	1.80	1.79
Field Moisture Content	%	16.1	14.9	15.0	13.3
Oversize Material Retained (Wet Basis)	%	0% (+19.0 mm)	0% (+19.0 mm)	0% (+19.0 mm)	0% (+19.0 mm)
Oversize Material Retained (Dry Basis)	%	0% (+19.0 mm)	0% (+19.0 mm)	0% (+19.0 mm)	0% (+19.0 mm)

Field Test Procedures: AS1289 5.8.1 Nuclear Method, AS1289 2.1.1 Moisture Content Oven Drying Method

Laboratory Procedures: AS1289 5.1.1 Standard Compaction, AS1289 5.4.1 Density & Moisture Ratio

NOTE: When oversize material is recorded the Maximum Dry Density and OptimumMoisture Content are corrected in accordance with AS1289 5.4.1.

REMARKS:

Authorised Signatory
G.W.Collins

NATA ACCREDITED LABORATORY Number 1742.
Accredited for compliance with ISO/IEC 17025.

Date of Issue: 7/03/2016

TESTCRETE
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Client: ..... Veolia Environmental Services (Australia) Pty Ltd WOODLAWN NSW
Principal: ..... Veolia Environmental Services (Australia) Pty Ltd
Project: ..... Woodlawn Bioreactor
Location: ..... via TARAGO NSW

Test Number	**TS 038 / 37**	**TS 038 / 38**	**TS 038 / 39**	**TS 038 / 40**
Date and Time Tested	23.02.16 0900hrs			
Test Location	Dam Floor 2	Dam Floor 2	Dam Floor 3	Dam Floor 3
Soil Description	General Fill	General Fill	General Fill	General Fill
Field Remarks	E 233 640.45 N 611 7056.27 0.6 m below final level	E 233 640.45 N 611 7056.27 0.9 m below final level	E 733 671.99 N 611 7048.64 0.3 m below final level	E 733 671.99 N 611 7048.64 0.6 m below final level

TEST RESULTS

Density Ratio	%	**105.5**	**107.5**	**96.5**	**100.0**
Moisture Ratio	%	**120.0**	**77.5**	**127.0**	**97.5**
Optimum Moisture Content	%	11.0	16.0	14.0	13.0
Moisture Variation	%	2.5% WET	3.5% DRY	4.0% WET	FMC=OMC

FIELD AND LABORATORY DATA

Depth of Test	mm	150	150	150	150
Field Wet Density	t/m^3	2.11	2.12	2.05	2.04
Field Dry Density	t/m^3	1.86	1.89	1.74	1.81
Maximum Dry Density	t/m^3	1.76	1.76	1.80	1.81
Field Moisture Content	%	13.2	12.4	17.8	12.7
Oversize Material Retained (Wet Basis)	%	0% (+19.0 mm)	0% (+19.0 mm)	0% (+19.0 mm)	0% (+19.0 mm)
Oversize Material Retained (Dry Basis)	%	0% (+19.0 mm)	0% (+19.0 mm)	0% (+19.0 mm)	0% (+19.0 mm)
Field Test Procedures		AS1289 5.8.1 Nuclear Method, AS1289 2.1.1 Moisture Content Oven Drying Method			
Laboratory Procedures		AS1289 5.1.1 Standard Compaction, AS1289 5.4.1 Density & Moisture Ratio			
NOTE:		When oversize material is recorded the Maximum Dry Density and OptimumMoisture Content are corrected in accordance with AS1289 5.4.1.			

REMARKS:

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Field Density Test Certificate

Client:	Veolia Environmental Services (Australia) Pty Ltd WOODLAWN NSW
Principal:	Veolia Environmental Services (Australia) Pty Ltd
Project:	Woodlawn Bioreactor
Location:	via TARAGO NSW

Test Number	TS 038 / 41	TS 038 / 42	TS 038 / 43	TS 038 / 44
Date and Time Tested	23.02.16 0900hrs			
Test Location	Dam Floor 3	Dam Floor 4	Dam Floor 4	Dam Floor 4
Soil Description	General Fill	General Fill	General Fill	General Fill
Field Remarks	E 733 671.99 N 611 7048.64 0.9 m below final level	E 733 711.33 N 611 7048.92 0.3 m below final level	E 733 711.33 N 611 7048.92 0.6 m below final level	E 733 711.33 N 611 7048.92 0.9 m below final level

TEST RESULTS

Density Ratio	%	**100.5**	**97.0**	**100.0**	**96.0**
Moisture Ratio	%	**94.0**	**89.0**	**84.0**	**115.5**
Optimum Moisture Content	%	16.0	20.5	19.0	15.0
Moisture Variation	%	1.0% DRY	2.0% DRY	3.0% DRY	2.0% WET

FIELD AND LABORATORY DATA

Depth of Test	mm	150		150		150		150
Field Wet Density	t/m^3	2.06		1.93		1.96		1.97
Field Dry Density	t/m^3	1.79		1.63		1.69		1.68
Maximum Dry Density	t/m^3	1.78		1.68		1.70		1.75
Field Moisture Content	%	15.0		18.2		16.0		17.3
Oversize Material Retained (Wet Basis)	%	0%	(+19.0 mm)	0%	(+19.0 mm)	0%	(+19.0 mm)	0% (+19.0 mm)
Oversize Material Retained (Dry Basis)	%	0%	(+19.0 mm)	0%	(+19.0 mm)	0%	(+19.0 mm)	0% (+19.0 mm)

Field Test Procedures	AS1289 5.8.1 Nuclear Method, AS1289 2.1.1 Moisture Content Oven Drying Method
Laboratory Procedures	AS1289 5.1.1 Standard Compaction, AS1289 5.4.1 Density & Moisture Ratio
NOTE:	When oversize material is recorded the Maximum Dry Density and OptimumMoisture Content are corrected in accordance with AS1289 5.4.1.

REMARKS:

Authorised Signatory
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TESTCRETE
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Telephone 02 6241 1322
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ABN: 35 102 659 754

Job No.
TS 038

Field Density Test Certificate

Client:	Veolia Environmental Services (Australia) Pty Ltd WOODLAWN NSW
Principal:	Veolia Environmental Services (Australia) Pty Ltd
Project:	Woodlawn Bioreactor
Location:	via TARAGO NSW

Test Number	**TS 038 / 45**	**TS 038 / 46**	**TS 038 / 47**	**TS 038 / 48**
Date and Time Tested	23.02.16 0900hrs			
Test Location	Dam Floor 5	Dam Floor 5	Dam Floor 5	Dam Floor 6
Soil Description	General Fill	General Fill	General Fill	General Fill
Field Remarks	E 733 619.46 N 611 7033.52 0.3 m below final level	E 733 619.46 N 611 7033.52 0.6 m below final level	E 733 619.46 N 611 7033.52 0.9 m below final level	E 733 595.45 N 611 7012.07 0.3 m below final level

TEST RESULTS

Density Ratio	%	**97.5**	**96.0**	**94.0**	**108.5**
Moisture Ratio	%	**100.0**	**89.5**	**92.5**	**94.5**
Optimum Moisture Content	%	15.0	18.5	16.5	15.5
Moisture Variation	%	FMC=OMC	2.0% DRY	1.0% DRY	1.0% DRY

FIELD AND LABORATORY DATA

Depth of Test	mm	150		150		150		150	
Field Wet Density	t/m^3	1.96		1.96		1.92		2.15	
Field Dry Density	t/m^3	1.71		1.68		1.67		1.87	
Maximum Dry Density	t/m^3	1.75		1.75		1.78		1.73	
Field Moisture Content	%	15.0		16.6		15.3		14.6	
Oversize Material Retained (Wet Basis)	%	0%	(+19.0 mm)	0%	(+19.0 mm)	0%	(+19.0 mm)	0%	(+19.0 mm)
Oversize Material Retained (Dry Basis)	%	0%	(+19.0 mm)	0%	(+19.0 mm)	0%	(+19.0 mm)	0%	(+19.0 mm)

Field Test Procedures	AS1289 5.8.1 Nuclear Method, AS1289 2.1.1 Moisture Content Oven Drying Method
Laboratory Procedures	AS1289 5.1.1 Standard Compaction, AS1289 5.4.1 Density & Moisture Ratio
NOTE:	When oversize material is recorded the Maximum Dry Density and OptimumMoisture Content are corrected in accordance with AS1289 5.4.1.
REMARKS:	

Authorised Signatory
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Job No.

TS 038

Field Density Test Certificate

Client: ..... Veolia Environmental Services (Australia) Pty Ltd WOODLAWN NSW

Principal: ..... Veolia Environmental Services (Australia) Pty Ltd

Project: ..... Woodlawn Bioreactor

Location: ..... via TARAGO NSW

Test Number	TS 038 / 49	TS 038 / 50	TS 038 / 51	TS 038 / 52
Date and Time Tested	23.02.16 0900hrs			
Test Location	Dam Floor 6	Dam Floor 6	Dam Floor 7	Dam Floor 7
Soil Description	General Fill	General Fill	General Fill	General Fill
Field Remarks	E 733 629.45 N 611 7012.07 0.6 m below final level	E 733 629.45 N 611 7012.07 0.9 m below final level	E 733 629.65 N 611 7001.65 0.3 m below final level	E 733 629.65 N 611 7001.65 0.6 m below final level

TEST RESULTS

Density Ratio	%	**107.0**	**97.5**	**106.0**	**109.5**
Moisture Ratio	%	**88.5**	**92.5**	**106.0**	**111.0**
Optimum Moisture Content	%	19.0	16.5	10.0	11.0
Moisture Variation	%	2.0% DRY	1.5% DRY	0.5% WET	1.0% WET

FIELD AND LABORATORY DATA

Depth of Test	mm	150		150		150		150	
Field Wet Density	t/m^3	2.15		1.99		2.14		2.16	
Field Dry Density	t/m^3	1.84		1.72		1.94		1.93	
Maximum Dry Density	t/m^3	1.72		1.77		1.83		1.76	
Field Moisture Content	%	16.8		15.2		10.6		12.2	
Oversize Material Retained (Wet Basis)	%	0%	(+19.0 mm)	0%	(+19.0 mm)	0%	(+19.0 mm)	0%	(+19.0 mm)
Oversize Material Retained (Dry Basis)	%	0%	(+19.0 mm)	0%	(+19.0 mm)	0%	(+19.0 mm)	0%	(+19.0 mm)

Field Test Procedures	AS1289 5.8.1 Nuclear Method, AS1289 2.1.1 Moisture Content Oven Drying Method
Laboratory Procedures	AS1289 5.1.1 Standard Compaction, AS1289 5.4.1 Density & Moisture Ratio
NOTE:	When oversize material is recorded the Maximum Dry Density and OptimumMoisture Content are corrected in accordance with AS1289 5.4.1.

REMARKS:

Authorised Signatory
G.W.Collins

NATA

NATA ACCREDITED LABORATORY Number 1742.
Accredited for compliance with ISO/IEC 17025.

Date of Issue: 7/03/2016

TESTCRETE
LABORATORIES PTY LIMITED

16 Kemble Court
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ABN: 35 102 659 754

Job No.
TS 038

Field Density Test Certificate

Client: ..... Veolia Environmental Services (Australia) Pty Ltd WOODLAWN NSW

Principal: ..... Veolia Environmental Services (Australia) Pty Ltd

Project: ..... Woodlawn Bioreactor

Location: ..... via TARAGO NSW

Test Number	**TS 038 / 53**	**TS 038 / 54**	**TS 038 / 55**	**TS 038 / 56**
Date and Time Tested	23.02.16 0900hrs			
Test Location	Dam Floor 7	VOID	VOID	VOID
Soil Description	General Fill	General Fill	General Fill	General Fill
Field Remarks	E 733 629.65 N 611 7001.65 0.9 m below final level	Clay Lining 1	Clay Lining 2	Clay Lining 3

TEST RESULTS

Density Ratio	%	**101.5**	**97.5**	**94.5**	**88.0**
Moisture Ratio	%	**128.5**	**122.0**	**119.5**	**135.0**
Optimum Moisture Content	%	10.5	19.5	23.0	19.0
Moisture Variation	%	3.0% WET	4.0% WET	4.5% WET	6.5% WET

FIELD AND LABORATORY DATA

Depth of Test	mm	150	150	150	150
Field Wet Density	t/m^3	2.00	1.91	1.92	1.86
Field Dry Density	t/m^3	1.77	1.54	1.50	1.48
Maximum Dry Density	t/m^3	1.74	1.58	1.59	1.68
Field Moisture Content	%	13.5	23.8	27.5	25.6
Oversize Material Retained (Wet Basis)	%	0% (+19.0 mm)	0% (+19.0 mm)	0% (+19.0 mm)	0% (+19.0 mm)
Oversize Material Retained (Dry Basis)	%	0% (+19.0 mm)	0% (+19.0 mm)	0% (+19.0 mm)	0% (+19.0 mm)

Field Test Procedures	AS1289 5.8.1 Nuclear Method, AS1289 2.1.1 Moisture Content Oven Drying Method
Laboratory Procedures	AS1289 5.1.1 Standard Compaction, AS1289 5.4.1 Density & Moisture Ratio
NOTE:	When oversize material is recorded the Maximum Dry Density and OptimumMoisture Content are corrected in accordance with AS1289 5.4.1.

REMARKS:

Authorised Signatory
G.W.Collins

NATA ACCREDITED LABORATORY Number 1742.
Accredited for compliance with ISO/IEC 17025.

Date of Issue: 7/03/2016

TESTCRETE
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ABN: 35 102 659 754

Job No.

TS 038

Field Density Test Certificate

Client: ..... Veolia Environmental Services (Australia) Pty Ltd WOODLAWN NSW

Principal: ..... Veolia Environmental Services (Australia) Pty Ltd

Project: ..... Woodlawn Bioreactor

Location: ..... via TARAGO NSW

Test Number	**TS 038 / 57**	**TS 038 / 58**	**TS 038 / 59**	**TS 038 / 60**
Date and Time Tested	24.03.16 0900hrs			
Test Location	Dam # 3	Dam # 3	Dam # 3	Dam # 3
Soil Description	General Fill	General Fill	General Fill	General Fill
Field Remarks	Clay # 1 Final level	Clay # 2 Final level	Clay # 3 Final level	Clay # 4 Final level

TEST RESULTS

Density Ratio	%	**109.5**	**108.0**	**101.0**	**101.0**
Moisture Ratio	%	**75.5**	**62.5**	**68.5**	**64.0**
Optimum Moisture Content	%	19.5	19.0	20.5	18.5
Moisture Variation	%	4.5% DRY	7.0% DRY	6.5% DRY	7.0% DRY

FIELD AND LABORATORY DATA

Depth of Test	mm	150				150				150				150			
Field Wet Density	t/m^3	2.02				2.01				1.96				1.91			
Field Dry Density	t/m^3	1.76				1.79				1.72				1.70			
Maximum Dry Density	t/m^3	1.61				1.66				1.70				1.69			
Field Moisture Content	%	14.7				11.8				14.0				11.8			
Oversize Material Retained (Wet Basis)	%	0%	(+19.0 mm)			0%	(+19.0 mm)			0%	(+19.0 mm)			0%	(+19.0 mm)		
Oversize Material Retained (Dry Basis)	%	0%	(+19.0 mm)			0%	(+19.0 mm)			0%	(+19.0 mm)			0%	(+19.0 mm)		

Field Test Procedures	AS1289 5.8.1 Nuclear Method, AS1289 2.1.1 Moisture Content Oven Drying Method
Laboratory Procedures	AS1289 5.1.1 Standard Compaction, AS1289 5.4.1 Density & Moisture Ratio
NOTE:	When oversize material is recorded the Maximum Dry Density and OptimumMoisture Content are corrected in accordance with AS1289 5.4.1.

REMARKS:

Authorised Signatory
G.W.Collins

NATA ACCREDITED LABORATORY Number 1742.
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Date of Issue: 5/04/2016

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Job No.
TS 038

Field Density Test Certificate

Client:	Veolia Environmental Services (Australia) Pty Ltd WOODLAWN NSW
Principal:	Veolia Environmental Services (Australia) Pty Ltd
Project:	Woodlawn Bioreactor
Location:	via TARAGO NSW

Test Number	**TS 038 / 61**	**TS 038 / 62**	**-- --**	**-- --**
Date and Time Tested	24.03.16 0900hrs			
Test Location	Dam # 3	Dam # 3	----	----
Soil Description	General Fill	General Fill	----	----
Field Remarks	Clay # 5 Final level	Clay # 6 Final level	----	----

TEST RESULTS

Density Ratio	%	**106.0**	**104.0**	**----**	**----**
Moisture Ratio	%	**69.0**	**82.5**	**----**	**----**
Optimum Moisture Content	%	19.0	23.0	----	----
Moisture Variation	%	6.0% DRY	4.0% DRY	----	----

FIELD AND LABORATORY DATA

Depth of Test	mm	150		150		----		----	
Field Wet Density	t/m^3	2.04		2.06		----		----	
Field Dry Density	t/m^3	1.80		1.73		----		----	
Maximum Dry Density	t/m^3	1.70		1.66		----		----	
Field Moisture Content	%	13.1		19.0		----		----	
Oversize Material Retained (Wet Basis)	%	0%	(+19.0 mm)	0%	(+19.0 mm)	--	--	--	--
Oversize Material Retained (Dry Basis)	%	0%	(+19.0 mm)	0%	(+19.0 mm)	--	--	--	--

Field Test Procedures	AS1289 5.8.1 Nuclear Method, AS1289 2.1.1 Moisture Content Oven Drying Method
Laboratory Procedures	AS1289 5.1.1 Standard Compaction, AS1289 5.4.1 Density & Moisture Ratio
NOTE:	When oversize material is recorded the Maximum Dry Density and OptimumMoisture Content are corrected in accordance with AS1289 5.4.1.
REMARKS:	

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Job No.
TS 038

Field Density Test Certificate

Client:	Veolia Environmental Services (Australia) Pty Ltd WOODLAWN NSW
Principal:	Veolia Environmental Services (Australia) Pty Ltd
Project:	Woodlawn Bioreactor
Location:	via TARAGO NSW

Test Number	**TS 038 / 9**	**TS 038 / 10**	**TS 038 / 11**	**TS 038 / 12**
Date and Time Tested	15.12.15 1050hrs			
Test Location	Wall 1	Wall 1	Wall 1	Wall 2
Soil Description	General Fill	General Fill	General Fill	General Fill
Field Remarks	E 733 696.74 N 611 7020.17 0.2 m below final level	E 733 696.74 N 611 7020.17 0.5 m below final level	E 733 696.74 N 611 7020.17 1.0 m below final level	E 733 635.68 N 611 6975.01 0.2 m below final level

TEST RESULTS

Density Ratio	%	**100.5**	**102.0**	**100.5**	**107.0**
Moisture Ratio	%	**88.0**	**126.5**	**95.5**	**90.5**
Optimum Moisture Content	%	11.5	9.0	16.0	14.5
Moisture Variation	%	1.5% DRY	2.5% WET	0.5% DRY	1.5% DRY

FIELD AND LABORATORY DATA

Depth of Test	mm	150		150		150		150	
Field Wet Density	t/m^3	2.03		2.04		2.05		2.17	
Field Dry Density	t/m^3	1.85		1.83		1.78		1.92	
Maximum Dry Density	t/m^3	1.83		1.79		1.77		1.79	
Field Moisture Content	%	10.1		11.4		15.3		13.1	
Oversize Material Retained (Wet Basis)	%	0%	(+19.0 mm)	0%	(+19.0 mm)	0%	(+19.0 mm)	0%	(+19.0 mm)
Oversize Material Retained (Dry Basis)	%	0%	(+19.0 mm)	0%	(+19.0 mm)	0%	(+19.0 mm)	0%	(+19.0 mm)

Field Test Procedures	AS1289 5.8.1 Nuclear Method, AS1289 2.1.1 Moisture Content Oven Drying Method
Laboratory Procedures	AS1289 5.1.1 Standard Compaction, AS1289 5.4.1 Density & Moisture Ratio
NOTE:	When oversize material is recorded the Maximum Dry Density and OptimumMoisture Content are corrected in accordance with AS1289 5.4.1.

REMARKS:

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TS 038

Field Density Test Certificate

Client:	Veolia Environmental Services (Australia) Pty Ltd WOODLAWN NSW
Principal:	Veolia Environmental Services (Australia) Pty Ltd
Project:	Woodlawn Bioreactor
Location:	via TARAGO NSW

Test Number	TS 038 / 13	TS 038 / 14	TS 038 / 15	TS 038 / 16
Date and Time Tested	15.12.15 1050hrs			
Test Location	Wall 2	Wall 2	Wall 3	Wall 3
Soil Description	General Fill	General Fill	General Fill	General Fill
Field Remarks	E 733 635.68 N 611 6975.01 0.5 m below final level	E 733 635.68 N 611 6975.01 1.0 m below final level	E 733 605.05 N 611 6968.64 0.2 m below final level	E 733 605.05 N 611 6968.64 0.5 m below final level

TEST RESULTS

Density Ratio	%	**99.0**	**97.0**	**97.0**	**108.0**
Moisture Ratio	%	**86.5**	**87.0**	**88.0**	**68.0**
Optimum Moisture Content	%	15.0	15.5	14.5	17.0
Moisture Variation	%	2.0% DRY	2.0% DRY	1.5% DRY	5.5% DRY

FIELD AND LABORATORY DATA

Depth of Test	mm	150		150		150		150	
Field Wet Density	t/m^3	2.00		1.99		1.93		2.12	
Field Dry Density	t/m^3	1.77		1.75		1.71		1.90	
Maximum Dry Density	t/m^3	1.79		1.80		1.76		1.76	
Field Moisture Content	%	13.0		13.5		12.8		11.6	
Oversize Material Retained (Wet Basis)	%	0%	(+19.0 mm)	0%	(+19.0 mm)	0%	(+19.0 mm)	0%	(+19.0 mm)
Oversize Material Retained (Dry Basis)	%	0%	(+19.0 mm)	0%	(+19.0 mm)	0%	(+19.0 mm)	0%	(+19.0 mm)

Field Test Procedures	AS1289 5.8.1 Nuclear Method, AS1289 2.1.1 Moisture Content Oven Drying Method
Laboratory Procedures	AS1289 5.1.1 Standard Compaction, AS1289 5.4.1 Density & Moisture Ratio
NOTE:	When oversize material is recorded the Maximum Dry Density and OptimumMoisture Content are corrected in accordance with AS1289 5.4.1.

REMARKS:

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Job No.
TS 038

Field Density Test Certificate

Client: ..... Veolia Environmental Services (Australia) Pty Ltd WOODLAWN NSW
Principal: ..... Veolia Environmental Services (Australia) Pty Ltd
Project: ..... Woodlawn Bioreactor
Location: ..... via TARAGO NSW

Test Number	**TS 038 / 17**	**TS 038 / 18**	**TS 038 / 19**	**TS 038 / 20**
Date and Time Tested	15.12.15 1050hrs			
Test Location	Wall 3	Wall 4	Wall 4	Wall 4
Soil Description	General Fill	General Fill	General Fill	General Fill
Field Remarks	E 733 605.05 N 611 6968.64 1.0 m below final level	E 733 554.39 N 611 6987.05 0.2 m below final level	E 733 554.39 N 611 6987.05 0.5 m below final level	E 733 554.39 N 611 6987.05 1.0 m below final level

TEST RESULTS

Density Ratio	%	**101.0**	**96.0**	**98.0**	**93.0**
Moisture Ratio	%	**85.0**	**105.0**	**86.5**	**109.5**
Optimum Moisture Content	%	13.5	12.0	13.0	11.5
Moisture Variation	%	2.0% DRY	0.5% WET	1.5% DRY	1.0% WET

FIELD AND LABORATORY DATA

Depth of Test	mm	150				150				150				150			
Field Wet Density	t/m^3	2.00				1.97				1.96				1.86			
Field Dry Density	t/m^3	1.79				1.75				1.76				1.65			
Maximum Dry Density	t/m^3	1.78				1.83				1.80				1.78			
Field Moisture Content	%	11.5				12.6				11.3				12.6			
Oversize Material Retained (Wet Basis)	%	0%	(+19.0 mm)			0%	(+19.0 mm)			0%	(+19.0 mm)			0%	(+19.0 mm)		
Oversize Material Retained (Dry Basis)	%	0%	(+19.0 mm)			0%	(+19.0 mm)			0%	(+19.0 mm)			0%	(+19.0 mm)		

Field Test Procedures	AS1289 5.8.1 Nuclear Method, AS1289 2.1.1 Moisture Content Oven Drying Method
Laboratory Procedures	AS1289 5.1.1 Standard Compaction, AS1289 5.4.1 Density & Moisture Ratio
NOTE:	When oversize material is recorded the Maximum Dry Density and OptimumMoisture Content are corrected in accordance with AS1289 5.4.1.

REMARKS:

Authorised Signatory
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Date of Issue: 13/01/2016

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Job No.
TS 038

Field Density Test Certificate

Client:	Veolia Environmental Services (Australia) Pty Ltd WOODLAWN NSW
Principal:	Veolia Environmental Services (Australia) Pty Ltd
Project:	Woodlawn Bioreactor
Location:	via TARAGO NSW

Test Number	TS 038 / 21	TS 038 / 22	TS 038 / 23	TS 038 / 24
Date and Time Tested	15.12.15 1050hrs			
Test Location	Wall 5	Wall 5	Wall 5	Wall 6
Soil Description	General Fill	General Fill	General Fill	General Fill
Field Remarks	E 733 729.27 N 611 7072.40 0.2 m below final level	E 733 729.27 N 611 7072.40 0.5 m below final level	E 733 729.27 N 611 7072.40 1.0 m below final level	E 733 746.31 N 611 7029.05 0.2 m below final level

TEST RESULTS

Density Ratio	%	**105.0**	**103.5**	**103.0**	**103.0**
Moisture Ratio	%	**126.0**	**92.5**	**97.0**	**60.5**
Optimum Moisture Content	%	11.0	16.5	14.5	12.5
Moisture Variation	%	2.5% WET	1.0% DRY	0.5% DRY	5.0% DRY

FIELD AND LABORATORY DATA

Depth of Test	mm	150		150		150		150	
Field Wet Density	t/m^3	2.13		2.17		2.09		2.05	
Field Dry Density	t/m^3	1.88		1.88		1.84		1.91	
Maximum Dry Density	t/m^3	1.79		1.81		1.78		1.85	
Field Moisture Content	%	13.8		15.3		14.1		7.6	
Oversize Material Retained (Wet Basis)	%	0%	(+19.0 mm)	0%	(+19.0 mm)	0%	(+19.0 mm)	0%	(+19.0 mm)
Oversize Material Retained (Dry Basis)	%	0%	(+19.0 mm)	0%	(+19.0 mm)	0%	(+19.0 mm)	0%	(+19.0 mm)

Field Test Procedures	AS1289 5.8.1 Nuclear Method, AS1289 2.1.1 Moisture Content Oven Drying Method
Laboratory Procedures	AS1289 5.1.1 Standard Compaction, AS1289 5.4.1 Density & Moisture Ratio
NOTE:	When oversize material is recorded the Maximum Dry Density and OptimumMoisture Content are corrected in accordance with AS1289 5.4.1.

REMARKS:

Authorised Signatory
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TS 038

Field Density Test Certificate

Client: ..... Veolia Environmental Services (Australia) Pty Ltd WOODLAWN NSW
Principal: ..... Veolia Environmental Services (Australia) Pty Ltd
Project: ..... Woodlawn Bioreactor
Location: ..... via TARAGO NSW

Test Number	TS 038 / 25	TS 038 / 26	TS 038 / 27	TS 038 / 28
Date and Time Tested	15.12.15 1050hrs			
Test Location	Wall 6	Wall 6	Wall 7	Wall 7
Soil Description	General Fill	General Fill	General Fill	General Fill
Field Remarks	E 733 746.31 N 611 7029.05 0.5 m below final level	E 733 746.31 N 611 7029.05 1.0 m below final level	E 733 591.62 N 611 7099.058 0.2 m below final level	E 733 591.62 N 611 7099.058 0.5 m below final level

TEST RESULTS

Density Ratio	%	**99.5**	**103.5**	**113.0**	**103.0**
Moisture Ratio	%	**81.0**	**75.5**	**80.0**	**69.5**
Optimum Moisture Content	%	11.5	13.5	9.5	12.0
Moisture Variation	%	2.5% DRY	3.0% DRY	2.0% DRY	3.5% DRY

FIELD AND LABORATORY DATA

Depth of Test	mm	150	150	150	150
Field Wet Density	t/m^3	2.04	2.16	2.19	1.98
Field Dry Density	t/m^3	1.86	1.96	2.04	1.83
Maximum Dry Density	t/m^3	1.87	1.89	1.81	1.77
Field Moisture Content	%	9.3	10.2	7.6	8.4
Oversize Material Retained (Wet Basis)	%	0% (+19.0 mm)	0% (+19.0 mm)	0% (+19.0 mm)	0% (+19.0 mm)
Oversize Material Retained (Dry Basis)	%	0% (+19.0 mm)	0% (+19.0 mm)	0% (+19.0 mm)	0% (+19.0 mm)
Field Test Procedures		AS1289 5.8.1 Nuclear Method, AS1289 2.1.1 Moisture Content Oven Drying Method			
Laboratory Procedures		AS1289 5.1.1 Standard Compaction, AS1289 5.4.1 Density & Moisture Ratio			
NOTE:		When oversize material is recorded the Maximum Dry Density and OptimumMoisture Content are corrected in accordance with AS1289 5.4.1.			
REMARKS:					

Authorised Signatory
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Job No.

TS 038

Field Density Test Certificate

Client: ..... Veolia Environmental Services (Australia) Pty Ltd WOODLAWN NSW

Principal: ..... Veolia Environmental Services (Australia) Pty Ltd

Project: ..... Woodlawn Bioreactor

Location: ..... via TARAGO NSW

Test Number	**TS 038 / 29**	**TS 038 / 30**	**TS 038 / 31**	**TS 038 / 32**
Date and Time Tested	15.12.15 1050hrs			
Test Location	Wall 7	Wall 8	Wall 8	Wall 8
Soil Description	General Fill	General Fill	General Fill	General Fill
Field Remarks	E 733 591.62 N 611 7099.058 1.0 m below final level	E 733 674.34 N 611 7077.93 0.2 m below final level	E 733 674.34 N N 611 7077.93 0.5 m below final level	E 733 674.34 N N 611 7077.93 1.0 m below final level

TEST RESULTS

Density Ratio	%	**91.0**	**110.5**	**100.0**	**95.0**
Moisture Ratio	%	**161.0**	**85.5**	**100.0**	**85.5**
Optimum Moisture Content	%	7.0	15.5	12.5	13.5
Moisture Variation	%	4.0% WET	2.0% DRY	FMC=OMC	2.0% DRY

FIELD AND LABORATORY DATA

Depth of Test	mm	150				150				150				150			
Field Wet Density	t/m^3	1.83				2.21				1.93				1.93			
Field Dry Density	t/m^3	1.65				1.95				1.71				1.73			
Maximum Dry Density	t/m^3	1.81				1.77				1.71				1.83			
Field Moisture Content	%	11.3				13.2				12.5				11.5			
Oversize Material Retained (Wet Basis)	%	0%	(+19.0 mm)			0%	(+19.0 mm)			0%	(+19.0 mm)			0%	(+19.0 mm)		
Oversize Material Retained (Dry Basis)	%	0%	(+19.0 mm)			0%	(+19.0 mm)			0%	(+19.0 mm)			0%	(+19.0 mm)		

Field Test Procedures	AS1289 5.8.1 Nuclear Method, AS1289 2.1.1 Moisture Content Oven Drying Method
Laboratory Procedures	AS1289 5.1.1 Standard Compaction, AS1289 5.4.1 Density & Moisture Ratio
NOTE:	When oversize material is recorded the Maximum Dry Density and OptimumMoisture Content are corrected in accordance with AS1289 5.4.1.
REMARKS:	

Authorised Signatory
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Date of Issue: 13/01/2016

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Job No.
TS 038

Particle Size Distribution / Atterberg Limits

Client: ..... Veolia Environmental Services (Australia) Pty Ltd WOODLAWN NSW Date Tested.... 02.12.15

Principal: ..... Veolia Environmental Services (Australia) Pty Ltd

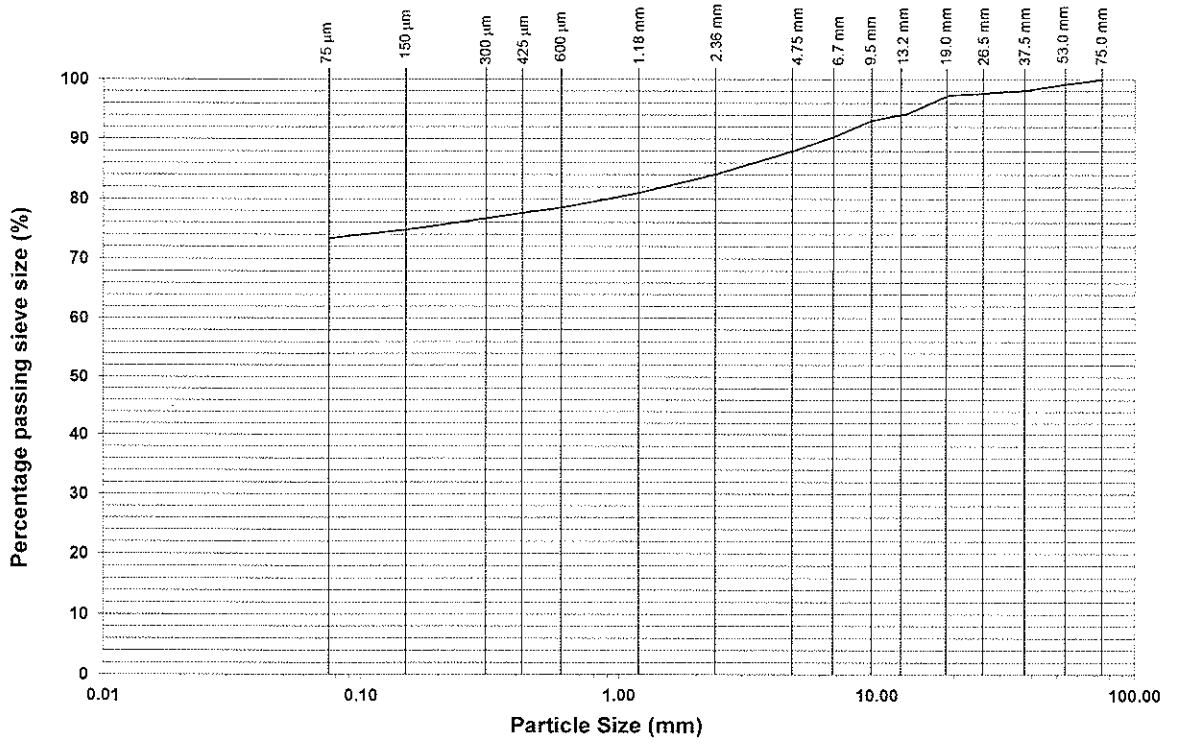
Project: ..... Woodlawn Bioreactor

Location: ..... via TARAGO NSW

Sample Identification: **TS038/S14** Client ID: ED3SS Excavated Material 1

Test Procedure: AS 1289 3.6.1 Sampled by Client Submitted 26.11.15

AS Sieve size	150 mm	75 mm	53 mm	37.5 mm	26.5 mm	19.0 mm	13.2 mm	9.5 mm	6.7 mm	4.75 mm	2.36 mm	1.18 mm	600 um	425 um	300 um	150 um	75 um	13.2 um	0.02 um
Percent Passing	-	100	99	98	98	97	94	93	90	88	84	81	79	78	77	75	73	-	-



Atterberg Limits (Test procedure)							
	Liquid Limit AS 1289 3.1.1	28 %	Plastic Limit AS 1289 3.2.1	27 %	Plasticity Index AS 1289 3.3.1	1 %
	Linear Shrinkage AS 1289 3.4.1	1.5 %	-			

Remarks: Unless otherwise stated Atterberg Limits have been oven dried & dry sieved.
Linear Shrinkage moisture condition determined by AS1289 3.1.1

Authorised Signatory
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Page 1 of 1
Issue # 1

NATA ACCREDITED LABORATORY Number 1742.
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Date of Issue: 3/12/2015

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Job No.
TS 038

Particle Size Distribution / Atterberg Limits

Client: ..... Veolia Environmental Services (Australia) Pty Ltd WOODLAWN NSW Date Tested... 02.12.15

Principal: ..... Veolia Environmental Services (Australia) Pty Ltd

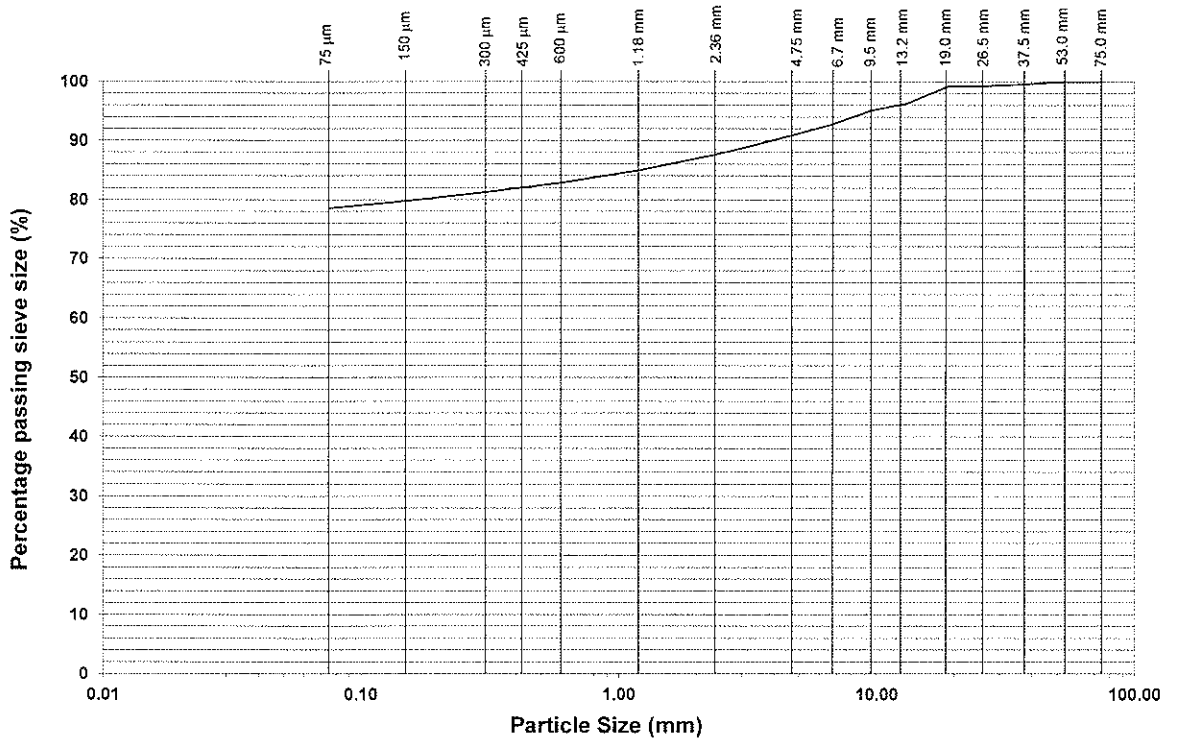
Project: ..... Woodlawn Bioreactor

Location: ..... via TARAGO NSW

Sample Identification: **TS038/S15** Client ID: ED3SS Excavated Material 2

Test Procedure: AS 1289 3.6.1 Sampled by Client Submitted 26.11.15

AS Sieve size	150 mm	75 mm	53 mm	37.5 mm	26.5 mm	19.0 mm	13.2 mm	9.5 mm	6.7 mm	4.75 mm	2.36 mm	1.18 mm	600 um	425 um	300 um	150 um	75 um	13.2 um	0.02 um
Percent Passing	-	-	-	100	99	99	96	95	93	91	88	85	83	82	81	80	79	-	-



Atterberg Limits (Test procedure)	Liquid Limit AS 1289 3.1.1	**29** %	Plastic Limit AS 1289 3.2.1	**25** %	Plasticity Index AS 1289 3.3.1	**4** %
	Linear Shrinkage AS 1289 3.4.1	**1.5** %	-			

Remarks: Unless otherwise stated Atterberg Limits have been oven dried & dry sieved.
Linear Shrinkage moisture condition determined by AS1289 3.1.1

Authorised Signatory

G.W.Collins

Page 1 of 1
Issue # 1

NATA

NATA ACCREDITED LABORATORY Number 1742.
Accredited for compliance with ISO/IEC 17025.

Date of Issue: 3/12/2015

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Telephone 02 6241 1322
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ABN: 35 102 659 754

Job No.
TS 038

Particle Size Distribution / Atterberg Limits

Client: ..... Veolia Environmental Services (Australia) Pty Ltd WOODLAWN NSW Date Tested... 21.12.15

Principal: ..... Veolia Environmental Services (Australia) Pty Ltd

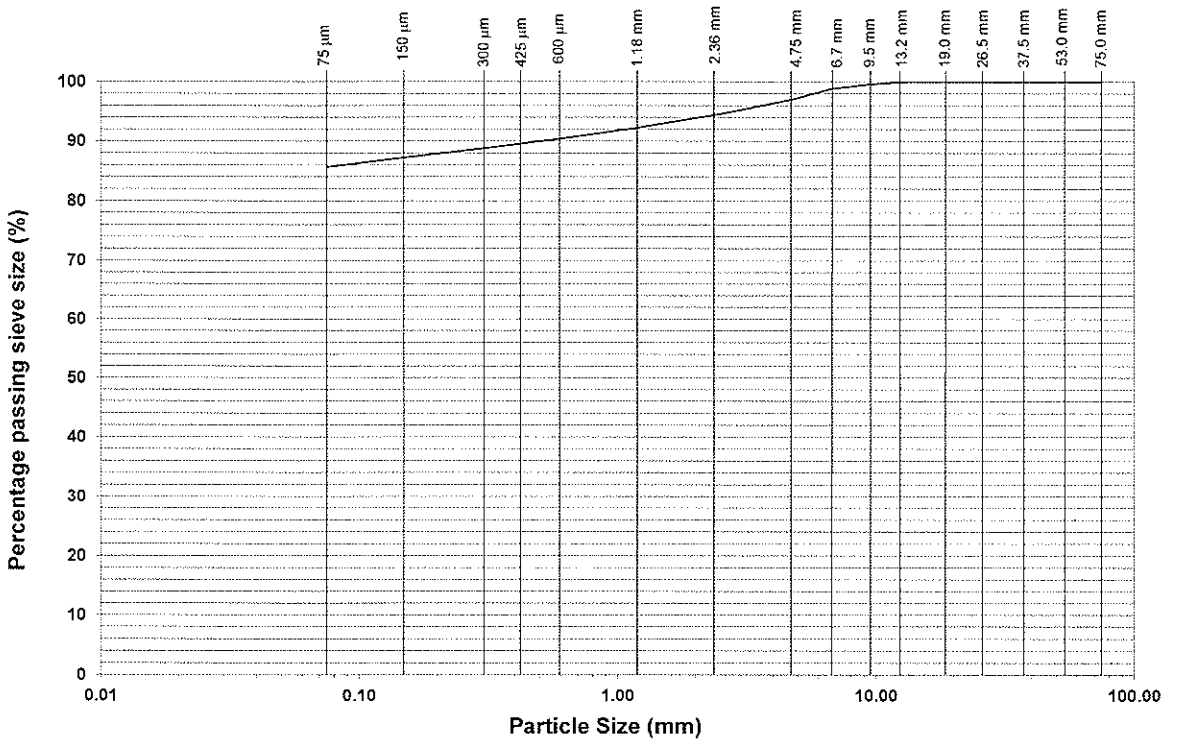
Project: ..... Woodlawn Bioreactor

Location: ..... via TARAGO NSW

Sample Identification: **TS038/S16** Client ID: ED3SS Wall 7 1,000 mm

Test Procedure: AS 1289 3.6.1 Sampled by Client Submitted 15.12.15

AS Sieve size	150 mm	75 mm	53 mm	37.5 mm	26.5 mm	19.0 mm	13.2 mm	9.5 mm	6.7 mm	4.75 mm	2.36 mm	1.18 mm	600 um	425 um	300 um	150 um	75 um	13.2 um	0.02 um
Percent Passing	-	-	-	-	-	-	-	100	99	97	94	92	90	90	89	87	86	-	-



Atterberg Limits (Test procedure)	Liquid Limit	- %	Plastic Limit	- %	Plasticity Index	- %
	-		-		-	
	Linear Shrinkage	- %	-			
	-					

Remarks:

Authorised Signatory

G.W.Collins

NATA

NATA ACCREDITED LABORATORY Number 1742.
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Date of Issue: 21/12/2015

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Job No.
TS 038

Particle Size Distribution / Atterberg Limits

Client: ..... Veolia Environmental Services (Australia) Pty Ltd WOODLAWN NSW Date Tested... 21.12.15

Principal: ..... Veolia Environmental Services (Australia) Pty Ltd

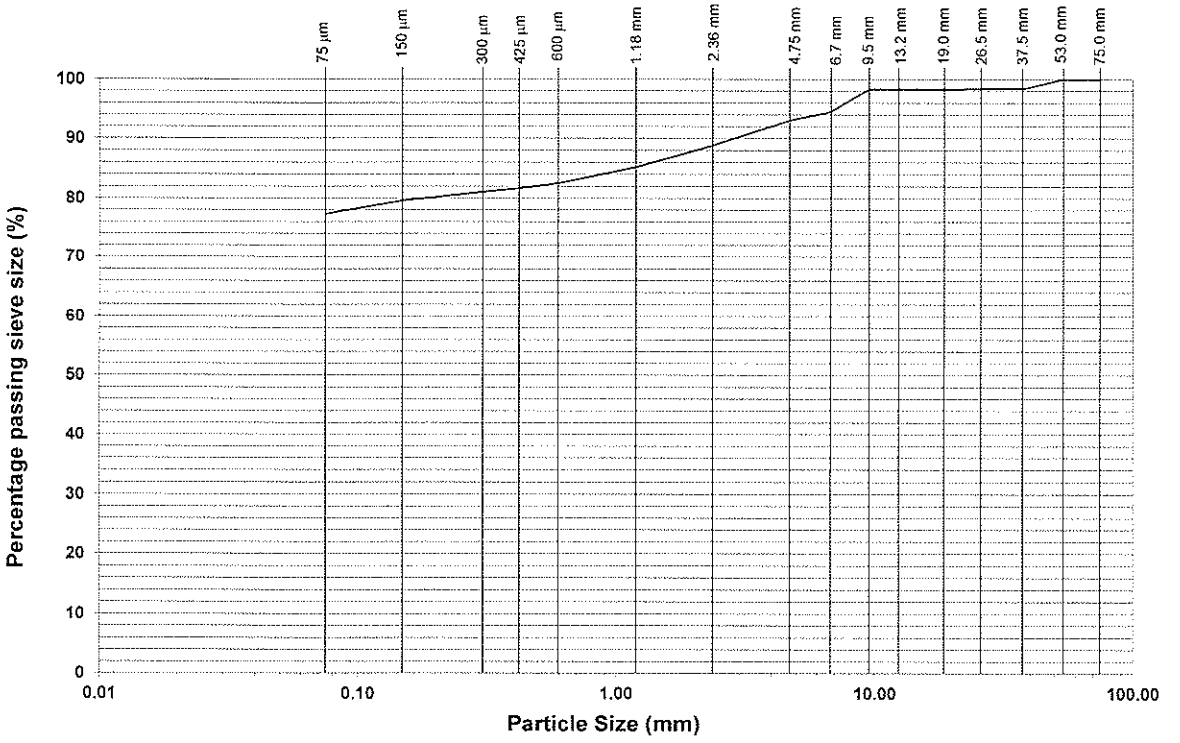
Project: ..... Woodlawn Bioreactor

Location: ..... via TARAGO NSW

Sample Identification: **TS038/S17** Client ID: ED3SS Wall 8 500 mm

Test Procedure: AS 1289 3.6.1 Sampled by Client Submitted 15.12.15

AS Sieve size	150 mm	75 mm	53 mm	37.5 mm	26.5 mm	19.0 mm	13.2 mm	9.5 mm	6.7 mm	4.75 mm	2.36 mm	1.18 mm	600 um	425 um	300 um	150 um	75 um	13.2 um	0.02 um					
Percent Passing	-	-	100	98	98	98	98	98	94	93	89	85	83	82	81	80	77	-	-					



Atterberg Limits (Test procedure)	Liquid Limit -	- %	Plastic Limit -	- %	Plasticity Index -	- %
	Linear Shrinkage -	- %	-			

Remarks:

Authorised Signatory
G.W.Collins

Date of Issue: 21/12/2015

NATA

NATA ACCREDITED LABORATORY Number 1742.
Accredited for compliance with ISO/IEC 17025.

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Aggregate/Soil Test Report

Report No: SYD1502153
Issue No: 1
This report replaces all previous issues of report no 'SYD1502153'.

Client:
Testcrete Laboratories Pty Ltd
Material Evaluation
Dickson ACT

Project: 2123564

Accredited for compliance with ISO / IEC 17025

NATA Accredited Laboratory Number: 679

Approved Signatory: D.P Brooke (Sydney Laboratory Manager)

Date of Issue: 22/12/2015

Sample Details

GHD Sample No	SYD15L-0444-01
Client Sample ID	TS038/S14
Date Sampled	01/12/2015
Sampled By	Supplied by Client
BH / TP No.	TS038 / S14
Soil Description	Sandy CLAY / SILT with gravel

Test Results

Description	Method	Result	Limits
Permeability (m/sec)	AS 1289.6.7.2	6 E -09	
Laboratory Moisture Ratio		103.5	
Laboratory Density Ratio		99.5	
CompactiveEffort		Standard	
Method of Compaction		Tamped	
Surcharge Applied (Kg)		0.5	
Pressure Applied (Kpa)		20	
Material Retained And Later Discarded (%)		6.0	
Sieve Size (mm)		9.50	
Date Tested		11/12/2015	

Comments

N/A

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Aggregate/Soil Test Report

Report No: SYD1502154
Issue No: 1
This report replaces all previous issues of report no 'SYD1502154'.

Client:
Testcrete Laboratories Pty Ltd
Material Evaluation
Dickson ACT

Project: 2123564

Accredited for compliance with ISO / IEC 17025

NATA Accredited Laboratory Number: 679

Approved Signatory: D.P Brooke (Sydney Laboratory Manager)

Date of Issue: 22/12/2015

Sample Details

GHD Sample No	SYD15L-0444-02
Client Sample ID	TS038/S15
Date Sampled	01/12/2015
Sampled By	Supplied by Client
BH / TP No.	TS038/S15
Soil Description	CLAY / SILT with sand

Test Results

Description	Method	Result	Limits
Permeability (m/sec)	AS 1289.6.7.2	1 E -08	
Laboratory Moisture Ratio		100.0	
Laboratory Density Ratio		97.0	
CompactiveEffort		Standard	
Method of Compaction		Tamped	
Surcharge Applied (Kg)		0.5	
Pressure Applied (Kpa)		20	
Material Retained And Later Discarded (%)		5.0	
Sieve Size (mm)		9.50	
Date Tested		17/12/2015	

Comments

N/A

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Aggregate/Soil Test Report

Report No: SYD1502346
Issue No: 1
This report replaces all previous issues of report no 'SYD1502346'.

Client:
Testcrete Laboratories Pty Ltd
Material Evaluation
Dickson ACT

Project: 2123564

Accredited for compliance with ISO / IEC 17025

NATA Accredited Laboratory Number: 679

Approved Signatory: G J Vukovic (Senior Laboratory Technician)

Date of Issue: 19/01/2016

Sample Details

GHD Sample No	SYD15L-0464-01
Client Sample ID	S16
Date Sampled	18/12/2015
Sampled By	Supplied by Client
BH / TP No.	TS038 / S16
Soil Description	Sandy CLAY/SILT with gravel

Test Results

Description	Method	Result	Limits
Permeability (m/sec)	AS 1289.6.7.2	9 E-09	
Laboratory Moisture Ratio		100.0	
Laboratory Density Ratio		100.5	
CompactiveEffort		Standard	
Method of Compaction		Remoulded	
Surcharge Applied (Kg)		0.0	
Pressure Applied (Kpa)		10	
Material Retained And Later Discarded (%)		1.2	
Sieve Size (mm)		9.50	
Date Tested		8/01/2016	

Comments

N/A

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Aggregate/Soil Test Report

Report No: SYD1502347
Issue No: 1
This report replaces all previous issues of report no 'SYD1502347'.

Client:
Testcrete Laboratories Pty Ltd
Material Evaluation
Dickson ACT

Project: 2123564

Accredited for compliance with ISO / IEC 17025

NATA Accredited Laboratory Number: 679

Approved Signatory: G J Vukovic (Senior Laboratory Technician)

Date of Issue: 19/01/2016

Sample Details

GHD Sample No	SYD15L-0464-02
Client Sample ID	S17
Date Sampled	18/12/2015
Sampled By	Supplied by Client
BH / TP No.	TS038 / S17
Soil Description	Sandy CLAY/SILT with gravel

Test Results

Description	Method	Result	Limits
Permeability (m/sec)	AS 1289.6.7.2	2 E-08	
Laboratory Moisture Ratio		99.5	
Laboratory Density Ratio		100.0	
CompactiveEffort		Standard	
Method of Compaction		Remoulded	
Surcharge Applied (Kg)		0.0	
Pressure Applied (Kpa)		10	
Material Retained And Later Discarded (%)		1.1	
Sieve Size (mm)		9.50	
Date Tested		14/01/2016	

Comments

N/A

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Aggregate/Soil Test Report

Report No: SYD1600273
Issue No: 1
This report replaces all previous issues of report no 'SYD1600273'.

Client:
Testcrete Laboratories Pty Ltd
Material Evaluation
Dickson ACT

Project: 2123564

Accredited for compliance with ISO / IEC 17025

NATA Accredited Laboratory Number: 679

Approved Signatory: G J Vukovic (Senior Laboratory Technician)

Date of Issue: 15/03/2016

Sample Details

GHD Sample No	SYD16-0062-01
Client Sample ID	TS038 S18
Date Sampled	28/02/2016
Sampled By	Sampled By Client
Location	TS038
Soil Description	CLAY; brown grey/brown

Test Results

Description	Method	Result	Limits
Coef of Permeability (m/sec)	AS 1289.6.7.3	4.1 E-11	
Mean Stress Level (kPa)		30	
Permeant Used		Syd Tap Water	
Length (mm)		61.3	
Diameter (mm)		50.3	
Length/Diameter Ratio		1.22	
Laboratory Moisture Ratio (%)		101.0	
Laboratory Density Ratio (%)		99.0	
CompactiveEffort		Standard	
Method of Compaction		Remoulded	
Surcharge Applied (Kg)		0.0	
Pressure Applied (Kpa)		10	
Oversize Sieve (mm)		6.3	
Percentage Oversize (%)		1.1	
Moisture Content (%)		31.0	
Date Tested		8/03/2016	

Comments

N/A

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Aggregate/Soil Test Report

Report No: SYD1600274
Issue No: 1
This report replaces all previous issues of report no 'SYD1600274'.

Client:
Testcrete Laboratories Pty Ltd
Material Evaluation
Dickson ACT

Project: 2123564

Accredited for compliance with ISO / IEC 17025

NATA Accredited Laboratory Number: 679

Approved Signatory: G J Vukovic (Senior Laboratory Technician)

Date of Issue: 15/03/2016

Sample Details

GHD Sample No	SYD16-0062-02
Client Sample ID	TS038 S19
Date Sampled	28/02/2016
Sampled By	Sampled By Client
Location	TS038
Soil Description	CLAY; brown grey/brown

Test Results

Description	Method	Result	Limits
Coef of Permeability (m/sec)	AS 1289.6.7.3	1.3 E-10	
Mean Stress Level (kPa)		30	
Permeant Used		Syd Tap Water	
Length (mm)		60.1	
Diameter (mm)		50.3	
Length/Diameter Ratio		1.19	
Laboratory Moisture Ratio (%)		99.0	
Laboratory Density Ratio (%)		100.5	
CompactiveEffort		Standard	
Method of Compaction		Remoulded	
Surcharge Applied (Kg)		0.0	
Pressure Applied (Kpa)		10	
Oversize Sieve (mm)		6.3	
Percentage Oversize (%)		0.8	
Moisture Content (%)		28.6	
Date Tested		8/03/2016	

Comments

N/A

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Aggregate/Soil Test Report

Report No: SYD1600275
Issue No: 1
This report replaces all previous issues of report no 'SYD1600275'.

Client:
Testcrete Laboratories Pty Ltd
Material Evaluation
Dickson ACT

Project: 2123564

Accredited for compliance with ISO / IEC 17025

NATA Accredited Laboratory Number: 679

Approved Signatory: G J Vukovic (Senior Laboratory Technician)

Date of Issue: 22/03/2016

Sample Details

GHD Sample No	SYD16-0062-03
Client Sample ID	TS038 S20
Date Sampled	28/02/2016
Sampled By	Sampled By Client
Location	TS038
Soil Description	CLAY; brown grey/brown

Test Results

Description	Method	Result	Limits
Coef of Permeability (m/sec)	AS 1289.6.7.3	3.5 E-11	
Mean Stress Level (kPa)		30	
Permeant Used		Syd Tap Water	
Length (mm)		60.2	
Diameter (mm)		50.2	
Length/Diameter Ratio		1.20	
Laboratory Moisture Ratio (%)		98.5	
Laboratory Density Ratio (%)		100.5	
CompactiveEffort		Standard	
Method of Compaction		Remoulded	
Surcharge Applied (Kg)		0.0	
Pressure Applied (Kpa)		10	
Oversize Sieve (mm)		0.0	
Percentage Oversize (%)		6.3	
Moisture Content (%)		28.5	
Date Tested		14/03/2016	

Comments

N/A

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Aggregate/Soil Test Report

Report No: SYD1600276
Issue No: 1
This report replaces all previous issues of report no 'SYD1600276'.

Client:
Testcrete Laboratories Pty Ltd
Material Evaluation
Dickson ACT

Project: 2123564

Accredited for compliance with ISO / IEC 17025

NATA Accredited Laboratory Number: 679

Approved Signatory: G J Vukovic (Senior Laboratory Technician)

Date of Issue: 22/03/2016

Sample Details

GHD Sample No	SYD16-0062-04
Client Sample ID	TS038 S21
Date Sampled	28/02/2016
Sampled By	Sampled By Client
Location	TS038
Soil Description	CLAY; brown grey/brown

Test Results

Description	Method	Result	Limits
Coef of Permeability (m/sec)	AS 1289.6.7.3	3.5 E-11	
Mean Stress Level (kPa)		30	
Permeant Used		Syd Tap Water	
Length (mm)		60.0	
Diameter (mm)		50.2	
Length/Diameter Ratio		1.20	
Laboratory Moisture Ratio (%)		99.5	
Laboratory Density Ratio (%)		101.0	
CompactiveEffort		Standard	
Method of Compaction		Remoulded	
Surcharge Applied (Kg)		0.0	
Pressure Applied (Kpa)		10	
Oversize Sieve (mm)		6.3	
Percentage Oversize (%)		0.0	
Moisture Content (%)		25.8	
Date Tested		14/03/2016	

Comments

N/A

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Job No.
TS 038

Particle Size Distribution / Atterberg Limits

Client: ..... Veolia Environmental Services (Australia) Pty Ltd WOODLAWN NSW Date Tested... 26.02.16

Principal: ..... Veolia Environmental Services (Australia) Pty Ltd

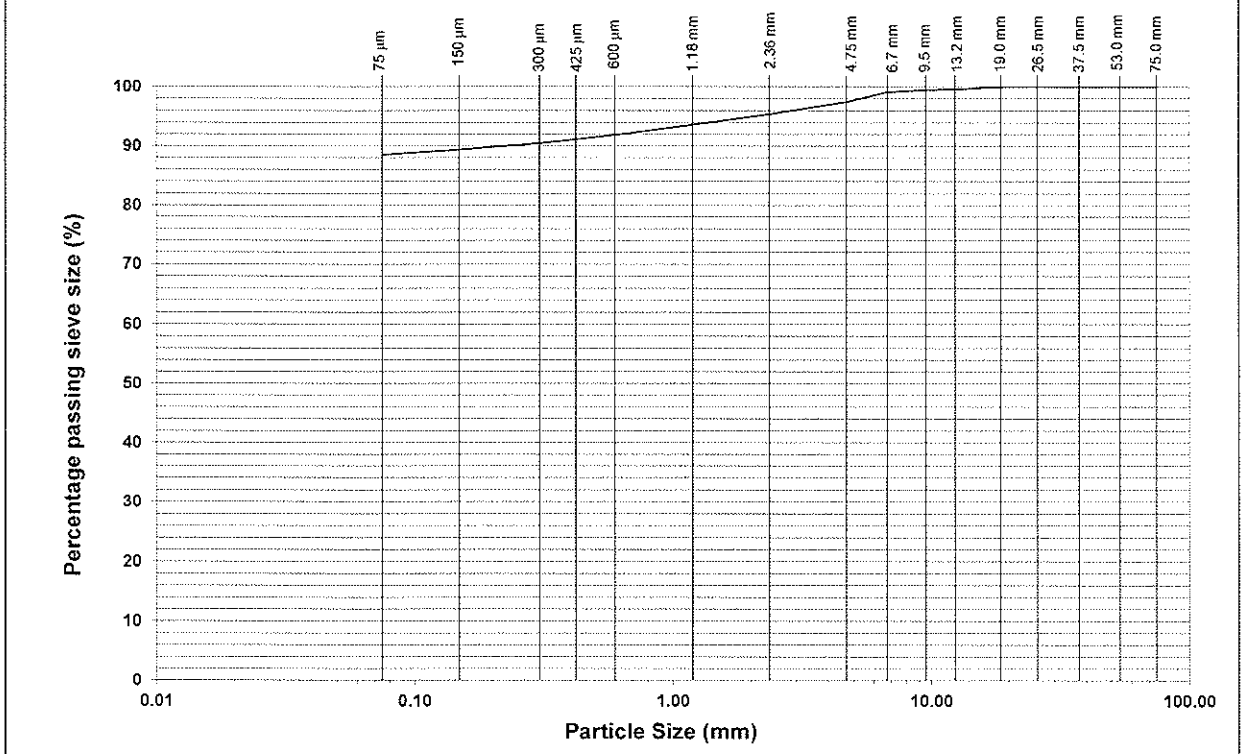
Project: ..... Woodlawn Bioreactor

Location: ..... via TARAGO NSW

Sample Identification: **TS038/S22** Client ID: ED3SS Floor 5, 300 mm

Test Procedure: AS 1289 3.6.1 Sampled by Client Submitted 23.02.16

AS Sieve size	150 mm	75 mm	53 mm	37.5 mm	26.5 mm	19.0 mm	13.2 mm	9.5 mm	6.7 mm	4.75 mm	2.36 mm	1.18 mm	600 um	425 um	300 um	150 um	75 um	13.2 um	0.02 um						
Percent Passing	-	-	-	-	-	-	100	99	99	98	95	94	92	91	90	89	89	-	-						



Atterberg Limits (Test procedure)	Liquid Limit -	- %	Plastic Limit -	- %	Plasticity Index -	- %
	Linear Shrinkage -	- %	-			

Remarks:

NATA ACCREDITED LABORATORY Number 1742.
Accredited for compliance with ISO/IEC 17025.

Authorised Signatory
G.W.Collins

Date of Issue: 29/02/2016

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Aggregate/Soil Test Report

Report No: SYD1601159
Issue No: 1
This report replaces all previous issues of report no 'SYD1601159'.

Client:
Testcrete Laboratories Pty Ltd
Material Evaluation
Dickson ACT

Project: 2123564

Accredited for compliance with ISO / IEC 17025

NATA Accredited Laboratory Number: 679

Approved Signatory: G J Vukovic (Senior Laboratory Technician)

Date of Issue: 22/07/2016

Sample Details

GHD Sample No	SYD16-0243-01
Date Sampled	07/07/2016
Sampled By	Supplied by Client
Location	TS038
BH / TP No.	S23
Soil Description	Sandy CLAY; brown with gravel

Test Results

Description	Method	Result	Limits
Coef of Permeability (m/sec)	AS 1289.6.7.3	2 E-10	
Mean Stress Level (kPa)		30	
Permeant Used		Syd Tap Water	
Length (mm)		62.9	
Diameter (mm)		50.8	
Length/Diameter Ratio		1.24	
Laboratory Moisture Ratio (%)		99.5	
Laboratory Density Ratio (%)		99.0	
CompactiveEffort		Standard	
Method of Compaction		Remoulded	
Surcharge Applied (Kg)		0.0	
Pressure Applied (Kpa)		10	
Oversize Sieve (mm)		6.3	
Percentage Oversize (%)		1.1	
Moisture Content (%)		23.3	
Date Tested		15/07/2016	

Comments

N/A

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Aggregate/Soil Test Report

Report No: SYD1601160
Issue No: 1
This report replaces all previous issues of report no 'SYD1601160'.

Client:
Testcrete Laboratories Pty Ltd
Material Evaluation
Dickson ACT

Project: 2123564

Accredited for compliance with ISO / IEC 17025

NATA Accredited Laboratory Number: 679

Approved Signatory: G J Vukovic (Senior Laboratory Technician)

Date of Issue: 22/07/2016

Sample Details

GHD Sample No	SYD16-0243-02
Date Sampled	07/07/2016
Sampled By	Supplied by Client
Location	TS038
BH / TP No.	S24
Soil Description	CLAY; red/grey brown

Test Results

Description	Method	Result	Limits
Coef of Permeability (m/sec)	AS 1289.6.7.3	1 E-11	
Mean Stress Level (kPa)		30	
Permeant Used		Syd Tap Water	
Length (mm)		60.4	
Diameter (mm)		50.2	
Length/Diameter Ratio		1.20	
Laboratory Moisture Ratio (%)		99.0	
Laboratory Density Ratio (%)		99.5	
CompactiveEffort		Standard	
Method of Compaction		Remoulded	
Surcharge Applied (Kg)		0.0	
Pressure Applied (Kpa)		10	
Oversize Sieve (mm)		6.3	
Percentage Oversize (%)		1.0	
Moisture Content (%)		29.6	
Date Tested		15/07/2016	

Comments

N/A

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Aggregate/Soil Test Report

Report No: SYD1601161
Issue No: 1
This report replaces all previous issues of report no 'SYD1601161'.

Client:
Testcrete Laboratories Pty Ltd
Material Evaluation
Dickson ACT

Project: 2123564

Accredited for compliance with ISO / IEC 17025

NATA Accredited Laboratory Number: 679

Approved Signatory: G J Vukovic (Senior Laboratory Technician)

Date of Issue: 22/07/2016

Sample Details

GHD Sample No	SYD16-0243-03
Date Sampled	07/07/2016
Sampled By	Supplied by Client
Location	TS038
BH / TP No.	S25
Soil Description	CLAY with sand; brown

Test Results

Description	Method	Result	Limits
Coef of Permeability (m/sec)	AS 1289.6.7.3	5 E-11	
Mean Stress Level (kPa)		30	
Permeant Used		Syd Tap Water	
Length (mm)		60.7	
Diameter (mm)		49.9	
Length/Diameter Ratio		1.22	
Laboratory Moisture Ratio (%)		102.0	
Laboratory Density Ratio (%)		99.0	
CompactiveEffort		Standard	
Method of Compaction		Remoulded	
Surcharge Applied (Kg)		0.0	
Pressure Applied (Kpa)		10	
Oversize Sieve (mm)		6.3	
Percentage Oversize (%)		1.0	
Moisture Content (%)		24.6	
Date Tested		15/07/2016	

Comments

N/A

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Aggregate/Soil Test Report

Report No: SYD1601162
Issue No: 1
This report replaces all previous issues of report no 'SYD1601162'.

Client:
Testcrete Laboratories Pty Ltd
Material Evaluation
Dickson ACT

Project: 2123564

Accredited for compliance with ISO / IEC 17025

NATA Accredited Laboratory Number: 679

Approved Signatory: G J Vukovic (Senior Laboratory Technician)

Date of Issue: 22/07/2016

Sample Details

GHD Sample No	SYD16-0243-04
Date Sampled	07/07/2016
Sampled By	Supplied by Client
Location	TS038
BH / TP No.	S26
Soil Description	CLAY with sand; brown

Test Results

Description	Method	Result	Limits
Coef of Permeability (m/sec)	AS 1289.6.7.3	2 E-11	
Mean Stress Level (kPa)		30	
Permeant Used		Syd Tap Water	
Length (mm)		60.5	
Diameter (mm)		50.2	
Length/Diameter Ratio		1.21	
Laboratory Moisture Ratio (%)		100.5	
Laboratory Density Ratio (%)		99.5	
CompactiveEffort		Standard	
Method of Compaction		Remoulded	
Surcharge Applied (Kg)		0.0	
Pressure Applied (Kpa)		10	
Oversize Sieve (mm)		6.3	
Percentage Oversize (%)		1.6	
Moisture Content (%)		22.6	
Date Tested		15/07/2016	

Comments

N/A

Appendix C1
Pre-Construction Plates (ED3SS during 2007)

Plate 1 (2 February 2007). Viewing south over evaporation dam (ED3 south) prior to construction of the clay liner (2016). Floor of liner showing the silty clay overlying the siltstone bedrock.

Plate 2 (27 July 2007). Viewing south over evaporation dam (ED3 south, full of water) prior to construction of the clay liner (2016).

Appendix C2
Initial Survey of ED3ss (pre construction, August 2015)

VOLUME	ML
789.37	6.85
789.47	7.78
789.57	8.80
789.67	9.91
789.77	11.14
789.87	12.45
789.97	13.84
790.07	15.32
790.17	16.89
790.27	18.57
790.37	20.38
790.80	29.20 (0.50m FREEBOARD)
791.20	38.50 (FULL)

SURFACE AREA AT FULL CAPACITY: 2·833ha
SURFACE AREA AT BASE OF WALL: 2·303ha

ISSUE	AMENDMENT	DATE
A	INITIAL ISSUE	24/08/2015

SCALE 1:800

0 10 20 30 40 50

Metres

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VEOLIA ENVIRONMENTAL SERVICES

PLAN SHOWING STORAGE INFORMATION
EVAPORATION DAM 5 - SOUTH
(SOUTHERN PARTITION)
WOODLAWN BIOREACTOR

DATUM: AHD | CONTOUR INTERVAL: 0.5m

DATE: 24/08/2015
SURVEYED: KAR | SIZE: A3
DRAWN: MK
CHECKED: JK
DRAWING No.
16800-437

Appendix C3
Early Construction Plates of ED3SS (November 2015)

Plate 1 (19 November 2015). View over the construction works and liner preparation at evaporation dam (ED3SS). The brown weathered bedrock (Silurian siltstone/tuff) is levelled and re-worked to provide a clay seal foundation over the floor of the dam. Evidence of the impervious fine grained material is shown by the ponded water (centre of frame).

Plate 2 (19 November 2015). View over floor liner preparation at evaporation dam (ED3SS). The weathered bedrock (Silurian siltstone/tuff) is re-worked to provide an impervious clay barrier/foundation. Stockpiled material is predominantly silty clay with weathered siltstone gravel.

Appendix D1
Veolia Dam Lining Specifications (December 2015) & Design Plans for ED3SS (2015).

MGA

COLLECTOR ROAD

EVAPORATION DAM 2

EVAPORATION DAM 1

EVAPORATION DAM 3 NORTH

EVAPORATION DAM 3 SOUTH

RAW WATER DAM

VOID

PLANT AREA

PLANT COLLECTION DAM

HICKORY'S PADDOCK

SITE LOCATION

LAKE GEORGE CATCHMENT

WASTE ROCK DAM

REHABILITATED WASTE DUMP

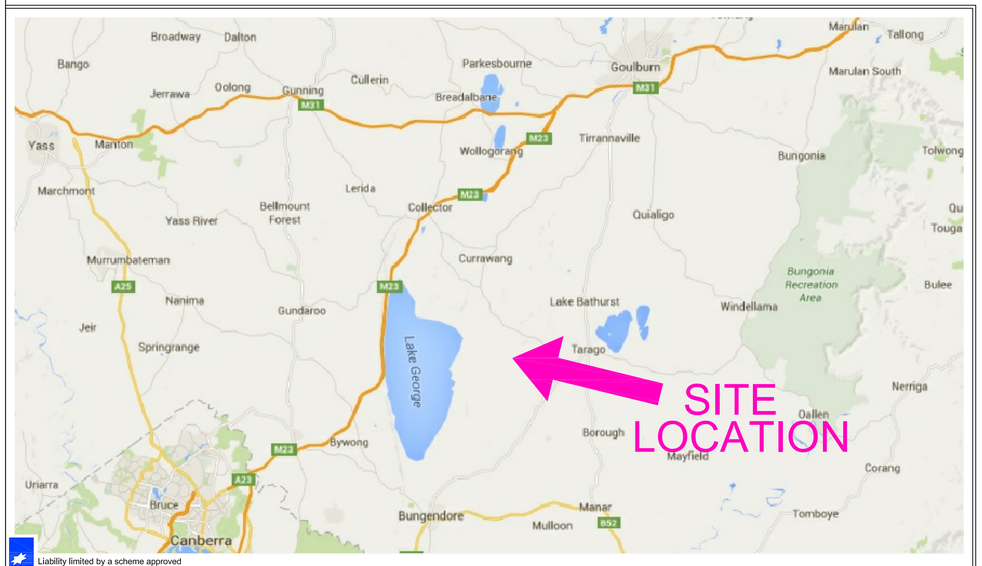
WOLLONDILLY CATCHMENT

NORTH TAILINGS DAM

WEST TAILINGS DAM

SOUTH TAILINGS DAM

LAKE GEORGE CATCHMENT



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DRAWING	TITLE
16800-440	SITE LOCATION AND DRAWING SCHEDULE
16800-441	EXISTING SITE SURVEY
16800-442	PROPOSED ED3S - SOUTHERN PARTITION UPGRADE PLAN
16800-443	TYPICAL SECTION DETAILS
16800-445	DAM DELINEATION PLAN

File Name: J:\Surveyors\Jobs\Veolia\16800 Engineering\CAD\16800-440 ED3S-South Design Plans Issue E.dwg

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SCALE 1:10,000

0 200 400 600 800 1000

Metres

ISSUE	AMENDMENT	DRAWN	DATE
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C	CLAY PERMEABILITY SPECIFICATIONS MODIFIED	MK	14/12/2015
D	GENERAL REDESIGN TO SITE CONDITIONS	MK	11/02/2016
E	CLAY LINER EXTENDED & COVER MATERIAL ADDED	MK	26/02/2016

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A1 SHEET

VEOLIA ENVIRONMENTAL SERVICES

WOODLAWN BIOREACTOR
COLLECTOR ROAD, TARAGO

EVAPORATION DAM 3 SOUTH - SOUTHERN PARTITION RECONSTRUCTION PROJECT

SITE LOCATION AND DRAWING SCHEDULE

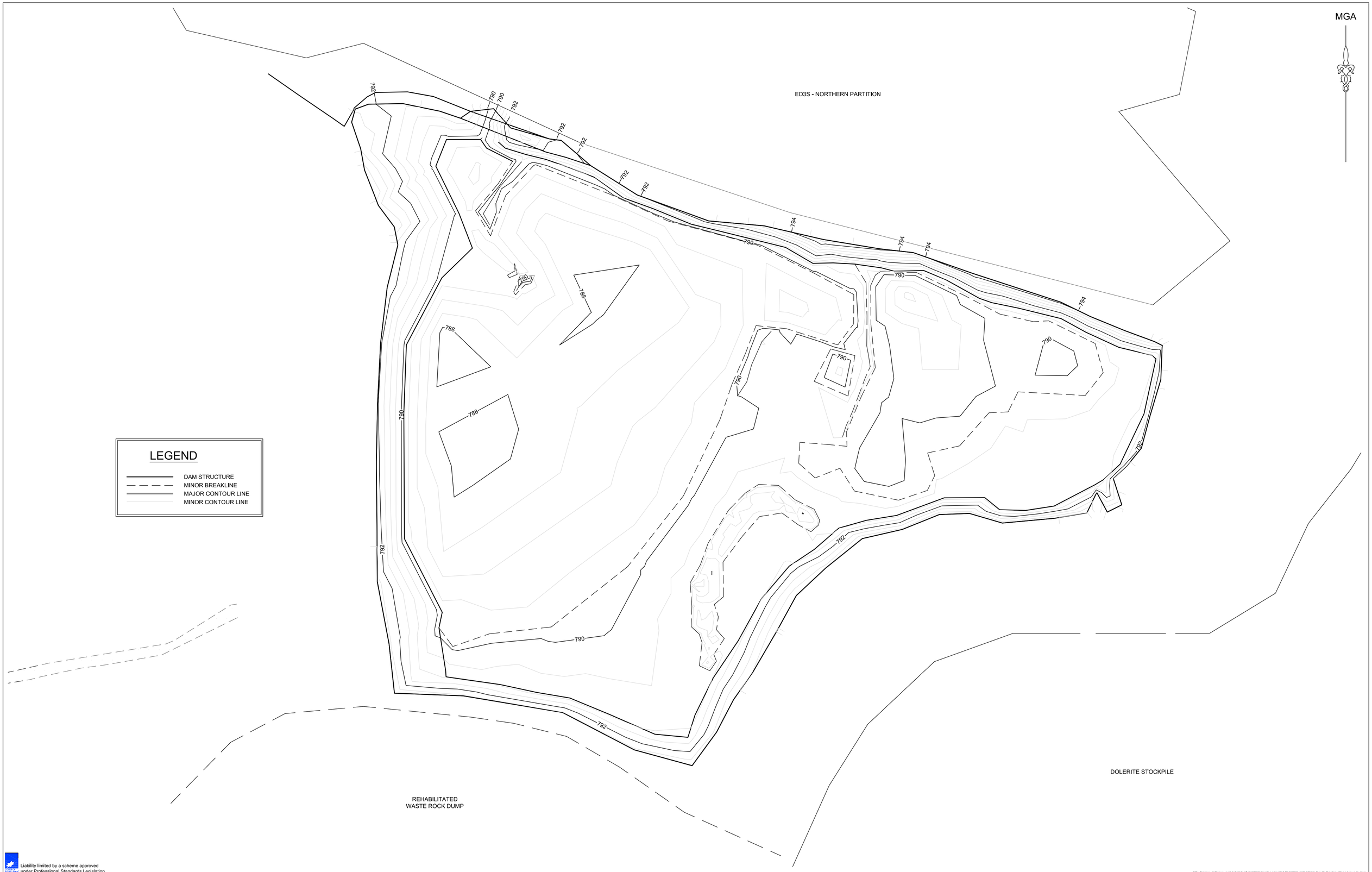
DESIGNED: MK/SB	ISSUE
DRAWN: MK	E
CHECKED: JK	

DRAWING No. 16800-440

DATUM	AHD	CONTOUR INTERVAL	10m	DATE	26/02/2016

MGA

ED3S - NORTHERN PARTITION



LEGEND

- DAM STRUCTURE
- MINOR BREAKLINE
- MAJOR CONTOUR LINE
- MINOR CONTOUR LINE

REHABILITATED
WASTE ROCK DUMP

DOLERITE STOCKPILE

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File Name: J:\Surveyors\Jobs\Veolia\16800 Engineering\CAD\16800-440 ED3S-South Design Plans Issue E.dwg

VEOLIA ENVIRONMENTAL SERVICES

SCALE 1:500

0 10 20 30 40 50

Metres

ISSUE	AMENDMENT	DRAWN	DATE
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C	CLAY PERMEABILITY SPECIFICATIONS MODIFIED	MK	14/12/2015
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VEOLIA ENVIRONMENTAL SERVICES

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EVAPORATION DAM 3 SOUTH - SOUTHERN PARTITION RECONSTRUCTION PROJECT

EXISTING SITE SURVEY

DESIGNED: MK/SB
DRAWN: MK
CHECKED: JK
ISSUE E

DRAWING No. 16800-441

DATUM	AHD	CONTOUR INTERVAL	0·5m	DATE	26/02/2016

MGA

ED3S - NORTHERN PARTITION

REFER DRAWING 16800-443 (B)

REFER DRAWING 16800-443 (A)

CELAN OUT AND LOCALLY SHAPE BASE OF DAM AS REQUIRED. RETAIN MINIMUM 1% FALL TOWARDS WESTERN LOW POINT

DAM WALLS APPROX 1:3

NOTE: CONTOURS SHOWN HEREON REPRESENT DESIGN SUBGRADE LEVELS.

PROPOSED COMPACTED CLAY LINER COVERING THE BASE AND WALLS OF THE DAM TO BE CONSTRUCTED OVER SUBGRADE. CLAY LINER THICKNESS TO BE 300mm WHERE THE MATERIAL TO BE USED HAS A PERMEABILITY OF 1 x 10^{-10} m/s OR AS OTHERWISE RECOMMENDED FOLLOWING GEOTECHNICAL TESTING AND INVESTIGATION, PLACED IN MAXIMUM 150mm HIGH LIFTS.

CLAY LINER ON DAM WALLS TO BE SEALED WITH A LAYER OF COMPACTED CRUSHED ROCK/AGGREGATE (PARTICLE SIZE GENERALLY 10mm - 100mm) COVERING MINIMUM 95% OF DAM WALL SURFACE AREA.

REFER DRAWING 16800-443 FOR DETAILS.

LEVEL OUT, OR BUILD UP AND LEVEL, EXISTING DAM WALL MAXIMUM RL 794.00

REFER DRAWING 16800-443 (A)

REFER DRAWING 16800-443 (B)

REHABILITATED WASTE ROCK DUMP

DOLERITE STOCKPILE

LEGEND

- DESIGN DAM STRUCTURE
- MINOR BREAKLINE
- DESIGN MAJOR CONTOUR LINE
- DESIGN MINOR CONTOUR LINE

VEOLIA ENVIRONMENTAL SERVICES

SCALE 1:500

0 10 20 30 40 50

Metres

ISSUE	AMENDMENT	DRAWN	DATE
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E	CLAY LINER EXTENDED & COVER MATERIAL ADDED	MK	26/02/2016

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A1 SHEET

VEOLIA ENVIRONMENTAL SERVICES

WOODLAWN BIOREACTOR
COLLECTOR ROAD, TARAGO

EVAPORATION DAM 3 SOUTH - SOUTHERN PARTITION RECONSTRUCTION PROJECT

PROPOSED ED3S - SOUTHERN PARTITION UPGRADE PLAN

DESIGNED: MK/SB
DRAWN: MK
CHECKED: JK
ISSUE E

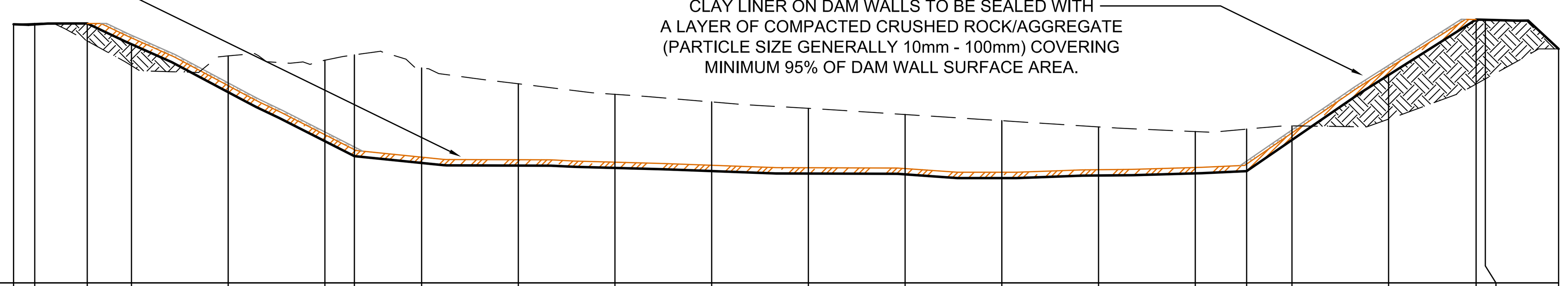
DRAWING No. 16800-442

DATUM AHD | CONTOUR INTERVAL 0·5m | DATE 26/02/2016

File Name: J:\Surveyors\Jobs\Veolia\16800 Engineering\CAD\16800-440 ED3S-South Design Plans Issue E.dwg

PROPOSED COMPACTED CLAY LINER COVERING THE BASE AND WALLS OF THE DAM TO BE CONSTRUCTED OVER SUBGRADE.
CLAY LINER THICKNESS TO BE 300mm WHERE THE MATERIAL TO BE USED HAS A PERMEABILITY OF 1 x 10^{-10} m/s
OR AS OTHERWISE RECOMMENDED FOLLOWING GEOTECHNICAL TESTING AND INVESTIGATION, PLACED IN MAXIMUM 150mm HIGH LIFTS.

CLAY LINER ON DAM WALLS TO BE SEALED WITH A LAYER OF COMPACTED CRUSHED ROCK/AGGREGATE (PARTICLE SIZE GENERALLY 10mm - 100mm) COVERING MINIMUM 95% OF DAM WALL SURFACE AREA.



DATUM LEVEL 780

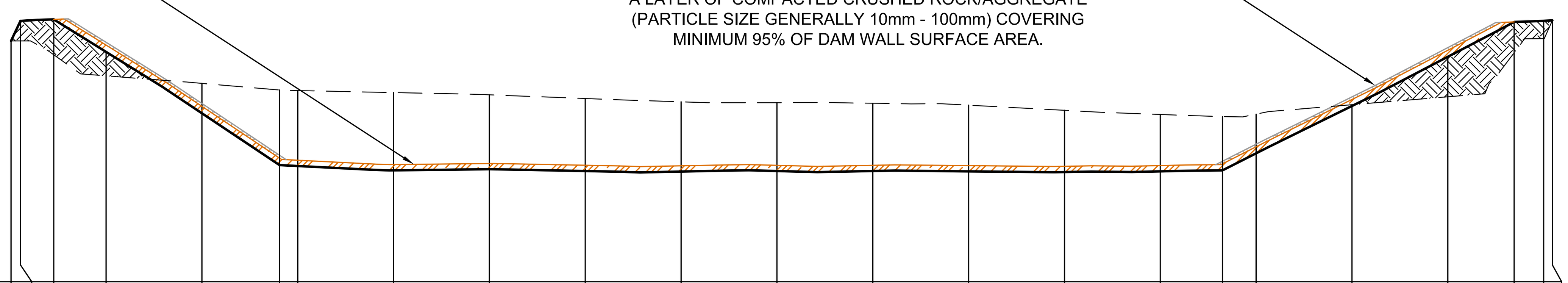
DESIGN SUBGRADE	EXISTING SURFACE	CHAINAGE
		0.00
		10.00
		20.00
		30.00
		40.00
		50.00
		60.00
793.35	793.35	67.81
793.34	793.39	70.00
793.39	792.48	75.42
792.32	791.21	80.00
789.84	791.71	90.00
787.31	791.49	100.00
786.54	791.76	103.05
786.19	791.09	110.00
786.05	790.27	120.00
785.93	789.73	130.00
785.77	789.34	140.00
785.64	789.01	150.00
785.60	788.69	160.00
785.41	788.37	170.00
785.54	788.05	180.00
785.65	787.81	190.00
785.77	787.93	195.31
787.37	788.10	200.00
790.73	788.45	210.00
793.59	790.26	219.04
793.57	790.52	220.00
792.07	792.07	227.58

SECTION A

HORIZONTAL SCALE 1:500
VERTICAL SCALE 1:250

PROPOSED COMPACTED CLAY LINER COVERING THE BASE AND WALLS OF THE DAM TO BE CONSTRUCTED OVER SUBGRADE.
CLAY LINER THICKNESS TO BE 300mm WHERE THE MATERIAL TO BE USED HAS A PERMEABILITY OF 1 x 10^{-10} m/s
OR AS OTHERWISE RECOMMENDED FOLLOWING GEOTECHNICAL TESTING AND INVESTIGATION, PLACED IN MAXIMUM 150mm HIGH LIFTS.

CLAY LINER ON DAM WALLS TO BE SEALED WITH A LAYER OF COMPACTED CRUSHED ROCK/AGGREGATE (PARTICLE SIZE GENERALLY 10mm - 100mm) COVERING MINIMUM 95% OF DAM WALL SURFACE AREA.



DATUM LEVEL 780

DESIGN SUBGRADE	EXISTING SURFACE	CHAINAGE
		0.00
		10.00
792.56	792.56	20.08
793.61	792.56	21.07
793.68	791.83	24.54
791.98	790.73	30.00
788.79	790.34	40.00
786.08	790.00	48.10
786.03	789.97	50.00
785.81	789.86	60.00
785.87	789.74	70.00
785.77	789.55	80.00
785.74	789.38	90.00
785.77	789.34	100.00
785.77	789.30	110.00
785.75	789.20	120.00
785.72	788.94	130.00
785.75	788.72	140.00
785.81	788.61	146.48
786.70	788.74	150.00
789.16	789.23	160.00
791.73	789.64	170.00
793.55	791.94	176.92
793.61	792.68	180.00
793.63	793.63	180.91

SECTION B

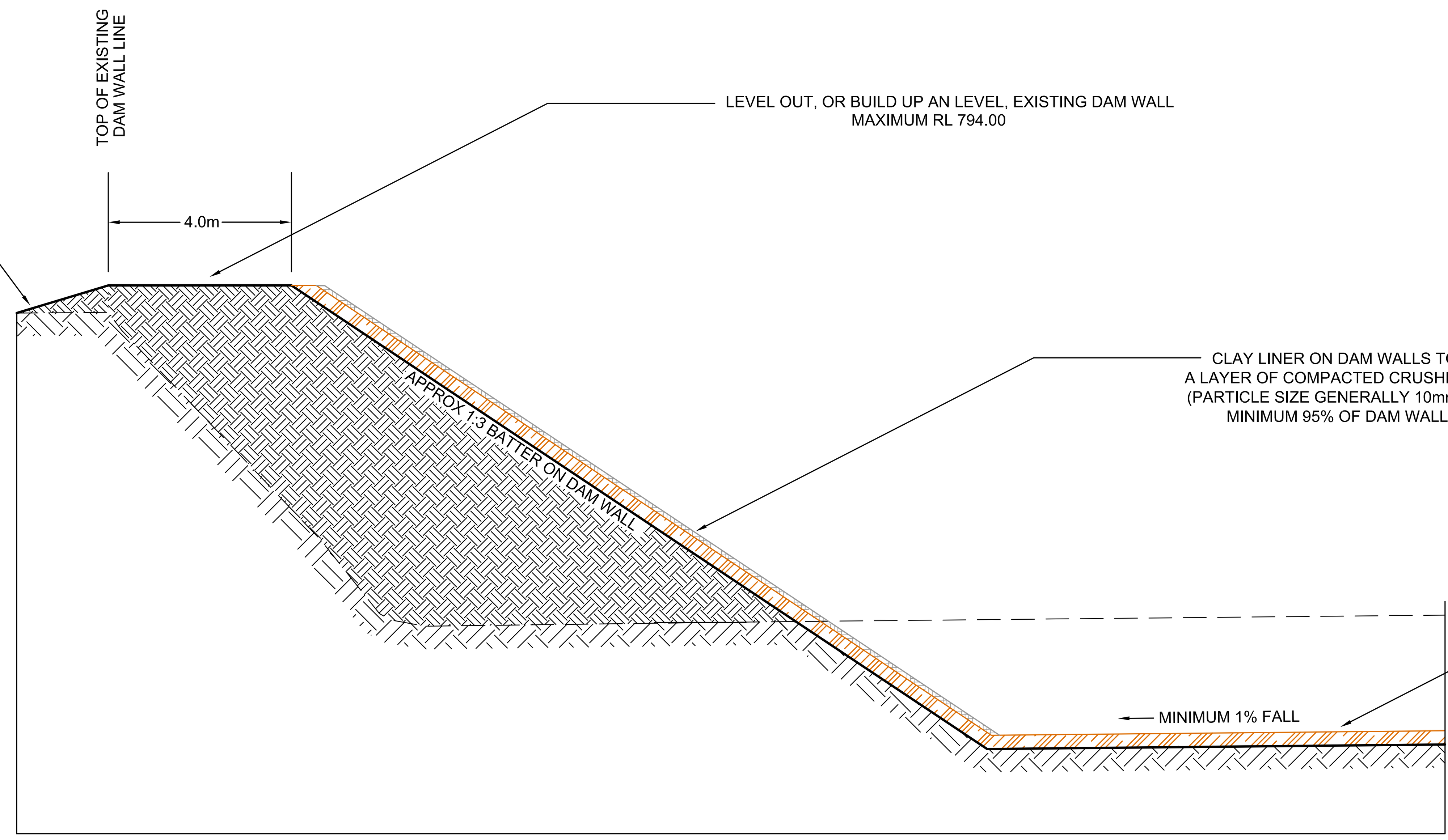
HORIZONTAL SCALE 1:500
VERTICAL SCALE 1:250

LEVEL OUT, OR BUILD UP AN LEVEL, EXISTING DAM WALL MAXIMUM RL 794.00

MATCH TO EXISTING SURFACE

CLAY LINER ON DAM WALLS TO BE SEALED WITH A LAYER OF COMPACTED CRUSHED ROCK/AGGREGATE (PARTICLE SIZE GENERALLY 10mm - 100mm) COVERING MINIMUM 95% OF DAM WALL SURFACE AREA.

PROPOSED COMPACTED CLAY LINER COVERING BASE AND LOWER 2 METRES OF THE WALLS OF THE DAM TO BE CONSTRUCTED OVER SUBGRADE.
CLAY LINER THICKNESS TO BE 300mm WHERE THE MATERIAL TO BE USED HAS A PERMEABILITY OF 1 x 10^{-10} m/s
OR AS OTHERWISE RECOMMENDED FOLLOWING GEOTECHNICAL TESTING AND INVESTIGATION, PLACED IN MAXIMUM 150mm HIGH LIFTS.



TYPICAL SECTION

NOT TO SCALE

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VEOLIA ENVIRONMENTAL SERVICES

SCALE AS SHOWN

ISSUE	AMENDMENT	DRAWN	DATE
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C	CLAY PERMEABILITY SPECIFICATIONS MODIFIED	MK	14/12/2015
D	GENERAL REDESIGN TO SITE CONDITIONS	MK	11/02/2016
E	CLAY LINER EXTENDED & COVER MATERIAL ADDED	MK	26/02/2016

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VEOLIA ENVIRONMENTAL SERVICES

WOODLAWN BIOREACTOR
COLLECTOR ROAD, TARAGO

EVAPORATION DAM 3 SOUTH - SOUTHERN PARTITION RECONSTRUCTION PROJECT

TYPICAL SECTION DETAILS

DESIGNED: MK/SB
DRAWN: MK
CHECKED: JK

ISSUE E

DRAWING No. 16800-443

DATUM	AHD	CONTOUR INTERVAL	N/A	DATE	26/02/2016

MGA

ED3S - NORTHERN PARTITION

LEGEND

- DESIGN DAM STRUCTURE
- MINOR BREAKLINE
- DESIGN MAJOR CONTOUR LINE
- DESIGN MINOR CONTOUR LINE

5
6165m²

2
4962m²

1
5658m²

4
5638m²

3
3888m²

Ch 276.014
Ch 260.000
Ch 240.000
Ch 220.000
Ch 200.000
Ch 180.000
Ch 160.000
Ch 140.000
Ch 120.000
Ch 100.000
Ch 80.000
Ch 60.000
Ch 40.000
Ch 20.000
Ch 0.000

REHABILITATED
WASTE ROCK DUMP

DOLERITE STOCKPILE

File Name: J:\Surveyors\Jobs\Veolia\16800 Engineering\CAD\16800-440 ED3S-South Design Plans Issue E.dwg

VEOLIA ENVIRONMENTAL SERVICES

SCALE 1:500

0 10 20 30 40 50
Metres

ISSUE	AMENDMENT	DRAWN	DATE
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COLLECTOR ROAD, TARAGO

EVAPORATION DAM 3 SOUTH - SOUTHERN PARTITION
RECONSTRUCTION PROJECT

DAM DELINEATION PLAN

DESIGNED: MK/SB
DRAWN: MK
CHECKED: JK
ISSUE E

DRAWING No.
16800-444

DATUM | AHD | CONTOUR INTERVAL | 0.5m | DATE | 26/02/2016

Dam Lining Specification

Woodlawn Bioreactor

December 2015

Contents

1.1 SCOPE 4
1.2 REFERENCE DOCUMENTS 4
1.3 DESIGN 4
1.4 MATERIALS....5
1.4.1 CLAY LINER MATERIAL....5
1.4.2 SUBGRADE FILL....6
1.5 FOUNDATION PREPARATION 7
1.5.1 FOUNDATION PREPARATION 7
1.5.2 UNSUITABLE FOUNDATION MATERIAL 7
1.6 CLAY LINER TEST PAD 9
1.6.1 SCOPE AND PURPOSE 9
1.6.2 TEST PAD REQUIREMENTS 9
1.7 CLAY LINER CONSTRUCTION....9
1.7.1 SCOPE 10
1.7.2 MATERIAL PLACEMENT AND COMPACTION....10
1.7.3 PROTECTION OF CLAY LINER 10
1.7.4 COMPLETION OF CLAY LINER SURFACE....11
1.8 LIMITS AND TOLERANCES 11
1.8.1 LIMITS AND TOLERANCES 11
1.9 QUALITY CONTROL....12
1.9.1 REQUIREMENTS FR QUALITY CONTROL AND TESTING....12
1.9.2 LOTS....12
1.9.3 SAMPLING AND TESTING....12
ANNEXURE 1 14
1.9.4 MAXIMUM LOT SIZES AND MINIMUM TEST FREQUENCIES....16
ANNEXURE 2 15
ANNEXURE 3 16

1.1 SCOPE

1. The work covered under this Specification consists of:
(a) Clay Liner material requirements
(b) Foundation preparation
(c) Clay Liner test pad construction
(d) Clay Liner

1.2 REFERENCE DOCUMENTS

1. Documents referenced in this Specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Australian Standards
AS 1289 - Methods of testing soils for engineering purposes.
AS 1289.3.1.1 - Soil classification tests – Determination of the liquid limit of a soil – Four point Casagrande method.
AS 1289.3.2.1 - Soil classification tests – Determination of the plastic limit of a soil – Standard method.
AS 1289.3.3.1 - Soil classification tests – Calculation of the plasticity index of a soil.
AS 1289.3.6.1 - Soil classification tests – Determination of the particle size distribution of a soil – Standard method of analysis by sieving.
AS 1289.3.6.1 - Soil classification tests – Determination of the particle size distribution of a soil – Standard method of analysis by sieving.
AS 1289.5.1.1 - Determination of the dry density/moisture content relation of a soil using standard compactive effort.
AS 1289.5.4.1 - Soil compaction and density tests – Compaction control test - Dry density ratio, moisture variation and moisture ratio.
AS 1289.5.7.1 - Soil compaction and density tests - Compaction control test – Hilf density ratio and Hilf moisture variation (rapid method).
AS 1289.6.1.1 - Soil strength and consolidation tests - Determination of the California Bearing Ratio of a soil - Standard laboratory method for a remoulded specimen.
AS 1289.6.7.1 - Soil strength and consolidation tests - Determination of the permeability of a soil - Constant head method for a remoulded specimen.
AS 1289.6.7.3 - Soil strength and consolidation tests - Determination of the permeability of a soil - Constant head method using a flexible wall permeameter.
AS 1141 - Methods for sampling and testing aggregates
AS 1141.11 - Particle size distribution by sieving.
AS 1141.12 - Materials finer than 75 µm in aggregates (by washing).
AS 1141.22 - Wet/Dry strength variation.

(b) NSW State Legislation and Guidelines
Protection of the Environment Operations Act, 1997
NSW Environment Protection Authority: Waste Classification Guidelines, 2014
NSW Environment Protection Authority: Solid Waste Landfills Environmental Guidelines, 1996

1.3 DESIGN

1. The design of the clay liner shall meet the minimum requirements specified in the NSW Environment Protection Authority Solid Waste Landfills: Environmental Guidelines, 1996, which are:
(i) A minimum thickness of 900mm of recompacted clay
(ii) A minimum insitu coefficient of permeability of 1 x10^{-9}m/s
(iii) Consist of compatible material for each layer

(iv) Sides to have a slope not exceeding a gradient of one vertical to three horizontal

2. Design drawings for the dam lining works have been completed and are referenced in this specification

1.4 MATERIALS

1.4.1 CLAY LINER MATERIAL

1. Clay Liner material shall consist of a well-graded, naturally occurring clay soil which at the time of incorporation into the works is capable of being compacted in accordance with the specified requirements in clause 1.7.2 to form a stable liner material with an in-situ permeability of $1x10^{-9}$ m/s or less. The material shall have a plasticity index (PI) between 10 and 40.

2. Clay Liner material shall not contain any of the following:
(i) Marine-origin soils
(ii) Reactive clays and collapsible soils;
(iii) Peat, vegetation, timber, organic, soluble or perishable material;
(iv) Dangerous or toxic material or material susceptible to combustion;
(v) Metal, rubber, plastic or synthetic material
(vi) Construction debris

3. Clay Liner material shall comply with the following general grading requirement:

Table 1: Clay Liner Material Grading Requirements

Test Method	Property	Requirement
	Material passing AS sieve	Percent by Mass
AS 1289.3.6.2	75mm	100%
AS 1289.3.6.2	0.075mm	30% Minimum

For any source of Clay Liner material used in the works not supplied by the Principal, the Contractor shall submit a geological source description and test results for the proposed Clay Liner material prior to delivery of material to site. This action constitutes a **HOLD POINT (1)**. The Superintendent's acceptance of the source is required prior to the release of the hold point. Material placement shall not occur prior to release of this Hold Point. Test results and required values for the submittal are given in Table 2 and are in addition to the grading requirement set out in Table 1. The submittal and Hold Point mentioned in this clause are not required if stockpiled material supplied by the Principal is used as the source:

HOLD POINT 1 – Approval of clay liner source material

	Contractor Approval	Veolia Approval	CQA Approval
Name			
Signature			
Date			

Required documentation:

1. Particle Size Distribution Analysis Laboratory Report

5. Clay Liner material supplied by the Principal shall be tested to document its properties at the frequency given in Section 1.9 Test results should be submitted to the Superintendent within 1 week of sampling.

6. Clay Liner supplied by the Contractor shall be tested to confirm that it meets the above material property requirements at the test frequencies given in Section 1.9. Test results should be submitted to the Superintendent within 1 week of sampling.

7. The Contractor shall provide appropriate soil testing certification to the Superintendent for all Clay Liner material supplied by the Contractor in accordance with the NSW Environment Protection Authority: Waste Classification Guidelines. This action constitutes a **HOLD POINT (2)**. The Superintendent's acceptance of the certification is required prior to the release of the hold point and prior to importing material to site.

HOLD POINT 2 – Certification of VENM or ENM for source materials

	Contractor Approval	Veolia Approval	CQA Approval
Name			
Signature			
Date			

Required documentation:

1. VENM / ENM certification of clay used for lining

Table 2: Clay Liner Material Requirements

Test Method	Property	Requirement
AS 1289.3.2.1, 3.3.1	Atterberg Limits	Plasticity Index (PI) between 10 and 40
AS 1289.3.4.1	Linear Shrinkage	<5%
AS 1289.5.4.1	Compaction (standard)	Max dry density>1.6 t/m3
AS 1289.6.7.1	Permeability Test (Constant Head, 100% compaction)	K < $1x10^{-8}$ m/s, in-situ Requirement [note: measured values are generally higher in field test than in lab tests].
N/A	Source Description	Geographic and Geological Source

1.4.2 SUBGRADE FILL

1. Material for any general subgrade filling requirements shall be obtained from general excavation/cutting works and from stockpiles nominated on site within the Works. The material shall conform to the requirements of General Fill (Annexure 1).

1.5 FOUNDATION PREPARATION

1.5.1 FOUNDATION PREPARATION

1. The foundation for the clay liner shall generally consist of a firm surface, comprised of insitu rock or soils. Any foundation surfaces with loosened materials are unacceptable for Clay Liner placement. In addition, in any areas where the foundation surface is irregular, with local relief greater than 50mm, the surface shall be made firm and smooth prior to Clay Liner construction by placement and compaction of General Fill material (Annexure 1).

2. The foundation material is to be comprised of material that has been excavated from the dam, dependent on the test results of this material.

1.5.2 UNSUITABLE FOUNDATION MATERIAL

1. Unsuitable material is that occurring below the designed bottom of the Clay Liner, which the Superintendent deems to be unsuitable for Clay Liner support in its present position and condition. Unsuitable material shall be excavated to the extent directed by the Superintendent.

2. After removal of the unsuitable material, the floor of the excavation shall be re-presented to the Superintendent for inspection, prior to backfilling with replacement material, to determine whether a sufficient depth of unsuitable material has been removed. This action constitutes a **HOLD POINT (3)**. The Superintendent's approval to the floor of the excavation is required prior to the release of the hold point.

HOLD POINT 3 – Floor Inspection of excavations after removal of unsuitable materials

	Contractor Approval	Veolia Approval	CQA Approval
Name			
Signature			
Date			

Requirements:

1. Visual inspection of dam floor is free of unsuitable material

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3. Prior to placing replacement material the excavated floor shall be compacted to the satisfaction of the Superintendent.

4. The unsuitable material which has been removed shall be replaced with material meeting the material and compaction requirements of General Fill (Annexure 1).

5. All costs associated with reworking or replacing any material which the Superintendent deems to have become unsuitable because of inappropriate construction activities shall be borne by the Contractor.

1.6 Sump Construction

1. A sump shall be constructed within the subgrade material at low points of the dam floor in accordance with the Drawings. The sump shall be constructed as follows:

- Excavation of 2m x 2m x 2m proportion of subgrade material
- Base of sump to slope at a minimum 3% fall
- Backfilling with aggregate material between 20mm – 100mm
- Aggregate material to achieve a permeability not less than 1 x 10^{-3} m/s
- Insertion of PE 100 200mm diameter HDPE SDR 9 pipe
- The pipe shall be slotted with minimum 10mm holes at 10cm spacings
- Pipe shall be trenched to surface along wall, beneath the clay liner layer

2. A suitable submersible pump and pipework shall be inserted within the 200mm HDPE pipe for the purpose of returning any leachate back into the dam. The pump shall be set no higher than 300mm from the base of the pipe.

HOLD POINT 4 – Verification of sump construction and aggregate permeability

	Contractor Approval	Veolia Approval	CQA Approval
Name			
Signature			
Date			

Requirements:

1. Visual inspection of sump construction
2. Laboratory test report for aggregate permeability

1.7 Hydrogeological Assessment of Existing Material

1. A hydrogeological assessment by a hydrogeological expert (which could also be the Construction Quality Assurance expert, if suitable) can be undertaken to determine:
   - the extent of the material (thickness)
   - the permeability of the material to leachate
   - the integrity of the material, and the presence of any imperfections that may compromise its effectiveness (e.g. root holes, cracks, or gravel layers)
   - any possible reactions between the material and the leachate.

2. The report will assess whether the existing material (which may have been excavated, moved and recompacted in the past) provides a suitable barrier which meets the requirements of the design drawings and will be supported by sufficient laboratory test results. The number of laboratory tests, boreholes and/or other investigations required will be determined by the independent hydrogeological expert. At minimum sampling and testing requirements shall confirm the requirements detailed in annexure 3.

3. If the hydrogeological assessment proves the existing material meets the requirements of the design, then this report will be used as part of the Construction Quality Assurance report and no further works will be required. The clay liner surface will still require inspection and sign off by the Construction Quality Assurance expert.

4. If the hydrogeological assessment proves the existing material does not meet the requirements of the design, then the recommendations from the hydrogeological report must be followed. If the material is completely unsuitable then section 1.7 clay liner test pad and section 1.8 clay liner construction will be followed.

1.8 CLAY LINER TEST PAD

1.8.1 SCOPE AND PURPOSE

1. A test pad shall be constructed prior to Clay Liner placement using each proposed Clay Liner material. The test pad shall have minimum overall dimensions of 20x10x0.9m thick to allow the use of full-scale compaction equipment, lift thicknesses, and procedures. The test pad shall include moisture, density, and permeability testing of completed lifts. The purpose is to assess compaction and moisture control procedures that produce a firm liner with an in-situ permeability that meets the project requirements (1×10^{-9} m/s), and to assess the range of corresponding moisture content and dry densities. If accepted by the Superintendent, the corresponding range of moisture content and dry density would be used as the primary construction quality control requirement for the Clay Liner.

1.8.2 TEST PAD REQUIREMENTS

1. Location of the test pad shall be within the dam area. The Contractor shall nominate and agree a proposed location to the Superintendent.
2. The Contractor shall organise and execute the test pad, including selection of compaction equipment and procedures, and coordination of moisture, density and permeability testing.
3. The Contractor shall prepare a report within one week of completing compaction of the test pad.
4. The report must provide test pad data sufficient to demonstrate that the proposed values will reliably produce a Clay Liner with an in-situ permeability less than 1×10^{-9} m/s. The report shall provide as a minimum the compaction procedures used in the trial (lift thickness, number of passes, equipment used) and the corresponding moisture content, density and in-situ permeability results for each compaction procedure. The report shall then present the Contractors proposed compaction procedure, and their proposed acceptable moisture content and density range for Clay Liner construction to achieve an in-situ permeability less than 1×10^{-9} m/s. The proposed values must be within the ranges given in clause 1.7.2.
5. The Contractor shall submit the test pad report to the Superintendent for review. This action constitutes a **HOLD POINT (5)**. The Superintendent's acceptance of the proposed compaction procedures, moisture and density ranges is required prior to the release of the hold point. Material placement shall not occur prior to release of this Hold Point.

HOLD POINT 5 – Acceptance of test pad report

	Contractor Approval	Veolia Approval	CQA Approval
Name			
Signature			
Date			

Requirements:

1. Submission of test pad report for construction quality assurance certification

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1.9 CLAY LINER CONSTRUCTION

1.9.1 SCOPE

1. Clay Liner construction includes material placement and compaction, and all other activities required to produce Clay Liner as specified to the alignment, grading and dimensions shown on the Drawings. It also includes any pre-treatment such as breaking down or blending material or drying out material containing excess moisture.

1.9.2 MATERIAL PLACEMENT AND COMPACTION

1. As indicated on the Drawings, Clay Liner material shall be used to construct a liner layer over the base and walls of the dam. The liner shall have a minimum compacted thickness of 900mm and a maximum in-situ permeability of $1x10^{-9}$ m/sec.
2. Compaction procedures, lift thicknesses, and acceptable ranges for moisture content and density will be proposed by the Contractor after liner test pad construction (refer clause 1.6.2). If accepted by the Superintendent, the proposed values will be used for Clay Liner construction. Proposed values outside the following ranges will not be accepted:
• Compactor static load - 15 tonnes minimum to achieve compaction through full lift thickness.
• Compactor roller - pad foot or sheep foot to achieve good bonding between lifts (smooth drum not acceptable).
• Lift thickness - 150 mm loose (max).
• Moisture content - within -2 to +4 percentage points of optimum moisture (relative to standard compaction).
• density - 98% compaction (min), and higher if practicable (relative to standard compaction).

3. Construction quality testing of the compacted Clay Liner will comprise frequent moisture content and density testing, as well as infrequent permeability testing (refer to clause 1.09). Results should be submitted to the Superintendent within 1 week of testing. It will be the responsibility of the Contractor to rework or replace Clay Liner materials not meeting the $1x10^{-9}$ m/sec permeability requirement, even in the case that all moisture content and density tests have passing results. It will also be the responsibility of the Contractor to rework or replace Clay Liner materials not placed in accordance with the proposed construction procedures, moisture and density ranges approved by the Superintendent under Clause 1.6.2.

1.9.3 PROTECTION OF CLAY LINER

1. The Contractor's responsibility for care of the Works shall include the protection of the Clay Liner.
2. Adequate drainage of all working areas shall be maintained throughout the period of construction to ensure run-off of water is managed without ponding, except where ponding forms part of an approved erosion and sedimentation control system.

3. When rain is likely or when work is not proposed to continue in a working area on the following day, precautions shall be taken to minimise ingress of any excess water into Clay Liner material. Ripped material remaining in cuttings and material placed on embankments or other filled areas shall be sealed off by adequate compaction to provide a smooth tight surface. The Contractor shall install effective measures to prevent surface water runoff and silt and sediment entering open excavations/trenches.

4. Should in-situ or stockpiled material become over wet as a result of the Contractor not providing adequate protection of earthworks, the Contractor shall be responsible for replacing and/or drying out the material and for any consequent delays to the operations.

5. Each lift of the Clay Liner shall be protected from desiccation cracking. The Contractor shall apply moisture and any other means of protection required to unprotected compacted Clay Liner surfaces as required to prevent desiccation cracking. Should cracks become apparent, the Contractor will be responsible for reworking the affected areas to the full crack depth.

1.9.4 COMPLETION OF CLAY LINER SURFACE

1. Refer to Annexure 2 for completion of earthworks surfaces.

2. Areas where Clay Liner is placed shall be made available for inspection by the Superintendent. Unless otherwise permitted by the Superintendent proof rolling shall be carried out on all completed Clay Liner surfaces in accordance with Annexure 2. This action constitutes a **HOLD POINT (6)**.

HOLD POINT 6 – Proof Rolling of completed Clay Liner

	Contractor Approval	Veolia Approval	CQA Approval
Name			
Signature			
Date			

Requirements:

1. Visual inspection of proof rolling of clay liner

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3. The liner surface shall be inspected for dessication cracking. This action constitutes a **HOLD POINT (7)**.

HOLD POINT 7 – Inspection of Clay Liner for Dessication Cracking

	Contractor Approval	Veolia Approval	CQA Approval
Name			
Signature			
Date			

Requirements:

1. Visual inspection for dessication cracking of clay liner

1.10 LIMITS AND TOLERANCES

1.10.1 LIMITS AND TOLERANCES

1. Levels of top of Clay Liner at any particular location may vary up to +50 mm from those shown on the Drawings provided that the following conditions are met:
- Overall grades of top of Clay Liner are consistent with the Drawings; and
- Clay Liner is min 900 mm thick at all survey points.

1.11 QUALITY CONTROL

1.11.1 **REQUIREMENTS FOR QUALITY CONTROL AND TESTING**

1. Prior to testing the Contractor shall work the lot to ensure uniform moisture content and compaction of all material within the lot. The test(s) then taken shall be considered to represent the total volume of material placed within the lot.

2. Where the Superintendent considers that the material which is present has not achieved uniformity required by this Clause, the Superintendent may take or direct the Contractor to perform additional testing. The Superintendent shall nominate the area represented by the additional testing. If any additional testing confirms that material not conforming to the Specification is present, the cost of such tests shall be borne by the Contractor.

3. If any moisture content or density tests indicate that material not conforming to the Specification is present, the Contractor shall carry out remedial works as necessary on the affected lots.

4. If any permeability tests indicate that material not conforming to the Specification is present, the Contractor shall perform additional tests on a lot by lot basis to determine the number of lots affected. The contractor shall then carry out remedial works as necessary on the affected lots.

1.11.2 **LOTS**

1. All items of work shall be subdivided into lots. Each lot shall be given a unique lot number.

2. Lots shall be chosen by the Contractor but shall be within the limits given in Annexure 3) In general, the size of the lot shall not exceed one day's output for each work process designated for lot testing.

3. The lot numbers shall be used as identifiers on all surveys and test results.

4. The Contractor shall determine the bounds of each lot before sampling and shall identify each lot clearly. A lot shall be an identifiable and specified quantity of items and/or material (either area or volume, as appropriate) of the same type, from the same source and which in the opinion of the Superintendent has similar properties throughout.

5. The boundaries of a lot may be changed if subsequent events cause the original lot to be no longer essentially homogeneous.

6. The lot identification system and sample numbering system shall allow test results to be positively identified with material incorporated in the works.

1.11.3 **SAMPLING AND TESTING**

1. All compliance inspections and tests shall be based on lots.

2. The maximum lot sizes and minimum inspection/testing frequencies are listed in the Annexure to this Specification. Where no minimum frequency of inspection/testing, or maximum lot size is stated in the Specification, the Contractor shall nominate appropriate frequencies for the Superintendent's approval.

3. Sampling shall not be restricted to locations dimensioned or otherwise defined for setting out the Works in the Drawings or Specification, but shall be undertaken in a random or unbiased manner, as approved by the Superintendent, at any location within the Works to demonstrate its compliance with the Specification.

4. Where Test Methods are nominated in the Specifications, a NATA-registered testing laboratory (referred to as Geotechnical Testing Authority shall be engaged to carry out the testing. The Geotechnical Testing Authority will also be engaged to assist with the Clay Liner Test Pad construction. The Geotechnical Testing Authority shall be engaged to provide a "Level 2" service, as defined in AS 3798, indicating that they do not attend the site full-time but have authority to select test locations when called to site for testing. Sampling shall be conducted by personnel from the NATA registered laboratory which has been accredited for that sampling procedure and shall be supervised by the approved signatory from that laboratory. Test results shall be reported on NATA endorsed test documentation which shall include a statement by the approved signatory certifying that the correct sampling procedures have been followed.

5. In special circumstances the Principal may accredit a laboratory that is not NATA registered for specific tests or inspection procedures.

6. The Contractor shall reinstate all core holes, test holes, excavations and any other disturbance resulting from any testing activity. The reinstatement shall be to a standard which is at least equal to the specified requirements for the particular work. The cost of reinstatement shall be at the Contractor’s expense.

7. Random sampling techniques shall be used for each lot for the control of compaction of each continuous layer of earthworks provided that, in the opinion of the Superintendent, the test locations include sites which are representative of the range of conditions present within the lot, and include potentially suspect areas such as the margins of fill layers, areas of noticeably higher moisture content and/or soft spots, limited working areas, or any other locations nominated by the Superintendent.

8. For quality control of processes other than compaction of layers of earthworks the sampling locations will be proposed by the Contractor and will require the approval of the Superintendent.

9. In all cases the samples shall be each considered to be representative of the lot and all test results will be required to meet the appropriate tolerances for the lot.

ANNEXURE 1

General Fill Material

1. General Fill shall consist of a naturally occurring or processed material which at the time of incorporation into the works is capable of being compacted in accordance with the specified requirements to form stable areas of fill. General Fill shall be sourced from designated stockpiles within the site and from general excavation works and shall be approved by the Superintendent prior to its use.

2. Any General Fill material shall not contain any of the following:
(i) material susceptible to volume change, including marine mud, soil with a liquid limit exceeding 45% or a plasticity index exceeding 20%, swelling clays and collapsible soils;
(ii) peat, vegetation, timber, organic, soluble or perishable material;
(iii) dangerous or toxic material or material susceptible to combustion;
(iv) metal, rubber, plastic or synthetic material; or
(v) construction debris.

3. General Fill material shall be natural or processed material which is well graded and complies with the following general grading requirement.

Table 4 - General Fill Material Grading Requirements

Test Method	Property	Requirement
AS 1141.11	Material Passing 200mm Material Passing AS Sieve 63mm	Percent by Mass 100% 75 to 100
AS 1141.11	0.075mm	10% Max

4. Approval of General Fill material, from any source, prior to its use constitutes a **HOLD POINT (8)**. Material placement shall not occur prior to release of this hold point by the Superintendent.

HOLD POINT 8 – Approval of General Fill Material

	Contractor Approval	Veolia Approval	CQA Approval
Name			
Signature			
Date			

Requirements:

1. Approval of laboratory test reports for general fill material.

ANNEXURE 2

COMPLETION OF EARTHWORKS SURFACES

1. (a) Earthworks final surfaces shall be completed to a stable condition as soon as practicable after excavation or after deposition and compaction of fill material has been completed. The subsequent permanent work or surface protection shall be carried out as soon as practicable after the earthworks final surface has been completed.
(b) Earthworks final surfaces shall be completed to smooth alignments without abrupt irregularities unless otherwise stated in the Contract.

2. (a) Formations above structures or utilities shall be completed after construction of the structures or utility.
(b) Unless otherwise permitted by the Superintendent, proof rolling shall be carried out on formations. The formation shall be rolled in the presence of the Superintendent by at least two passes of a non-vibrating roller. The roller shall have a static load of 15 tonnes and shall travel at a speed not exceeding 2 km/h. Any defect in the formation which is revealed during proof rolling by deformation of the formation which in the opinion of the Superintendent is excessive shall be made good as instructed by the Superintendent.
(c) Unless otherwise permitted by the Superintendent, formations which will not be immediately covered by the subsequent permanent work shall be protected by methods agreed by the Superintendent.

3. (a) Earthworks final surfaces and formations shall be maintained in a stable condition and shall be protected from damage due to water or other causes and from exposure to conditions which may adversely affect the surface.
(b) Formations shall not be used by Constructional Plant or vehicles other than those which in the opinion of the Superintendent are essential to construct the subsequent work.

ANNEXURE 3

MAXIMUM LOT SIZES AND MINIMUM TEST FREQUENCIES

1. The maximum lot sizes and minimum test frequencies are separately specified for all major activities covered by the Technical Specifications as listed hereunder.

2. Where material/product quality certification can be obtained from the supplier, tests listed per contract / separable part need not be repeated.

Table 3: Maximum Lot Sizes and Minimum Test Frequencies for Clay Liner Construction

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method	Acceptance Criteria
Clay Liner – Source Material	Atterberg Limits	1 per contract	1 per 5,000t placed	AS 1289.3.1.1 AS 1289.3.2.1 AS 1289.3.3.1	As per Clause
	Linear Shrinkage	1 per contract	1 per source and upon visual change	AS 1289.3.4.1	As per Clause
	Compaction	1 per contract	1 per source and upon visual change	AS 1289.5.4.1	As per Clause
	Grading	1 per contract	1 per source and upon visual change	AS 1289.3.6.2	As per Clause
	Permeability	1 per contract	1 per source and upon visual change	AS 1289.5.4.1	As per Clause
	Deleterious Substances	1 per contract	1 per source and upon visual change	Visual Inspection	As per Clause
Proof Rolling of Clay Liner Foundation	Firm. dry foundation	1 per contract	Proof roll 100% of area	Inspection by Superintendent	As per Clause
Clay Liner foundation levels	Geometry	1 per contract	1 per source or on visual change Testing controlled by Contractor. Testing will include minimum 3 x moisture content, density, and permeability.	AS 1289.5.4.1 AS 1289.5.7.1 AS 1289.6.7.1	As per Clause
Compaction of Clay Liner Material	Compaction and moisture content	Fill placed each day	1 per 500m^3 per lift at least 2 per day	AS 1289.5.4.1 AS 1289.5.7.1	As per Clause
	Permeability	Per lift of fill	1 per 10,000m^2 per lift	AS 1289.6.7.3 Thin-walled Shelby tube samples obtained by jacking into compacted fill surface. Multiple samples taken to ensure one is	As per Clause

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method	Acceptance Criteria
				obtained with no sampling disturbance. Permeability test in flexible wall permeameter	
Protection of clay liner	Protection against dessication and weather	1 per contract	100% of area	Contractor daily field logs	As per Clause
Clay liner final surface levels *	Geometry	1 per contract	10m grid	Survey and drawing showing clay liner thickness	As per Clause

* Survey works will not be the responsibility of the contractor. This will be commissioned separately by Veolia.

Floor Lining

Woodlawn Bioreactor

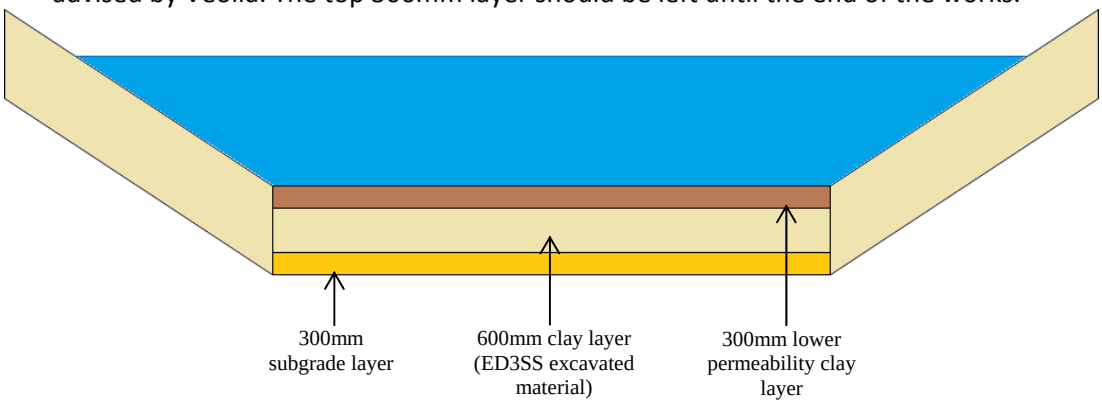
December 2015

SCOPE

This document outlines the methodology to be followed while completing lining works of the floor of Evaporation Dam 3 South (Southern Section):

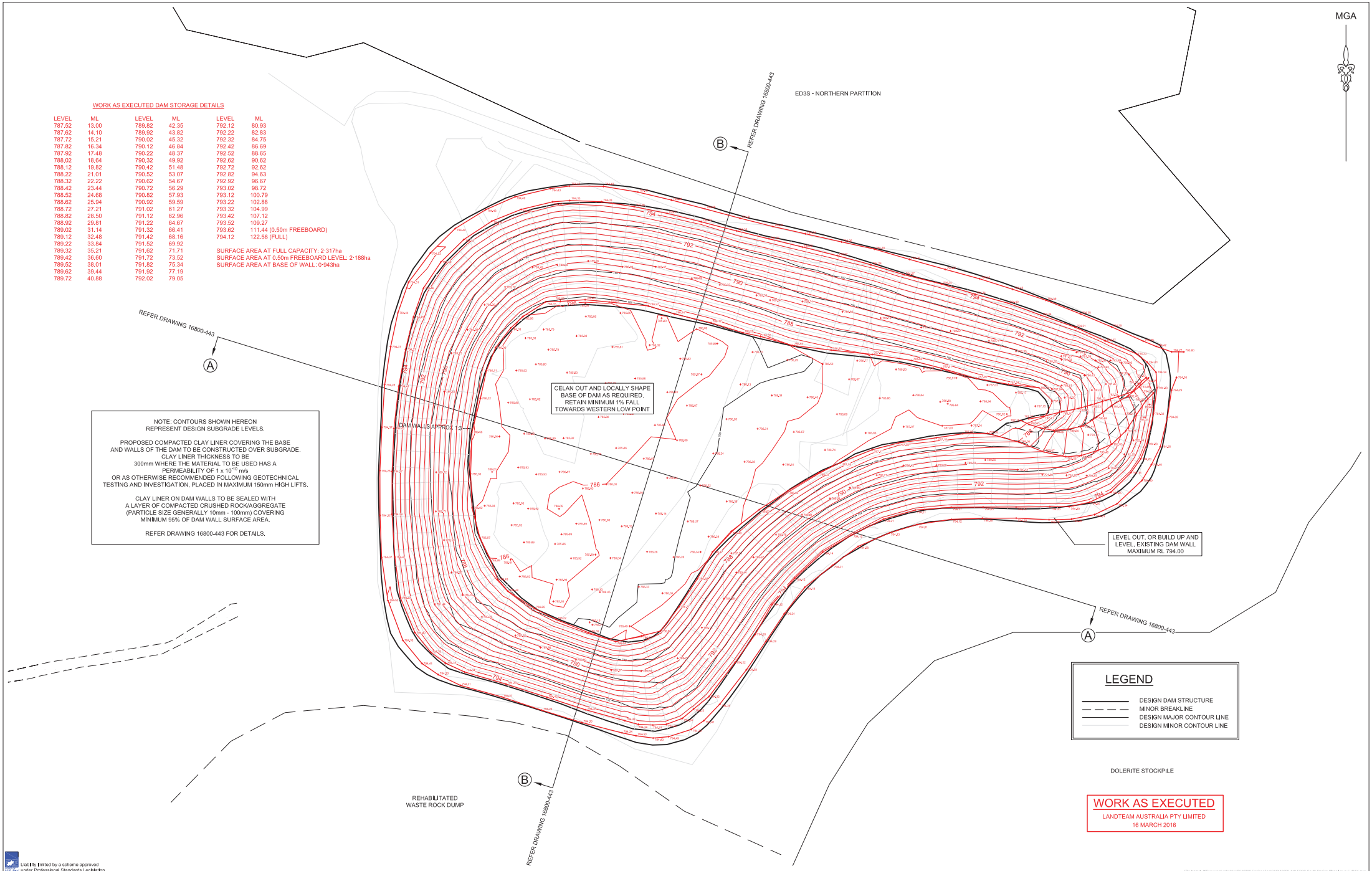
1. The contractor shall divide the floor up into segments (example as per attached plan) for the purpose of constructing the floor liner in stages.

2. The contractor shall rip up the existing material from the floor to a depth of 1,200mm. This material will be removed and stockpiled on another segment to enable a base level survey to be undertaken.
3. The stockpiled material shall be sorted to remove bulky material greater than 20mm. Bulky materials may be broken down to suitably sized material where possible, although where this is not possible the material should be discarded or used within a base 200mm layer.
4. The contractor shall place the material and compact in 150mm lifts, using a pad foot roller to a total thickness of 900mm (the remaining 300mm will be comprised of lower permeability clay).
5. A water cart must be dedicated to the job to ensure moisture content is within -2 to +4 percentage points of optimum moisture (relative to standard compaction). The water cart should be used throughout the compaction process for each layer.
6. Density should be 98% compaction (min), and higher if practicable (relative to standard compaction).
7. The contractor shall complete this in sequence until the entire floor of the dam is lined in this manner.
8. An allowance for a top 300mm layer of less permeable clay may be needed and will be advised by Veolia. The top 300mm layer should be left until the end of the works.



9. Insitu density tests and permeability tests will be collected at various depths over the liner. The final surface will be surveyed to verify thickness of the 900mm layer and the 300mm layer.

Appendix D2
Veolia Construction Design Plans for ED3SS (2016). Works as Executed (top of clay)



WORK AS EXECUTED DAM STORAGE DETAILS

LEVEL	ML	LEVEL	ML	LEVEL	ML
787.52	13.00	789.82	42.35	792.12	80.93
787.62	14.10	789.92	43.82	792.22	82.83
787.72	15.21	790.02	45.32	792.32	84.75
787.82	16.34	790.12	46.84	792.42	86.69
787.92	17.48	790.22	48.37	792.52	88.65
788.02	18.64	790.32	49.92	792.62	90.62
788.12	19.82	790.42	51.48	792.72	92.62
788.22	21.01	790.52	53.07	792.82	94.63
788.32	22.22	790.62	54.67	792.92	96.67
788.42	23.44	790.72	56.29	793.02	98.72
788.52	24.68	790.82	57.93	793.12	100.79
788.62	25.94	790.92	59.59	793.22	102.88
788.72	27.21	791.02	61.27	793.32	104.99
788.82	28.50	791.12	62.96	793.42	107.12
788.92	29.81	791.22	64.67	793.52	109.27
789.02	31.14	791.32	66.41	793.62	111.44 (0.50m FREEBOARD)
789.12	32.48	791.42	68.16	794.12	122.58 (FULL)
789.22	33.84	791.52	69.92		
789.32	35.21	791.62	71.71	SURFACE AREA AT FULL CAPACITY: 2·317ha	
789.42	36.60	791.72	73.52	SURFACE AREA AT 0.50m FREEBOARD LEVEL: 2·188ha	
789.52	38.01	791.82	75.34	SURFACE AREA AT BASE OF WALL: 0·943ha	
789.62	39.44	791.92	77.19		
789.72	40.88	792.02	79.05		

NOTE: CONTOURS SHOWN HEREON REPRESENT DESIGN SUBGRADE LEVELS.

PROPOSED COMPACTED CLAY LINER COVERING THE BASE AND WALLS OF THE DAM TO BE CONSTRUCTED OVER SUBGRADE. CLAY LINER THICKNESS TO BE 300mm WHERE THE MATERIAL TO BE USED HAS A PERMEABILITY OF 1 x 10^{-10} m/s OR AS OTHERWISE RECOMMENDED FOLLOWING GEOTECHNICAL TESTING AND INVESTIGATION, PLACED IN MAXIMUM 150mm HIGH LIFTS.

CLAY LINER ON DAM WALLS TO BE SEALED WITH A LAYER OF COMPACTED CRUSHED ROCK/AGGREGATE (PARTICLE SIZE GENERALLY 10mm - 100mm) COVERING MINIMUM 95% OF DAM WALL SURFACE AREA.

REFER DRAWING 16800-443 FOR DETAILS.

VEOLIA ENVIRONMENTAL SERVICES

SCALE 1:500

0 10 20 30 40 50

Metres

ISSUE	AMENDMENT	DRAWN	DATE
A	INITIAL ISSUE	MK	7/12/2015
B	SUMP REMOVED & PERMEABILITY MODIFIED	MK	10/12/2015
C	CLAY PERMEABILITY SPECIFICATIONS MODIFIED	MK	14/12/2015
D	GENERAL REDESIGN TO SITE CONDITIONS	MK	11/02/2016
E	CLAY LINER EXTENDED & COVER MATERIAL ADDED	MK	26/02/2016

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LandTeam

A1 SHEET

VEOLIA ENVIRONMENTAL SERVICES

WOODLAWN BIOREACTOR
COLLECTOR ROAD, TARAGO

EVAPORATION DAM 3 SOUTH - SOUTHERN PARTITION RECONSTRUCTION PROJECT

PROPOSED ED3S - SOUTHERN PARTITION UPGRADE PLAN

DESIGNED: MK/SB	ISSUE
DRAWN: MK	E
CHECKED: JK	

DRAWING No. 16800-442

DATUM	AHD	CONTOUR INTERVAL	0·5m	DATE	26/02/2016

MGA

ED3S - NORTHERN PARTITION

REFER DRAWING 16800-443

B

REFER DRAWING 16800-443

A

NOTE: CONTOURS SHOWN HEREON
REPRESENT DESIGN SUBGRADE LEVELS.

PROPOSED COMPACTED CLAY LINER COVERING THE BASE
AND WALLS OF THE DAM TO BE CONSTRUCTED OVER SUBGRADE.
CLAY LINER THICKNESS TO BE
300mm WHERE THE MATERIAL TO BE USED HAS A
PERMEABILITY OF 1 x 10^{-10} m/s
OR AS OTHERWISE RECOMMENDED FOLLOWING GEOTECHNICAL
TESTING AND INVESTIGATION, PLACED IN MAXIMUM 150mm HIGH LIFTS.

CLAY LINER ON DAM WALLS TO BE SEALED WITH
A LAYER OF COMPACTED CRUSHED ROCK/AGGREGATE
(PARTICLE SIZE GENERALLY 10mm - 100mm) COVERING
MINIMUM 95% OF DAM WALL SURFACE AREA.

REFER DRAWING 16800-443 FOR DETAILS.

DAM WALLS APPROX 1:3

CELAN OUT AND LOCALLY SHAPE
BASE OF DAM AS REQUIRED.
RETAIN MINIMUM 1% FALL
TOWARDS WESTERN LOW POINT

LEVEL OUT, OR BUILD UP AND
LEVEL, EXISTING DAM WALL
MAXIMUM RL 794.00

REFER DRAWING 16800-443

A

B

REFER DRAWING 16800-443

REHABILITATED
WASTE ROCK DUMP

DOLERITE STOCKPILE

LEGEND

- DESIGN DAM STRUCTURE
- MINOR BREAKLINE
- DESIGN MAJOR CONTOUR LINE
- DESIGN MINOR CONTOUR LINE

WORK AS EXECUTED
LANDTEAM AUSTRALIA PTY LIMITED
16 MARCH 2016

File Name: J:\Surveyors\Jobs\Vaults\16800 Engineering\CAD\16800-445 ED3S-South Design Plans Issue E WAK.dwg

VEOLIA ENVIRONMENTAL SERVICES

SCALE 1:500

0 10 20 30 40 50
Metres

ISSUE	AMENDMENT	DRAWN	DATE
A	INITIAL ISSUE	MK	7/12/2015
B	SUMP REMOVED & PERMEABILITY MODIFIED	MK	10/12/2015
C	CLAY PERMEABILITY SPECIFICATIONS MODIFIED	MK	14/12/2015
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E	CLAY LINER EXTENDED & COVER MATERIAL ADDED	MK	26/02/2016

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Integrated Management System

LandTeam

A1 SHEET

VEOLIA ENVIRONMENTAL SERVICES

WOODLAWN BIOREACTOR
COLLECTOR ROAD, TARAGO

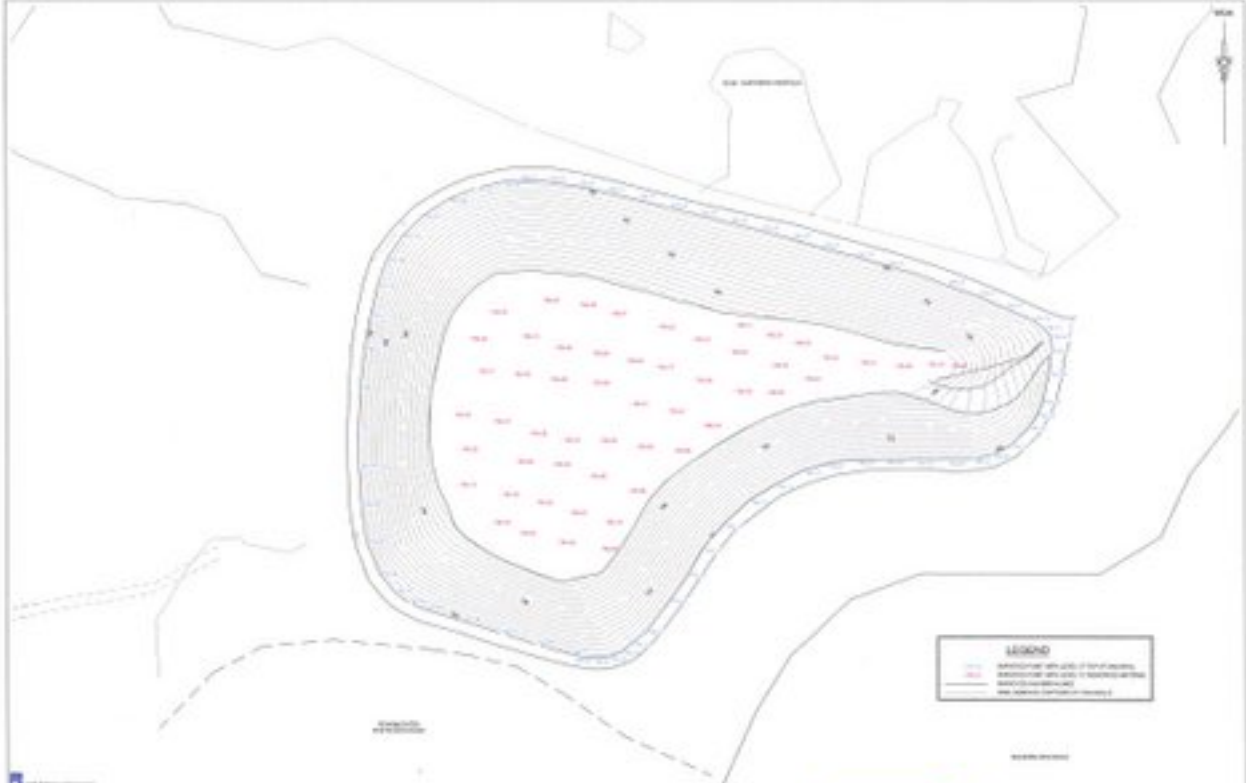
EVAPORATION DAM 3 SOUTH - SOUTHERN PARTITION
RECONSTRUCTION PROJECT

PROPOSED ED3S - SOUTHERN PARTITION UPGRADE PLAN

DESIGNED: MK/SB
DRAWN: MK
CHECKED: JK
ISSUE E

DRAWING No. 16800-442

DATUM AHD | CONTOUR INTERVAL 0·5m | DATE 26/02/2016



VEOLIA
ENVIRONMENTAL SERVICES

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15003-447

MGA

ED3S - NORTHERN PARTITION

REHABILITATED
WASTE ROCK DUMP

DOLERITE STOCKPILE

LEGEND

- SURVEYED POINT WITH DEPTH OF CLAY (+ 0.00)
- SURVEYED DAM BREAKLINES
- FINAL SURFACE CONTOURS
- AREAS EXTRA CLAY REQUIRED (30/05/2016)

NOTE: THE DEPTH OF CLAY AS STATED HEREON HAS BEEN CALCULATED BY THE DIFFERENCE BETWEEN THE SURVEYED LEVEL OF THE FINISHED CLAY SURFACE AS AT 02 JUNE 2016 AND LEVELS INTERPOLATED AT THE SAME LOCATIONS FROM THE SURVEY UNDERTAKEN ON 10 FEBRUARY 2016

File Name: J:\Surveyors\Jobs\Vec\8x16800 Engineering\CAD\16800-456 ED3S-South Clay Depth.dwg

VEOLIA ENVIRONMENTAL SERVICES

SCALE 1:500

0 10 20 30 40 50

Metres

ISSUE	AMENDMENT	DRAWN	DATE
A	INITIAL ISSUE	FO	07/06/2016

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A1 SHEET

VEOLIA ENVIRONMENTAL SERVICES

WOODLAWN BIOREACTOR
COLLECTOR ROAD, TARAGO

EVAPORATION DAM 3 SOUTH - SOUTHERN PARTITION
RECONSTRUCTION PROJECT
PLAN SHOWING TOTAL DEPTH OF CLAY LINING
IN AMENDED AREAS

SURVEYED: FO
DRAWN: FO
CHECKED: JK
ISSUE A

DRAWING No. 16800-456

DATUM AHD | CONTOUR INTERVAL 0·5m | DATE 02/06/2016

Appendix D3
Plates 1-4 (March 2016, Practical liner completion)

Plates 1 & 2 (10 March 2016) Viewing south over the construction of ED3SS, showing completed batter slopes and floor levels (capped by 0.3m of MBT clay). Further compaction (smooth drum) and installation of the gravel layer (0.1m) is still in progress. The left plate shows the completed floor and walls and sampling location of ED3ss (Fl= floor, blue bucket) and ED3SS (Wl=wall).

Plates 3 & 4 (10 March 2016 & 5 February 2016). View over the northern end of ED3SS showing the access ramp used to transport clay materials (& remove waste rock) for the liner construction (completed with 0.3m capping of MBT). The completion of the insitu floor liner (i.e. 1.2 m) using reworked insitu clay-silt is shown (5 Feb 2016) before capping by MBT clay (0.3m thick).

Woodlawn Bioreactor- ED3SS CQA (1 of 1)

Appendix D4
Plates 1-3 (July 2016, completion with gravel layer)

Plate 1 (20 July 2016). Viewing south over the completion of ED3SS construction works. Plate showing the clay floor and installation (0.10 m thick blue metal) protective gravel layer over the walls and top access road). Floor comprises a clay cap (~0.3m thick) of very low permeability materials (MBT clays of E-011 M/sec).

Plates 2 & 3 (20 July 2016). Panoramic views (north and south) over the completed ED3ss evaporation dam with recent construction of gravel layer.

PHOTOGRAPHIC PLATES

Appendix E
Earth2Water Pty Ltd, 2 March 2016. Lining Specification (Evaporation Dam ED3SS)-Woodlawn Bioreactor.

earth2water Pty Ltd
Environmental & Groundwater Consulting
ABN 64 100 859 238
175 Fern Street Gerringong NSW 2534
Phone: (02) 4234 0829 Fax: (02) 4236 1824

Ref: E2W-243 L001r
2 March 2016

Shaun Rainford
Veolia Australia & NZ Pty Ltd
NSW State Office
Cnr Unwin & Shirley St
Rosehill, NSW, 2142

Re: Lining Specification (Evaporation Dam ED3SS)-Woodlawn Bioreactor

1 Introduction

Earth2Water Pty Ltd (E2W) was engaged by Veolia Australia & NZ Pty Ltd (VES) to provide independent professional advice for the proposed liner system for an Evaporation Dam (ED3SS) at Woodlawn Bioreactor (Appendix A). The purpose of this letter by E2W is to verify the suitability of the proposed liner system and compliance with current published guidelines (NSWEPA 1996. *Environmental Guidelines- Solid Waste Landfills*) and NSWEPA December 2015: *Draft Environmental Guidelines- Solid Waste Landfills*).

VES is seeking to increase the capacity to store treated leachate onsite by utilizing the ED3SS. Currently, stormwater from the landfill void is pumped into existing evaporation dam at ED3 South and treated leachate is pumped to ED3 North. Following lining of ED3SS dam, VES intend to store treated leachate in ED3SS and transfer stormwater to another storage dam.

E2W (Dino Parisotto) has previously provided environmental and water assessment studies for the Woodlawn Bioreactor since 2006 (i.e. comprehensive groundwater and surface water monitoring status reports in November 2007, groundwater training workshops in January 2007, assessment of Evaporation Dam (ED3) and Monitoring Issues (June 2007), supervised well installation programs around the Void and evaporation dams, previous EPL & SML technical reports @ 2007 to 2011, and a hydrogeological study at Woodlawn @2015 & 2016).

This letter report by E2W outlines the technical justification for the Dam Lining Specification (ED3SS) at the Woodlawn Bioreactor (Appendix A, and Tables 1 &2).

2 Background & Environmental Setting

The location of ED3SS is within a group of existing evaporation dams (unlined) associated with current landfill operations and past mining activities. VES currently require an increase in water storage capacity to manage landfill leachate associated with the bioreactor/void. ED3SS is approximately 3 ha in area and sited within low permeability bedrock (siltstone/tuff) and silty clays (Table 1). The ED3SS is situated a few meters above the local water table, and has no water ingress from the neighbouring unlined evaporation dams (ED3 lagoons).

E2W (Dino Parisotto) conducted a site inspection at ED3SS in consultation with VES (Stephen Bernhart) on 19 November 2015, 12 January and 5 February 2016. The insitu material excavated at the site appeared to mainly comprise silty-clays and gravelly-clays associated with the reworking and leveling of the natural soils and weathered bedrock (siltstone/tuff with low permeability ~E-08 m/sec). Recent excavation at the nearby Lipmans site (MBT stockpile) has generated approximately 10,000 m3 of silty clays with very low permeability (E-11 m/sec, refer to Table 2).

3. Justification for Liner System

The details of ED3SS liner system and preferred cap design are summarised in Tables 1 & 2, and Appendix A. The construction of the liner system will be integrated with a construction quality control system (E2W) to ensure the suitability of the foundation materials, material properties (permeability, compaction) thickness and quality of the sealing/barrier layers.

Existing monitoring wells (e.g. WM5 and ED3B) and surface water testing locations are available for monitoring leakage and impacts to water ways.

The integrity of the EDSS liner system relies on the impervious nature of existing silty-clay/gravelly-clay soils and siltstone/tuff bedrock (estimated at K= E-08 to E-10 m/sec) and imported clays (MBT stockpile, approximately K= E-11 m/sec). The location of the dam is in a low risk setting situated alongside other evaporation dams associated with landfill and previous mine operations. ED3SS is greater than 250 m from the site boundary and at least 2 m above the groundwater table.

In summary, E2W consider that the proposed liner system design is suitable for the site given the environmental setting and low risk. The clay liner will be 1.2 m thick comprising 2 layers of K=E-08 (0.9m thick) and K=approx E-11 m/sec (0.3 m thick). The proposed liner is expected to achieve a similar or greater environmental performance relative to EPA guidelines. A gravel (~0.1m) layer will be used to cover the clay capping to protect against desiccation and erosion. Construction quality control will be implemented to address material geotechnical properties, layer thickness, use of protective layers and basement works.

Should you have any queries or comments regarding this letter, please feel free to contact the undersigned.

Yours sincerely,
Earth2Water Pty Ltd

Dino Parisotto (Principal Hydrogeologist)
BAppSc - Geology (Hons); MAppSc - Groundwater , C3 Driller DL1977
Mobile 0422 334102

Attached
Table 1: E2W Preliminary Geotechnical Investigation Results
Table 2: ED3SS Evaporation Dam Liner System
Appendix A: ED3SS Technical Details and Survey (ED3SS)

Tables

Table 1 - E2W Preliminary Geotechnical Investigation Results (2015 to 2016)

Woodlawn Bioreactor - Evaporation Dam ED3SS

Sample ID	Date	Sample Depth	Sample Description	Inferred Cap Quality (E2W interpretation from logging)	Permeability (m/sec)	Sampling Area	Comments
Floor of Evaporation Dam (section completed area of 0.9m thick , 2500 m2)							
FFK-1 @0.9m	**12/01/2016**	**0-0.18m**	Silty clay with fine gravel (tuff ~10%)-light brown (u50 tube)	**B**	**4.0 E-08**	Floor completed with 0.9m rerworked insitu	not meeting criteria for clay liner (E-9 m/sec)
FFK-2 @0.9m	**12/01/2016**	**0.05-0.15m**	Silty clay with fine gravel (tuff ~10%)-light brown (u50 tube)	**B**	**2.0 E-08**	Floor completed with 0.9m rerworked insitu	not meeting criteria for clay liner (E-9 m/sec)
FFK-3 @0.9m	**12/01/2016**	**0.05-0.15m**	Silty clay with fine gravel (tuff ~10%)-light brown (u50 tube)	**B**	**5.0 E-08**	Floor completed with 0.9m rerworked insitu	not meeting criteria for clay liner (E-9 m/sec)
Floor of Evaporation Dam (in progress- 1 to 2m higher)							
NFK-1	**15/12/2015**	**0-0.15m**	Silty clay with fine gravel (tuff ~10%)-light brown	**A**	**3.2 E-09**	Floor not completed within ~1m of final level	meets criteria for clay liner (E-9 m/sec)
SFK-2	**15/12/2015**	**0-0.15m**	Silty clay with fine gravel (tuff ~10%)-light brown	**B**	**1.3 E-08**	Floor not completed within ~1m of final level	not meeting criteria for clay liner (E-9 m/sec)
SFK-2 Rock	**15/12/2015**	**0-0.3m**	Tuff- light brown, fine grained, massive-clay matrix, poorly cemented, weathered.	**B**	**2.0 E-08**	Floor not completed within ~1m of final level	not meeting criteria for clay liner (E-9 m/sec)
SFK-3	**15/12/2015**	**BH-6 (0.1-0.6m)**	Silty clay with fine gravel (tuff ~10%)-light grey/white	**B**	**1.0 E-08**	Floor not completed within ~1m of final level	not meeting criteria for clay liner (E-9 m/sec)
MSFK-4	**15/12/2015**	**BH9B (0.2-0.8m)**	Silty clay with fine gravel (tuff ~10%)-light brown	**B**	**1.7 E-08**	Floor not completed within ~1m of final level. Predominant material type at centre of liner	not meeting criteria for clay liner (E-9 m/sec)
Batter Slope of Evaporation Dam (completed)							
u50TP-5 @0.2m	**15/12/2015**	**0.2-0.35m**	Silty clay with fine gravel (tuff ~10%)-light brown	**B**	**2.0 E-08**	sample collected from batter slope. Testpit excavated to 0.2m depth. Sample collected with steel u50 tube for insitu sample. Slopes completed and compacted	not meeting criteria for clay liner (E-9 m/sec)
u50TPx @0.5m	**15/12/2015**	**0.5-0.65m**	Silty clay with fine gravel (tuff ~10%)-light brown	**B**	**5.0 E-08**	sample collected from batter slope. Testpit excavated to 0.5m depth. Sample collected with steel u50 tube for insitu sample.Slopes completed and compacted	not meeting criteria for clay liner (E-9 m/sec)
MBT Stockpile (adjacent haul road)							
Lipmans Exacavated Material	**16/10/2015**	**Grab**	Silty clay with fine gravel (siltstone)-medium brown	**A+**	**4.0 E-11**	material collected at source	meets criteria for clay liner (E-9 m/sec)
Top Of Void	**17/10/2015**	**Grab**	Silty clay with fine gravel (siltstone)-medium brown	**A+**	**4.0 E-11**	material collected at stockpile area (top of void)	meets criteria for clay liner (E-9 m/sec)
MBT SP-2	**12/01/2016**	**0.1-0.4m**	Silty clay with fine gravel (siltstone)-medium brown	**A+**	**7.0 E-11**	Large stockpile situated next to Void-	meets criteria for clay liner (E-9 m/sec)
MBT SP	**15/12/2015**	**0-0.2m**	Silty clay with fine gravel (siltstone)-medium brown	**A+**	**7.0 E-11**	Large stockpile situated next to Void-other samples collected by Testright	meets criteria for clay liner (E-9 m/sec)

Notes:

Table 2: Woodlawn Bioreactor: ED3SS Evaporation Dam Liner System

Compliance Assessment

Layer Type	Compliance	NSW EPA 1996 Guidelines	NSW EPA 2015 Guidelines	Proposed & Implemented Liner Design	Comments and Justification for Changes to NSW EPA (2015)
Foundation Material & Sub-base Layer	Yes	Engineered Foundation Material & Layer (performance based)	Engineered Foundation Material & Layer- 0.2m thick	Minimum 0.2m of blended & compacted fine grained materials & similar to clay cap (~E-08 m/sec). Inspection & CQA of liner floor recommended to assess fractures/preferential pathways	Weathered to fresh Siltstone/Schist bedrock basement at evaporation dam- low permeability (estimated K= E-8 m/sec). Sealing of any fractured materials with compact clays to address localised seepage
Environmental Risks; Boundary & Depth to Groundwater	Yes	low risk environment	low risk environment	Evaporation Basin is >250m from site boundary. Water table >2 m below floor of evaporation dam. Average groundwater level of ~4m below floor liner	Monitoring data available to indicate general water level (RL 784). No groundwater relief layer required. Low yielding and saline fractured rock aquifer present in ore body area (groundwater is poor quality). ED3SS is a Low risk area- away from creeks or groundwater resource area. Raw water dam and Void are potential receptors (>250m distance)
Leachate Collection System	No (site specific)	leachate collection drains and sumps	leachate collection drains and sumps	Not required due to impervious metamorphic rocks (Silurian) with low permeability & porosity, and depth to water table >2m'	Flow in natural clay soils and rock is through diffusion or secondary porosity (fractures- sealed by reworking/compaction). Leachate migration is anticipated via very slow rates of diffusion. Existing dams (ED1& 2) show no evidence of leackage (impervious basement and fine silts sealing layer). Permeability testing of basement = (TBA, K= m/s). Climate of area shows that evaporation greatly exceeds rainfall (1400 mm vs 690mm)
Basin Gradients	NA (site specific)	liner gradients > 3% transversely and > 1% longitudinally.	liner gradients > 3% transversely and > 1% longitudinally.	1% to assist with optimum evaporation	1% proposed - as shown in technical survey drawings. Basin is to aid evaporation of water and the gentler slopes promote greater evaporation potential
Impermeable Barrier	Yes	Minimum Clay Permeability @ E-09 m/sec, 0.9m thick	1m Minimum Permeability @ E-09 m/sec	2 Layer system=1.2m thick. Base Insitu Clay liner @ 0.9m thick with E-08 m/sec, & Overlain by 0.3m clay cap at permeability @ approx E-11 m/sec	MBT clay (0.3m) has high plasticity and suitable particle size distribution. Construction quality control to be implemented (compaction, thickness, protective gravellayer). Exisiting insitu clays have permeability below EPA requirements therefore capping with MBT material (0.3m imported) is recommended. Clay capping to be covered by fine gravel (~0.1m) to address desication/erosion on batter slopes and above water line. Proposed liner system is considered to achieve a similar or greater environmental performance relative to the EPA guidelines.
Battered Slopes	Yes	Maximum '3H:1V Minimum 5% to drainage points	The elements of leachate barrier systems installed on slopes must have adequate slope stability.	VES design parameters complies with slope stability and requirements	Slope of gradients achieved without instability - compacted (>95%) fine grained soil and rock

Notes:

WM5 swl= 784 - 786 mRL (ave 784 mRL)

ED3B swl= 784 - 786m RL (ave 784 mRL)

Base of evaporation dam approximately 788m RL

The Woodlam deposit is hosted by a sequence of Late Silurian shales, cherts and pyroclastics intruded by dolerite sills. Site geology indicates sequence of volcanic tuff & siltstone bedrock

Appendix A

MGA

COLLECTOR ROAD

EVAPORATION DAM 2

EVAPORATION DAM 1

EVAPORATION DAM 3 NORTH

EVAPORATION DAM 3 SOUTH

RAW WATER DAM

VOID

PLANT AREA

PLANT COLLECTION DAM

HICKORY'S PADDOCK

SITE LOCATION

LAKE GEORGE CATCHMENT

WASTE ROCK DAM

REHABILITATED WASTE DUMP

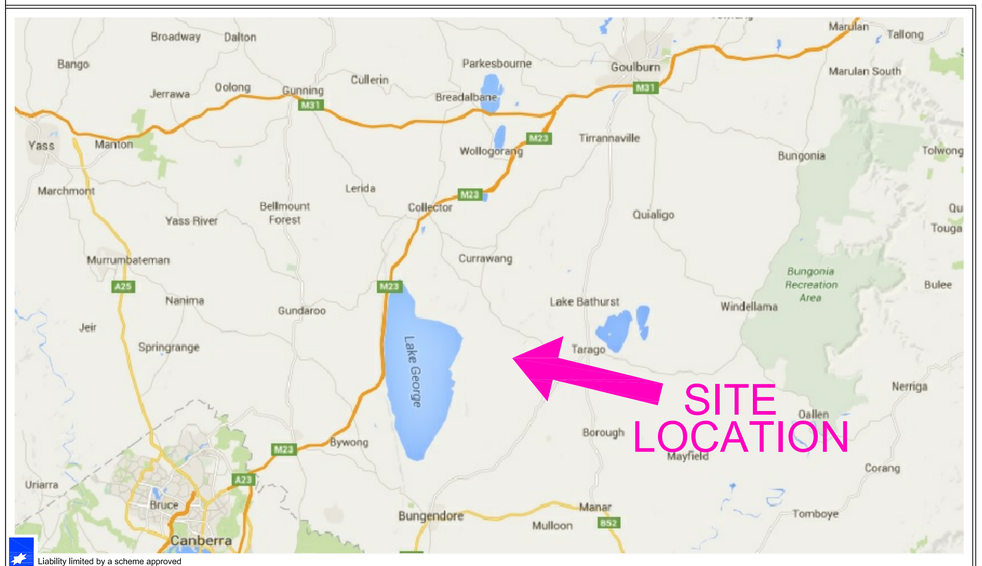
WOLLONDILLY CATCHMENT

NORTH TAILINGS DAM

WEST TAILINGS DAM

SOUTH TAILINGS DAM

LAKE GEORGE CATCHMENT



Liability limited by a scheme approved under Professional Standards Legislation.

DRAWING	TITLE
16800-440	SITE LOCATION AND DRAWING SCHEDULE
16800-441	EXISTING SITE SURVEY
16800-442	PROPOSED ED3S - SOUTHERN PARTITION UPGRADE PLAN
16800-443	TYPICAL SECTION DETAILS
16800-445	DAM DELINEATION PLAN

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VEOLIA ENVIRONMENTAL SERVICES

SCALE 1:10,000

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Metres

ISSUE	AMENDMENT	DRAWN	DATE
A	INITIAL ISSUE	MK	7/12/2015
B	SUMP REMOVED & PERMEABILITY MODIFIED	MK	10/12/2015
C	CLAY PERMEABILITY SPECIFICATIONS MODIFIED	MK	14/12/2015
D	GENERAL REDESIGN TO SITE CONDITIONS	MK	11/02/2016
E	CLAY LINER EXTENDED & COVER MATERIAL ADDED	MK	26/02/2016

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SITE LOCATION AND DRAWING SCHEDULE

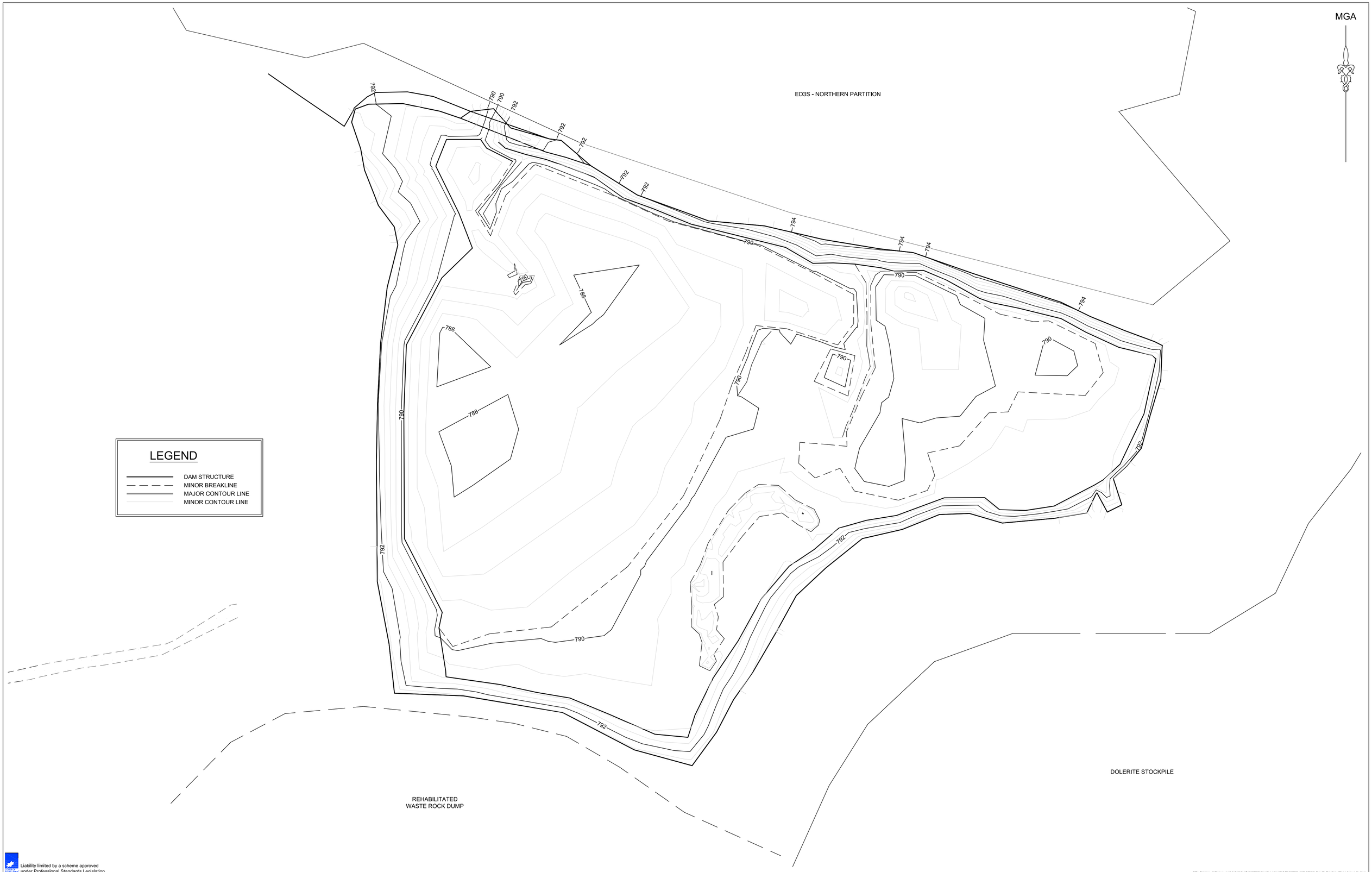
DESIGNED: MK/SB	ISSUE
DRAWN: MK	E
CHECKED: JK	

DRAWING No. 16800-440

DATUM	AHD	CONTOUR INTERVAL	10m	DATE	26/02/2016

MGA

ED3S - NORTHERN PARTITION



LEGEND

- DAM STRUCTURE
- MINOR BREAKLINE
- MAJOR CONTOUR LINE
- MINOR CONTOUR LINE

REHABILITATED
WASTE ROCK DUMP

DOLERITE STOCKPILE

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VEOLIA ENVIRONMENTAL SERVICES

SCALE 1:500

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Metres

ISSUE	AMENDMENT	DRAWN	DATE
A	INITIAL ISSUE	MK	7/12/2015
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EVAPORATION DAM 3 SOUTH - SOUTHERN PARTITION RECONSTRUCTION PROJECT

EXISTING SITE SURVEY

DESIGNED: MK/SB
DRAWN: MK
CHECKED: JK
ISSUE E

DRAWING No. 16800-441

DATUM	AHD	CONTOUR INTERVAL	0·5m	DATE	26/02/2016

MGA

ED3S - NORTHERN PARTITION

REFER DRAWING 16800-443 (B)

REFER DRAWING 16800-443 (A)

CELAN OUT AND LOCALLY SHAPE BASE OF DAM AS REQUIRED. RETAIN MINIMUM 1% FALL TOWARDS WESTERN LOW POINT

DAM WALLS APPROX 1:3

NOTE: CONTOURS SHOWN HEREON REPRESENT DESIGN SUBGRADE LEVELS.

PROPOSED COMPACTED CLAY LINER COVERING THE BASE AND WALLS OF THE DAM TO BE CONSTRUCTED OVER SUBGRADE. CLAY LINER THICKNESS TO BE 300mm WHERE THE MATERIAL TO BE USED HAS A PERMEABILITY OF 1 x 10^{-10} m/s OR AS OTHERWISE RECOMMENDED FOLLOWING GEOTECHNICAL TESTING AND INVESTIGATION, PLACED IN MAXIMUM 150mm HIGH LIFTS.

CLAY LINER ON DAM WALLS TO BE SEALED WITH A LAYER OF COMPACTED CRUSHED ROCK/AGGREGATE (PARTICLE SIZE GENERALLY 10mm - 100mm) COVERING MINIMUM 95% OF DAM WALL SURFACE AREA.

REFER DRAWING 16800-443 FOR DETAILS.

LEVEL OUT, OR BUILD UP AND LEVEL, EXISTING DAM WALL MAXIMUM RL 794.00

REFER DRAWING 16800-443 (A)

REFER DRAWING 16800-443 (B)

REHABILITATED WASTE ROCK DUMP

DOLERITE STOCKPILE

LEGEND

- DESIGN DAM STRUCTURE
- MINOR BREAKLINE
- DESIGN MAJOR CONTOUR LINE
- DESIGN MINOR CONTOUR LINE

VEOLIA ENVIRONMENTAL SERVICES

SCALE 1:500

0 10 20 30 40 50

Metres

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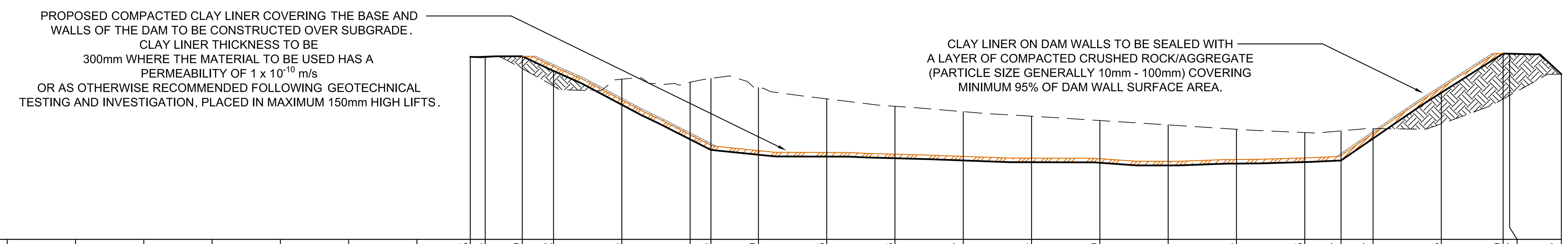

DATUM LEVEL 780

CHAINAGE	DESIGN SUBGRADE	EXISTING SURFACE
0.00		
10.00		
20.00		
30.00		
40.00		
50.00		
60.00		
67.81	793.35	793.35
70.00	793.34	793.39
75.42	793.39	792.48
80.00	792.32	791.21
90.00	789.84	791.71
100.00	787.31	791.49
103.05	786.54	791.76
110.00	786.19	791.09
120.00	786.05	790.27
130.00	785.93	789.73
140.00	785.77	789.34
150.00	785.64	789.01
160.00	785.60	788.69
170.00	785.41	788.37
180.00	785.54	788.05
190.00	785.65	787.81
195.31	785.77	787.93
200.00	787.37	788.10
210.00	790.73	788.45
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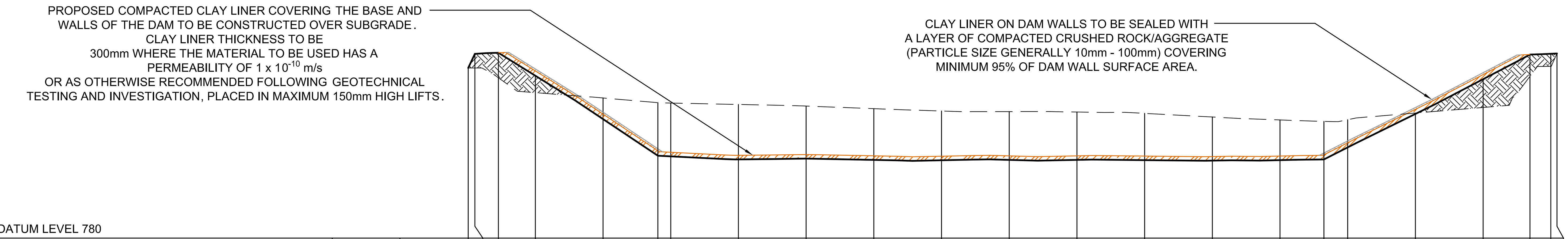
SECTION A

HORIZONTAL SCALE 1:500
VERTICAL SCALE 1:250

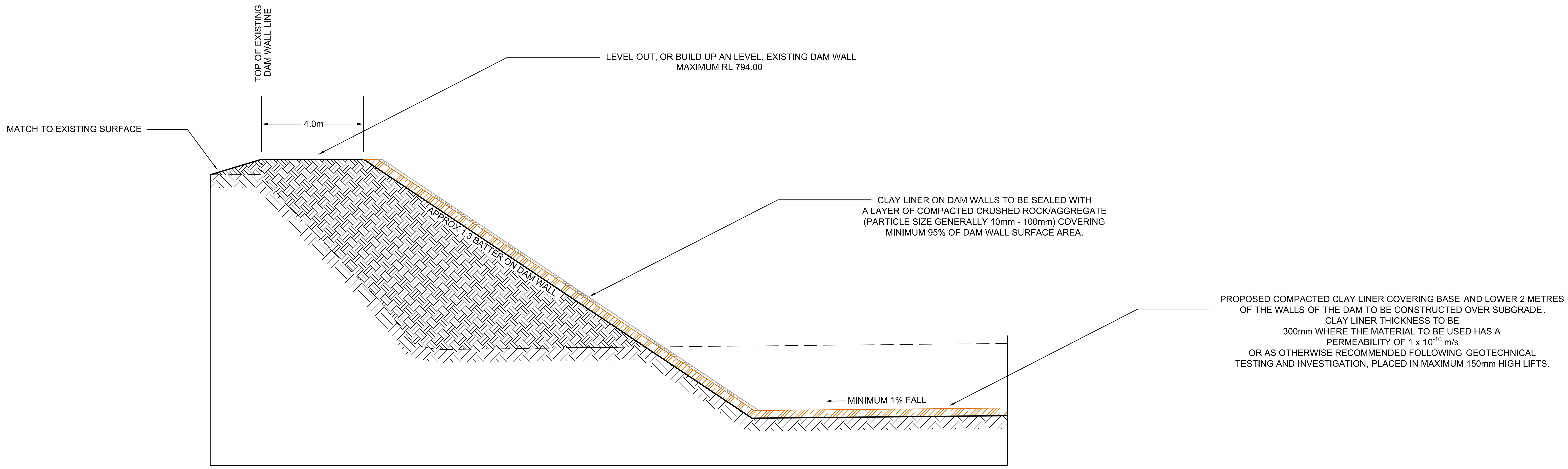


DATUM LEVEL 780

CHAINAGE	DESIGN SUBGRADE	EXISTING SURFACE
0.00		
10.00		
20.08	792.56	792.56
21.07	793.61	792.56
24.54	793.68	791.83
30.00	791.98	790.73
40.00	788.79	790.34
48.10	786.08	790.00
50.00	786.03	789.97
60.00	785.81	789.86
70.00	785.87	789.74
80.00	785.77	789.55
90.00	785.74	789.38
100.00	785.77	789.34
110.00	785.77	789.30
120.00	785.75	789.20
130.00	785.72	788.94
140.00	785.75	788.72
146.48	785.81	788.61
150.00	786.70	788.74
160.00	789.16	789.23
170.00	791.73	789.64
176.92	793.55	791.94
180.00	793.61	792.68
180.91	793.63	793.63

SECTION B

HORIZONTAL SCALE 1:500
VERTICAL SCALE 1:250



TYPICAL SECTION

NOT TO SCALE

VEOLIA ENVIRONMENTAL SERVICES

SCALE AS SHOWN

ISSUE	AMENDMENT	DRAWN	DATE
A	INITIAL ISSUE	MK	7/12/2015
B	SUMP REMOVED & PERMEABILITY MODIFIED	MK	10/12/2015
C	CLAY PERMEABILITY SPECIFICATIONS MODIFIED	MK	14/12/2015
D	GENERAL REDESIGN TO SITE CONDITIONS	MK	11/02/2016
E	CLAY LINER EXTENDED & COVER MATERIAL ADDED	MK	26/02/2016

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Integrated Management System

LandTeam

A1 SHEET

VEOLIA ENVIRONMENTAL SERVICES

WOODLAWN BIOREACTOR
COLLECTOR ROAD, TARAGO

EVAPORATION DAM 3 SOUTH - SOUTHERN PARTITION RECONSTRUCTION PROJECT

TYPICAL SECTION DETAILS

DESIGNED: MK/SB
DRAWN: MK
CHECKED: JK
ISSUE E

DRAWING No. 16800-443

DATUM AHD | CONTOUR INTERVAL N/A | DATE 26/02/2016

MGA

ED3S - NORTHERN PARTITION

LEGEND

- DESIGN DAM STRUCTURE
- MINOR BREAKLINE
- DESIGN MAJOR CONTOUR LINE
- DESIGN MINOR CONTOUR LINE

5
6165m²

2
4962m²

1
5658m²

4
5638m²

3
3888m²

Ch 276.014
Ch 260.000
Ch 240.000
Ch 220.000
Ch 200.000
Ch 180.000
Ch 160.000
Ch 140.000
Ch 120.000
Ch 100.000
Ch 80.000
Ch 60.000
Ch 40.000
Ch 20.000
Ch 0.000

REHABILITATED
WASTE ROCK DUMP

DOLERITE STOCKPILE

File Name: J:\Surveyors\Jobs\Veolia\16800 Engineering\CAD\16800-440 ED3S-South Design Plans Issue E.dwg

VEOLIA ENVIRONMENTAL SERVICES

SCALE 1:500

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Metres

ISSUE	AMENDMENT	DRAWN	DATE
A	INITIAL ISSUE	MK	7/12/2015
B	SUMP REMOVED & PERMEABILITY MODIFIED	MK	10/12/2015
C	CLAY PERMEABILITY SPECIFICATIONS MODIFIED	MK	14/12/2015
D	GENERAL REDESIGN TO SITE CONDITIONS	MK	11/02/2016
E	CLAY LINER EXTENDED & COVER MATERIAL ADDED	MK	26/02/2016

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VEOLIA ENVIRONMENTAL SERVICES

WOODLAWN BIOREACTOR
COLLECTOR ROAD, TARAGO

EVAPORATION DAM 3 SOUTH - SOUTHERN PARTITION
RECONSTRUCTION PROJECT

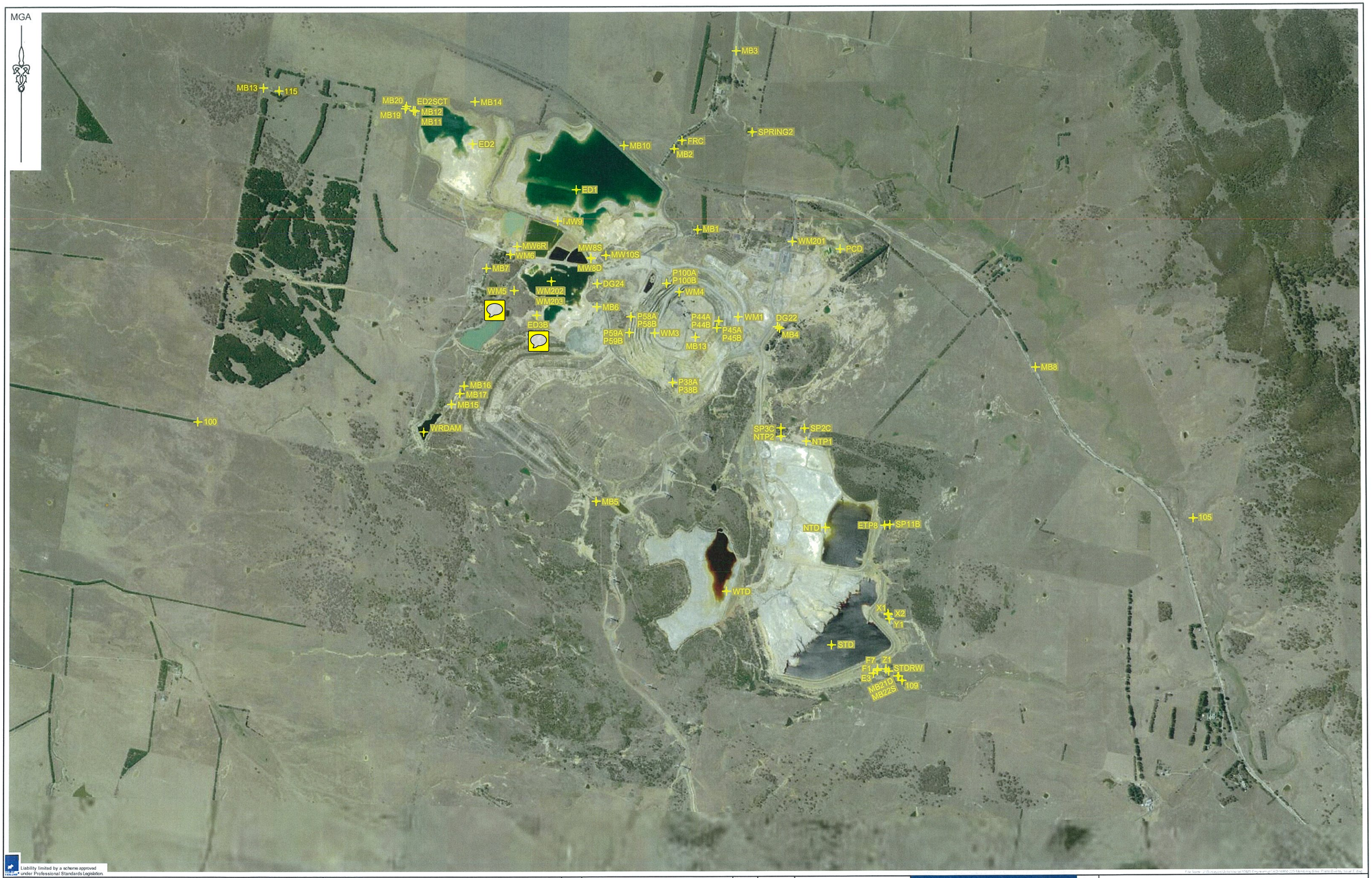
DAM DELINEATION PLAN

DESIGNED: MK/SB
DRAWN: MK
CHECKED: JK
ISSUE E

DRAWING No.
16800-444

DATUM | AHD | CONTOUR INTERVAL | 0.5m | DATE | 26/02/2016

Appendix F Monitoring location Plan



Liability limited by a scheme approved under Professional Standards Legislation.

VEOLIA ENVIRONMENTAL SERVICES

SCALE 1:10,000

0 200 400 600 800 1000

Metres

ISSUE	. AMENDMENT	DRAWN	DATE
A	INITIAL ISSUE	BR	12/10/2007
B	ADDITIONAL SITES ADDED	SH	01/06/2015
C	WELL POSITIONS AMENDED	MK	18/09/2015
D	REDUNDANT WELLS REMOVED & PLAN RESCALED	MK	06/10/2015
E	WELL LABELLING ENHANCED	MK	19/10/2015

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VEOLIA ENVIRONMENTAL SERVICES

WOODLAWN BIOREACTOR
COLLECTOR ROAD, TARAGO

WOODLAWN BIOREACTOR
SITE MONITORING
LOCATIONS

DESIGNED: N/A
DRAWN: MK
CHECKED: JK

ISSUE E

DRAWING No. 16800-220

DATUM	N/A	CONTOUR INTERVAL	N/A	DATE	19/10/2015

Appendix G Limitations

Earth2Water Pty Ltd has prepared this report for the use of Veolia in accordance with the standard terms and conditions of the consulting profession. This report is prepared with regard to Veolia brief and agreed scope of work. The methodology adopted and sources of information used by E2W are outlined in this report.

E2W has made no independent verification of the monitoring or technical information provided by the client. E2W assumes no responsibility for any inaccuracies or omissions in the data.

This report was prepared by E2W from November 2015 to September 2016 and is based on the information reviewed at the time of preparation. This report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties.

The precision with which site conditions are indicated depends largely on the frequency and method of sampling, and the uniformity of conditions as constrained by the project budget limitations. The behaviour of surface water and groundwater and some aspects of the contaminants in the environment are complex. Our professional interpretation and conclusions of the data and technical information are based upon our education, experience and review of available consultant reports from the site.

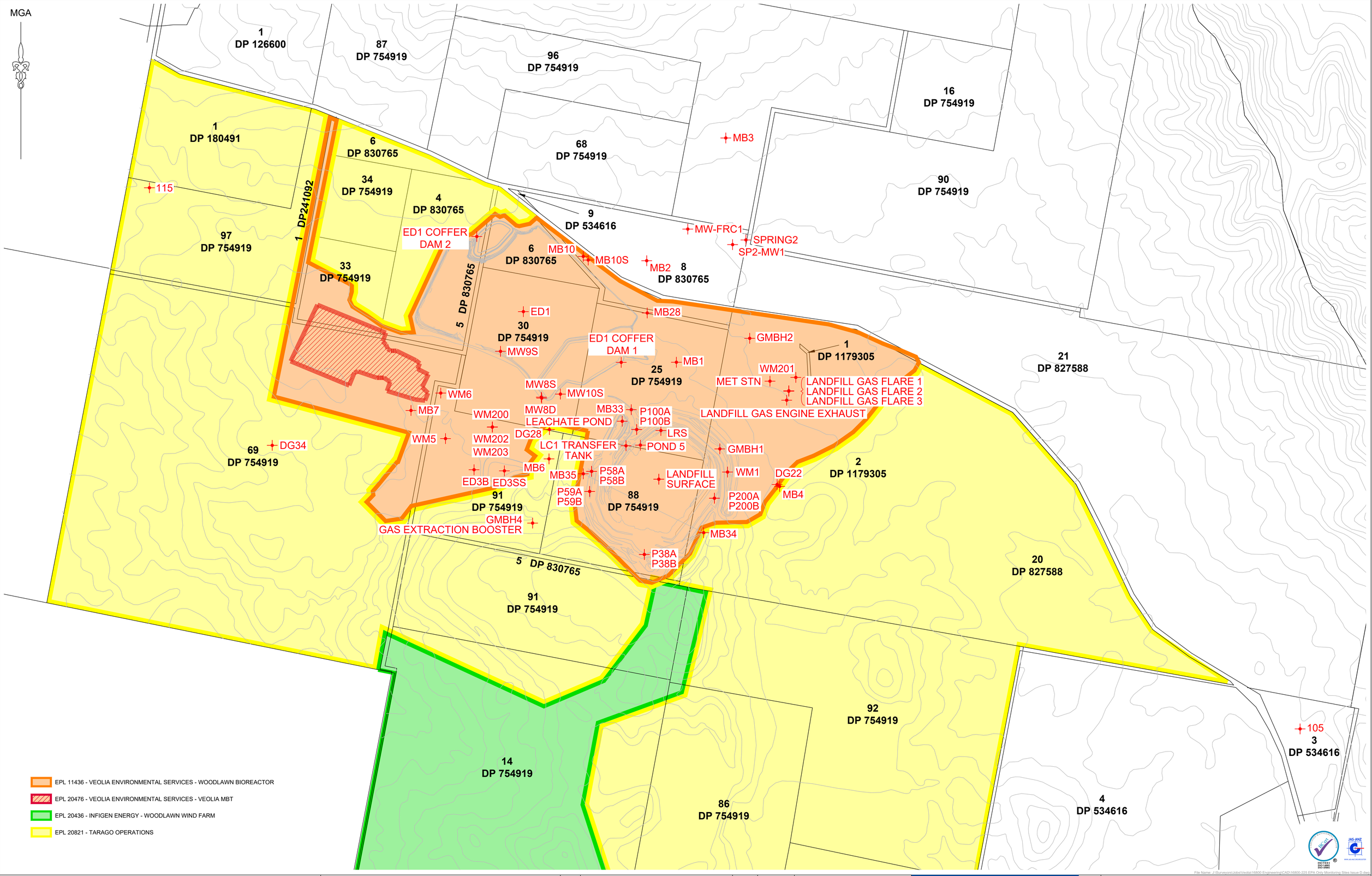
Where conditions encountered at the site are subsequently found to differ significantly from those anticipated in this report, E2W should be notified of any such findings and be provided with an opportunity to review the facts, content and recommendations included herein.

LAST PAGE OF REPORT

Thank you for the opportunity to work with Veolia.

Feedback is Welcomed at Earth2Water (dino@earth2water.com.au)

earth2water Pty Ltd
Environmental & Groundwater Consulting



VEOLIA ENVIRONMENTAL SERVICES

SCALE 1:8000

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Metres

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A	INITIAL ISSUE	MK	15/04/2020
B	MB34 (VOID EAST WALL) & MB35 (VOID WEST WALL) ADDED	MK	21/04/2021
C	LANDFILL GAS FLARE 2 & 3 ADDED	MK	24/05/2022
D	ED1CD2 & ADDITIONAL AERIAL UNDERLAY SHEET ADDED	MK	18/01/2023

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VEOLIA ENVIRONMENTAL SERVICES

WOODLAWN BIOREACTOR
COLLECTOR ROAD, TARAGO

WOODLAWN
ENVIRONMENTAL PROTECTION LICENCE
SITE MONITORING LOCATIONS

DESIGNED: N/A
DRAWN: MK
CHECKED: JK
ISSUE D

DRAWING No. 16800-225

DATUM AHD | CONTOUR INTERVAL 10m | DATE 18/01/2023

File Name: J:\Surveyors\Jobs\Veolia\16800 Engineering\CAD\16800-225 EPA Only Monitoring Sites Issue D.dwg

MGA

1 DP 126600
87 DP 754919
96 DP 754919
16 DP 754919
1 DP 180491
6 DP 830765
68 DP 754919
MB3
90 DP 754919
115
34 DP 754919
4 DP 830765
1 DP241092
9 DP 534616
MW-FRC1
SPRING2
SP2-MW1
97 DP 754919
ED1 COFFER DAM 2
6 DP 830765
MB10
MB10S
MB2
8 DP 830765
33 DP 754919
5 DP 830765
ED1
MB28
30 DP 754919
ED1 COFFER DAM 1
GMBH2
1 DP 1179305
MW9S
MB1
25 DP 754919
WM201
MET STN
LANDFILL GAS FLARE 1
LANDFILL GAS FLARE 2
LANDFILL GAS FLARE 3
21 DP 827588
MW8S
MW10S
WM6
MB7
MW8D
MB33
P100A
P100B
WM200
LEACHATE POND
LANDFILL GAS ENGINE EXHAUST
DG28
LRS
WM5
WM202
WM203
LC1 TRANSFER TANK
POND 5
GMBH1
69 DP 754919
DG34
MB6
MB35
P58A
P58B
LANDFILL SURFACE
WM1
DG22
2 DP 1179305
ED3B
ED3SS
91 DP 754919
P59A
P59B
88 DP 754919
P200A
P200B
MB4
GMBH4
GAS EXTRACTION BOOSTER
MB34
P38A
P38B
5 DP 830765
20 DP 827588
91 DP 754919
92 DP 754919
105
3 DP 534616
14 DP 754919
86 DP 754919
4 DP 534616

EPL 11436 - VEOLIA ENVIRONMENTAL SERVICES - WOODLAWN BIOREACTOR
EPL 20476 - VEOLIA ENVIRONMENTAL SERVICES - VEOLIA MBT
EPL 20436 - INFIGEN ENERGY - WOODLAWN WIND FARM
EPL 20821 - TARAGO OPERATIONS

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VEOLIA ENVIRONMENTAL SERVICES

SCALE 1:8000

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Metres

ISSUE	AMENDMENT	DRAWN	DATE
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VEOLIA ENVIRONMENTAL SERVICES

WOODLAWN BIOREACTOR
COLLECTOR ROAD, TARAGO

WOODLAWN
ENVIRONMENTAL PROTECTION LICENCE
SITE MONITORING LOCATIONS

DESIGNED: N/A
DRAWN: MK
CHECKED: JK
ISSUE D
DRAWING No.
16800-225(PH)

DATUM AHD | CONTOUR INTERVAL 10m | DATE 18/01/2023

Our ref: PS105723-RES-LTR-01 RevA (Leachate Management by Evaporators)

Your ref: email dated 13/09/2017 from Dr Ark Du

By email
Ark.du@veolia.com

28 September 2017

Dr. Ark Du
Landfill Engineer - Woodlawn
Veolia Australia and New Zealand
Woodlawn Bioreactor
619 Collector Rd Tarago NSW 2580

Dear Ark

Leachate management by mechanical evaporators and the proposed ED1 coffer dam

1. INTRODUCTION

This letter summarises results from modelled water balance for the dams ED1, ED3SS and ED3N based on Veolia's specified inflows, outflows and dam characteristics. Refer to Figure 1.2 for the dam locations. WSP was commissioned by Veolia Australia and New Zealand (Veolia) on 3 September 2017 to undertake simulations using the GOLDSIM based water balance model for ED1, ED3N (1,2,3,4) and ED3SS as per the scope of work and objectives tabulated in Section 1.3.

1.1 PREVIOUS WATER BALANCE ASSESSMENT BY WSP (JUNE 2016)

WSP|Parsons Brinckerhoff (now WSP) undertook a water balance assessment in June 2016 for Veolia's application for regulatory approval to utilise the ED1 and ED2 evaporation dams for treated leachate storage and evaporation (2269623B-RES-LTR-03 Rev0). The main objective of the Veolia nominated scenarios was to assess whether ED1 will overflow over a period of 40 years, if the treated leachate is discharged as per projected schedule (refer to Figure 1.1 for comparison between 2016 and 2017 estimates) under the following three scenarios:

- Scenario A. ED1 does not receive runoff from the Plant Containment Dam (PCD) catchment and groundwater from pit dewatering.
- Scenario B. Condition of Scenario A and water transfer from ED3N and ED3S cells at 1 L/s.
- Scenario C. Condition of Scenario B and groundwater transfer from pit dewatering with concurrent water use by Heron Resources for mineral processing.

The June 2016 modelled assessment suggested that Heron's mining operation may assist Veolia in reducing the water storage requirement for the planned leachate production from 2018 for the next 40 years by using some of the water stored in the dam.

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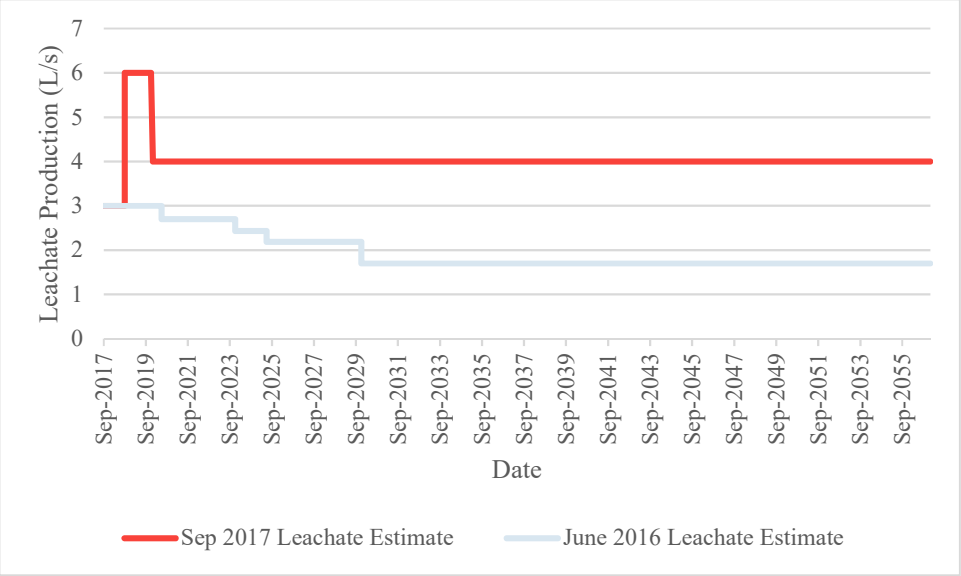


Figure 1.1 Comparison of leachate rates between June 2016 and Sep 2017 estimates (source: Veolia)

1.2 THIS WATER BALANCE ASSESSMENT BY WSP (SEPTEMBER 2017)

Veolia's current strategy is to use ED1 exclusively for its leachate management. A portion of ED1 in south-east corner will house a coffer dam that will be lined for subsequent storage and loss by natural and mechanical evaporation of treated leachate. The remainder of the ED1 dam will be allowed to dry up with the use of mechanical evaporators. Once evaporated, ED1 will be relined to avoid seepage and used subsequently for leachate storage and management. ED1 will only receive runoff from its external catchment including dolerite stockpile area. It will not receive transferred flows from the waste rock seepage dam or the old plant collection dam.

The water balance assessment presented in this report was required by Veolia to support an application to modify the existing ED1 as follows:

- construction of a suitable size of a lined coffer dam (referred to as ED1 Coffer Dam) to store and evaporate treated leachate from its leachate treatment plant from September 2018
- the remainder of ED1 dam (referred to as ED1 North Dam) to be evaporated until dry within next 10 years so that it can be engineered for future leachate management.

These amendments are being proposed by Veolia as a strategy to manage estimated future leachate production as follows:

- The expected leachate production rates are; 3 L/s until August 2018, 6 L/s until December 2019, 4 L/s thereafter as summarised in in Table 1.1.
- The existing ED3N and ED3SS leachate dams (also referred to as lagoons) will continue to receive leachate until the end of 2019 at a rate specified in Table 1.1; 3 L/s until August 2017, 2 L/s until December 2019 and 0 L/s thereafter.
- ED1 Coffer Dam will continue to receive the treated leachate from September 2018 at 4 L/s as summarised in Table 1.1.

Modelled dam characteristics and catchment areas are summarised in Table 1.2. Volume of water and leachate stored in these dams as of 30 August 2017 are summarised in Table 2.1

To enhance evaporation, Veolia intends to use commercially available mechanical evaporators and on-site manufactured floating evaporators. These evaporations pump specified volumes of liquid in the air

in the form of fine particles. Only a fraction of the pumped volume gets evaporated while falling back to the ground from the air. Modelled characteristics of the mechanical evaporators are specified in Table 3.1.

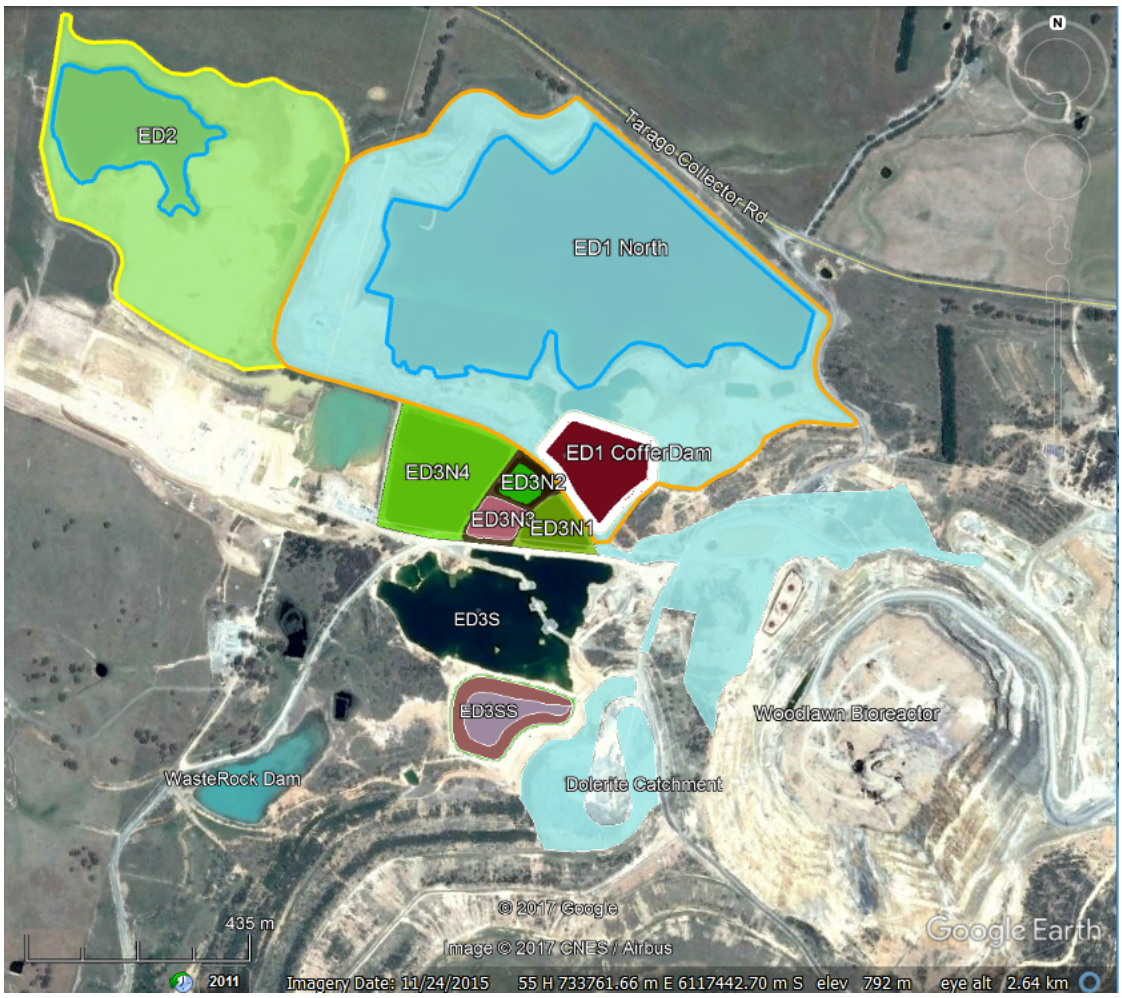


Figure 1.2 Location of dams in relation to Veolia's Woodlawn Bioreactor

Table 1.1 Current estimates of leachate production and distribution (source: Veolia)

DATE	LEACHATE PRODUCTION (L/s)	SUPPLY TO ED1 COFFER DAM (L/s)	SUPPLY TO ED3N, ED3SS (L/s)
September-2017	3	0	3
September-2018 (Commence treatment)	6	4	2
December-2019	6	4	2
January-2020	4	4	0
January-2057	4	4	0

1.3 SCOPE OF WORK

DAM	DAM INPUT	EVAPORATION SYSTEM	OUTPUTS	OBJECTIVE
New ED1 Coffer Dam	Treated water from Leachate Treatment Plant at the rate of 4 L/s and direct rainfall and local runoff	Floating Evaporator Type A × 4	Scenario1: Heron use water at a rate of 2 L/s Natural and assisted evaporation	Estimate the minimum size required for the coffer dam to service for 4-year period without filling.
			Scenario2: No water use by Heron Natural and assisted evaporation	Estimate the minimum size required for the coffer dam to service for 4-year period without filling.
ED1 North Dam with current water storage	Stormwater from its catchment and direct rainfall	75kw Minetek Units - throughput flow 25 L/s each unit.	Scenario2: Natural and assisted evaporation	Estimate number of evaporator units required to empty ED1 in 10 years
ED3N1, ED3N2 and ED3N3	Treated water from the existing leachate treatment dam and direct rainfall and local runoff	Floating Evaporation Unit Type A at ED3N1, ED3N2 and ED3N3	Scenario 2: Natural and assisted evaporation	Estimate the number of required floating evaporator units (Type A and Type B) required to achieve a water volume reduction rate at 1 L/s
ED3N4		Existing Mechanical Evaporator (× 5) at the bank of ED3N4 and Floating Evaporation Unit Type A		
ED3SS		Floating Evaporation Unit Type B x 3		

Table 1.2 Modelled dam characteristics and catchment areas (source: Veolia)

ED3 LEACHATE LAGOONS	LOCATION	WATER LEVEL (m AHD)	VOLUME (m^3)	AREA (m^2)	CATCHMENT (m^2)
ED3SS	Dam Crest	794.12	122,598	22,918	25,900
	Freeboard	793.62	111,446	21,782	
	Base	785.60	0	0	
ED3N Lagoon1	Dam Crest	791.80	26,742	9,065	11,483
	Freeboard	791.30	22,593	8,573	
	Base	787.40	0	4	
ED3N Lagoon2	Dam Crest	791.60	21,477	7,533	9,300
	Freeboard	791.10	18,080	7,104	
	Base	787.50	0	0	
ED3N Lagoon3	Dam Crest	791.50	17,789	6,757	8,900
	Freeboard	791.00	14,796	6,304	
	Base	787.80	0	0	
ED3N Lagoon4	Dam Crest	791.80	123,540	41,315	45,900
	Freeboard	791.30	104,210	39,720	
	Base	786.20	0	1	
ED1 North	Dam Crest	790.00	1,867,259	500,876	656,600
	Freeboard	788.80	1,274,241	484,006	
	Base	784.60	0	0	
ED1 Coffer Dam	Dam Crest	792.50	150,418	33,011	33,011
	Freeboard	792.00	134,223	31,761	
	Base	787.00	0	22,166	

2. CURRENT DAM VOLUMES

Veolia currently is planning to keep storing leachate to ED3N lagoons (1,2,3,4) and ED3SS at a rate of 3 L/s from September 2017 to August 2018 and at a rate of 2 L/s from September 2018 to December 2019. No leachate will be stored in these cells from January 2020.

Based on current volume as of 30 August 2017, available storages in the ED3 lagoons and ED3SS to the freeboard level is insufficient to store the planned leachate supply till December 2019 without losing water via natural and assisted evaporation by the proposed use of mechanical evaporators.

Table 2.1 Estimated water volumes in ED3 lagoons and ED1 as of 30 August 2017 (source: Veolia)

DAM	INITIAL RL (m AHD)	INITIAL VOLUME (m^3)	STORAGE AVAILABLE TO FREEBOARD LEVEL (m^3)	DAYS TO FILL TO FREEBOARD LEVEL AT 3 L/S
ED3SS	793.21	102,677	8,769	34

DAM	INITIAL RL (m AHD)	INITIAL VOLUME (m^3)	STORAGE AVAILABLE TO FREEBOARD LEVEL (m^3)	DAYS TO FILL TO FREEBOARD LEVEL AT 3 L/S
ED3N1	790.61	16,912	5,681	22
ED3N2	791.10	18,080	0	0
ED3N3	790.73	13,126	1,670	6
ED3N4	790.57	76,058	28,152	109
ED1	786.70	380,161	894,080	N/A

3. MECHANICAL EVAPORATORS

Table 3.1 lists the characteristics for the Existing, Minetek, Type A and Type B Evaporators provided by Veolia. The seasonal variation of water loss through Existing Mechanical Evaporators were related to monthly potential evaporation based on data provided by Veolia that were used in the June 2016 assessment (Table 3.2). The Existing Mechanical Evaporators are expected to be similar to TurboMist (http://www.turbomist.com/products). The same relationship was used for the Minetek unit without scaling.

The monthly evaporation characteristics for the floating evaporator Type A and Type B units were scaled from the characteristics for Existing Mechanical Evaporators to achieve Veolia's estimated average annual rate of water loss from the volume passing through the units for 2016-2017 period. Refer to Table 3.2 for the monthly scaled evaporation loss rates for Type A and Type B and Minetek units.

Table 3.1 Characteristics of modelled mechanical evaporator types

EVAPORATOR TYPE	MINETEK 400/200	TYPE A	TYPE B	EXISTING MECHANICAL EVAPORATOR
Applied quantity	1	1	1	1
Rated flow (L/min)	1500	126	86	350
Expected loss rate (L/min) at 100% availability	420	25	6.0	98
Availability % planned	Up to 70	70	70	Up to 70
Actual flow through (L/min) in 2016-2017 (source: Veolia)	Not installed	126	86	168 (due to pump restrictions)
Availability % in 2016-2017	Not installed	80	50	34
Evaporator flow (L/s) in 2016-2017		1.68	0.72	0.95
Average loss (L/s) in 2016-2017		0.33	0.05	0.27
% loss /year in 2016-2017		20%	7%	28%
Achieved loss rate (L/ min) in 2016-2017		19.9	3.0	16.20

Table 3.2 Relationship between potential evaporation and evaporation as % of the inflow volume through the mechanical evaporators

MONTH	POTENTIAL EVAPORATION (mm/day)	POTENTIAL EVAPORATION (mm/month)	% OF INFLOW EVAPORATED BY THE EXISTING MECHANICAL EVAPORATOR	% OF INFLOW EVAPORATED BY THE TYPE A EVAPORATOR	% OF INFLOW EVAPORATED BY THE TYPE B EVAPORATOR
1	5.9	180.1	40.0	28.8	7.3
2	4.5	136.4	36.8	26.5	6.7
3	3.9	119.2	35.3	25.4	6.4
4	2.3	71.2	30.2	21.8	5.5
5	1.4	43.4	26.1	18.8	4.8
6	0.9	27.9	22.8	16.4	4.2
7	1.1	32.0	23.8	17.2	4.4
8	1.7	52.5	27.6	19.9	5.0
9	2.6	79.7	31.3	22.6	5.7
10	3.7	112.4	34.7	25.0	6.3
11	4.6	139.8	37.0	26.7	6.8
12	5.8	175.1	39.6	28.5	7.2

4. MODELLLING APPROACH

The GOLDSIM based model for Woodlawn Site was modified to suit required simulations as per the scope of work outlined in Section 1.3 and schematically represented in Figure 4.1 as follows:

- Rainfall and natural evaporation is applied to all dams.
- Runoffs from the catchment of ED1 outside of the water filled surface were calculated using a volumetric runoff coefficient of 0.1.
- Runoffs from the catchments of ED3SS, ED3N1, ED3N2, ED3N3 and ED3N4 from area within the dam walls were calculated using a runoff coefficient of 1.0.
- Potential seepage loss from the dam floors were not considered in the simulations.
- Types of evaporators as per Section 1.3 were applied when running scenarios with evaporators.
- Natural evaporation was assumed to occur at a daily potential rates calculated by applying a pan factor of 0.60 to the pan evaporation data.
- Leachate input to ED3 dams was set to 3 L/s from September 2017 to August 2018 and at 2 L/s from September 2018 to December 2019. Leachate input to ED3 dams were stopped from January 2020.
- Leachate input to ED1 Coffer Dam was applied at 4 L/s from September 2018.
- Simulations were run from 01/09/2017 to 31/12/2027 at a daily time step.
- Future climate scenarios were based on climatic sequences presented in Section 6.

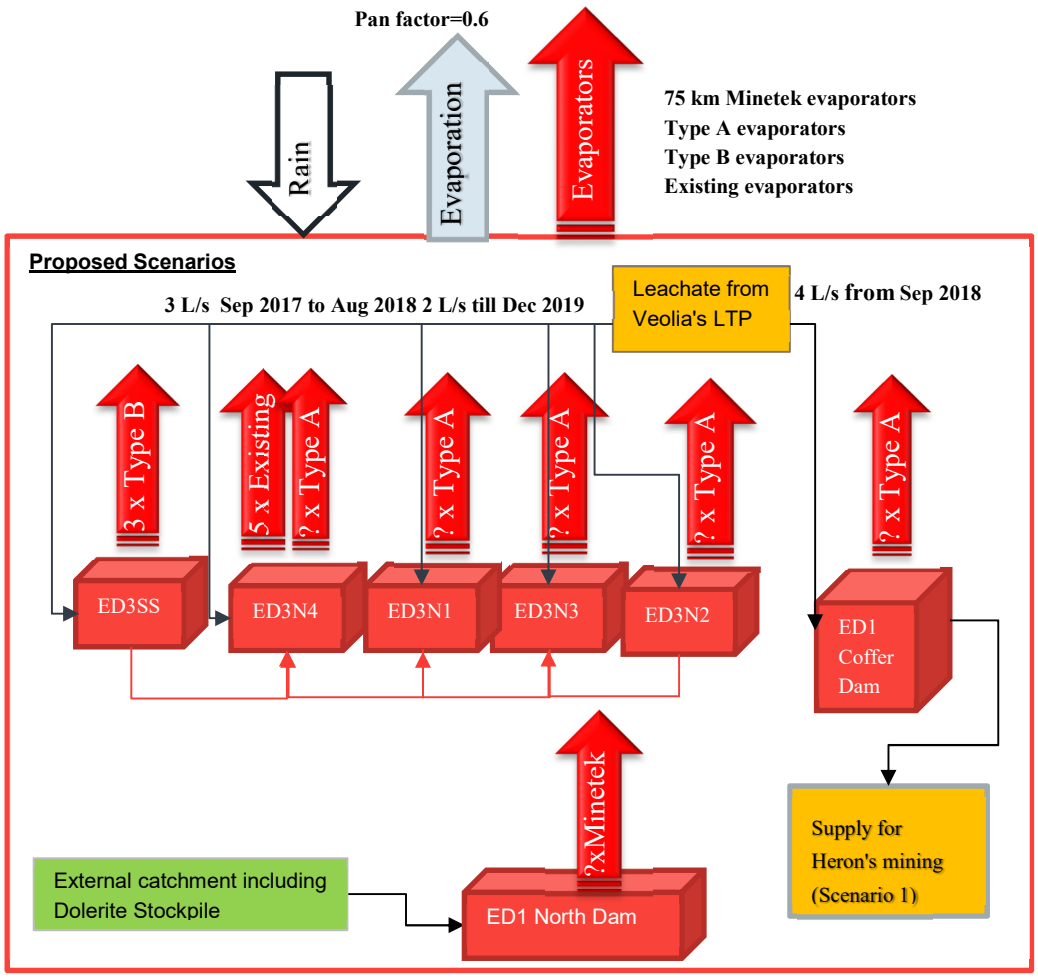


Figure 4.1 Schematic representation of modelled dams in GOLDSIM

5. WATER BALANCE MODEL VALIDATION

The site water balance for Woodlawn was validated based on recently built ED3SS leachate dam, which was operated from 11 Sep 2016 to date. Veolia provided the as-built bathymetric data for ED3SS (Figure 5.1), climatic data (Figure 5.2) and measured leachate flow (Figure 5.3) from 11 Sep 2016 to 11 Sep 2017. Simulated water storage in ED3SS, natural evaporation from ED3SS and required transfer of leachate to ED3N and loss by mechanical evaporator trialled by Veolia are also presented in Figure 5.3. Veolia confirmed that mechanical evaporators were operated in the dam from June 2017. Veolia also transferred leachate into ED3N lagoons to manage the leachate. The simulated results were obtained by using a pan factor of 0.6, direct rainfall runoff from within the dam footprint area and without any seepage loss from the dam floor. The water balance model was assumed to be representative for the purpose of scope of works presented in Section 1.3.

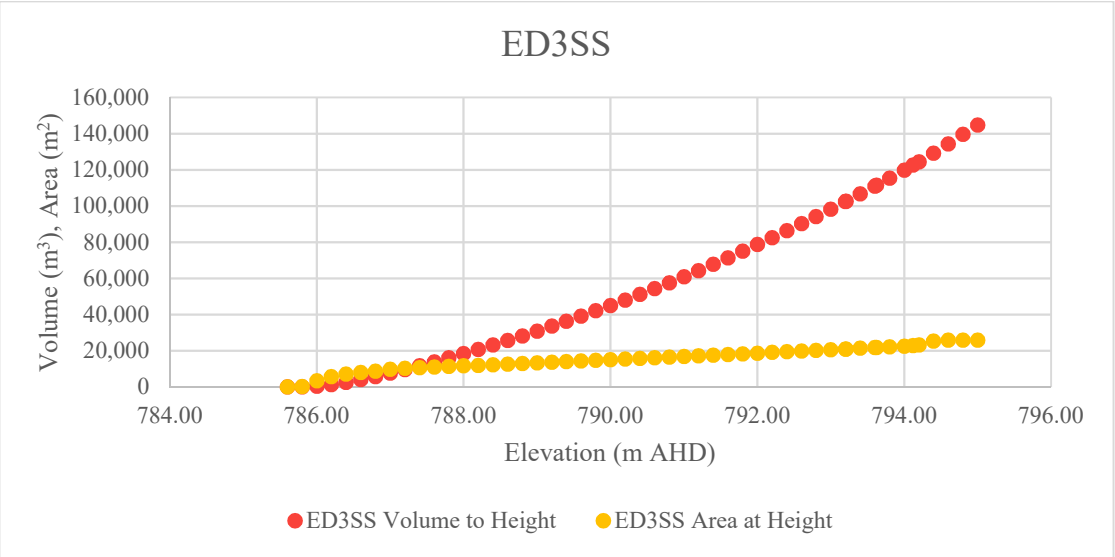


Figure 5.1 ED3SS bathymetric data used in simulations (source: Veolia)

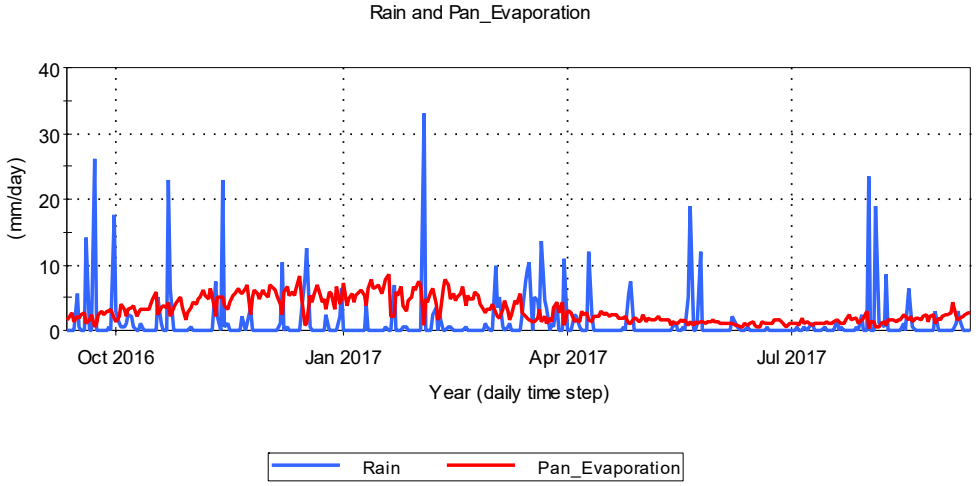


Figure 5.2 Daily rain and pan evaporation data from 11September 2016 to 11 September 2017 (source: Veolia)

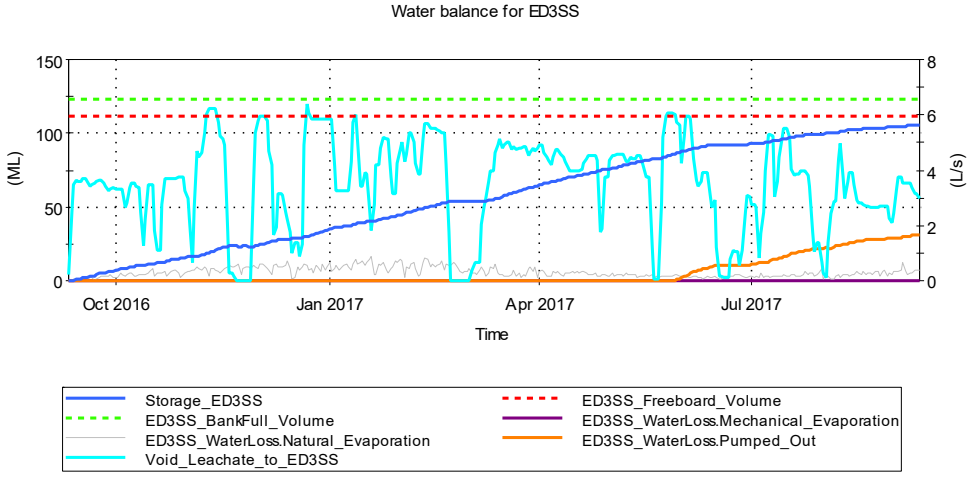


Figure 5.3 Simulated daily results from 11September 2016 to 11 September 2017 for ED3SS

6. CLIMATE SEQUENCES

The following sub-sets of climate sequences were used in assessing modelled scenarios:

1. Wettest (1950-1959), a sequence with 4 years of annual rainfalls > 1000 mm
2. Driest (1979-1988), a sequence with 5 years of annual pan evaporation > 1500 mm
3. Average (1963-1972), a sequence with annual rainfalls < 900 mm and annual pan evaporation between 1000 mm to 1200 mm.

The annual sequences are shown in Figure 6.1 for rainfall and Figure 6.2 for pan evaporation. Note that the long-term averages for annual rainfall and pan evaporation from 1932 to 2016 are 683 mm and 1,231mm respectively.

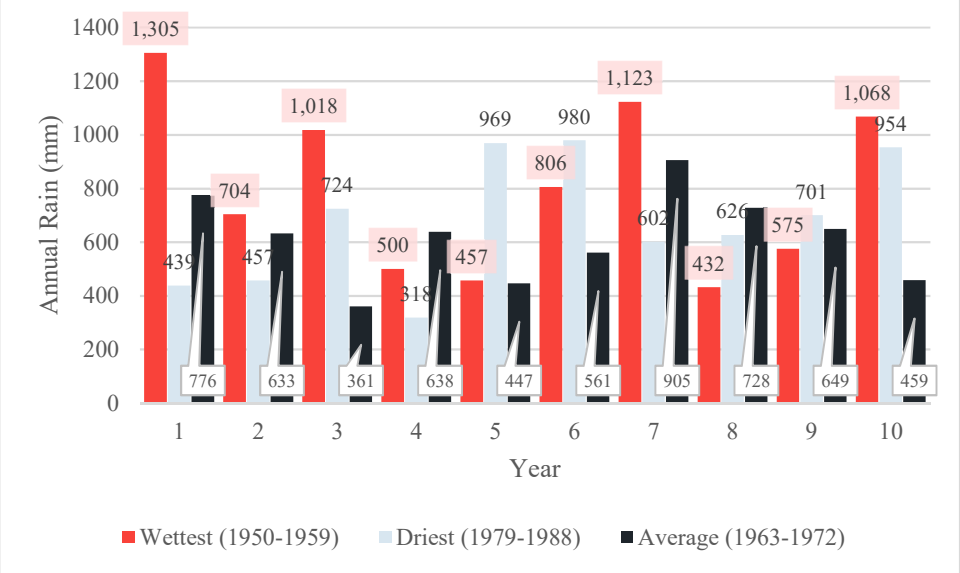


Figure 6.1 Annual sum of daily rainfall sequences used in modelling scenarios

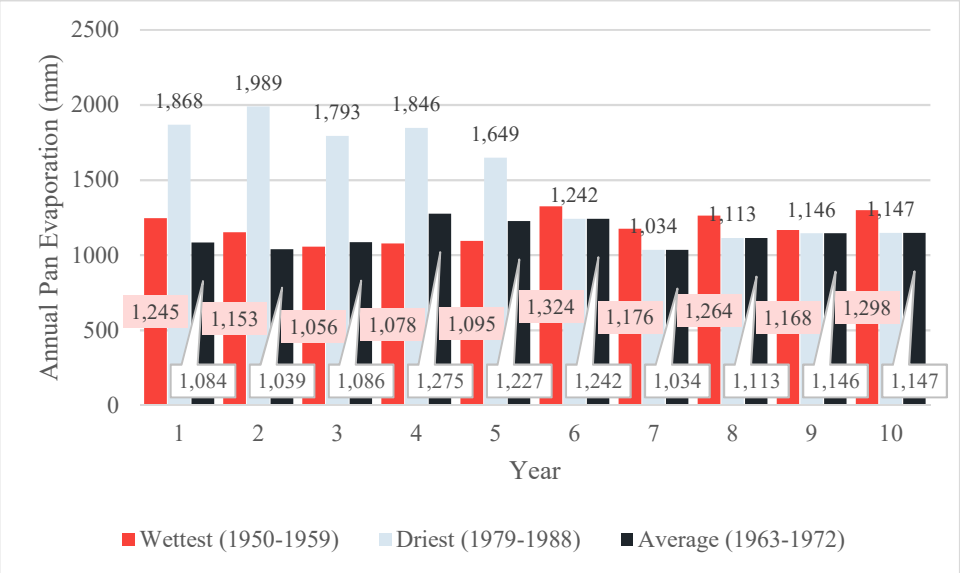


Figure 6.2 Annual sum of daily pan evaporation sequences used in modelling scenarios

7. SIMULATED RESULTS

7.1 ED1 COFFER DAM

The objective of the simulations was to estimate required size of ED1 Coffer Dam (referred to as ED1CD) so that the leachate supply at 4 L/s to the dam can be managed for 4 years without being at full capacity. Veolia provided a preliminary design for a coffer dam with a bank full capacity of 150 ML. This coffer dam will be situated within the footprint of ED1 thus splitting the dam into ED1 North and ED1 Coffer Dam. Veolia wanted to test the following two scenarios:

- ED1CD-Scenario1 assumes that Heron will use treated leachate in ED1CD at a rate of 2 L/s.
- ED1CD -Scenario2 assumes that Heron will not use the treated leachate from ED1CD.

Details of ED1 Coffer Dam scenarios and results are summarised in Table 7.1. The scenarios were assessed based on the time to reach the freeboard level volume. Daily simulated results for each of the scenarios are presented in charts from Figure 7.1 through to Figure 7.15.

The feasible solutions are as follows:

- The proposed 150 ML Coffer Dam may be able to service for the intended 4-year period, if Heron uses water from the coffer dam at a rate of 2 L/s and 4 x Type A Evaporators are used simultaneously for 70% of the time every year.
- One and a half cells of 150 ML Coffer Dam may be required to service the intended 4-year period, if Heron does not use water from the coffer dam and a total of 5 x Type A Evaporators are used simultaneously for 70% of the time every year.
- Three cells of 150 ML Coffer Dam may be required to service the intended 4-year period, if Heron does not use water from the coffer dam and evaporators are not used.

Table 7.1 Modelled scenarios for ED1 Coffer Dam

SCENARIOS	WATER LOSS IN ADDITION TO THE NATURAL EVAPORATION		CLIMATE	TIME TO REACH FREEBOARD VOLUME (DAYS)
ED1 COFFER DAM 150 ML AT BANK FULL				
SCENARIO 1A	HERON WATER USE AT 2 L/S	NO MECHANICAL EVAPORATORS	WETTEST	782
SCENARIO 1B			DRIEST	967
SCENARIO 1C			AVERAGE	900
SCENARIO 1D		4 X TYPE A EVAPORATORS	WETTEST	1,766
SCENARIO 1E			DRIEST	2,170
SCENARIO 1F			AVERAGE	2,157
SCENARIO 2D	NO WATER USE BY HERON	4 X TYPE A EVAPORATORS	WETTEST	615
SCENARIO 2E			DRIEST	735
SCENARIO 2F			AVERAGE	663
ED1 COFFER DAM 225 ML AT BANK FULL				
SCENARIO 3D	NO WATER USE BY HERON	5 X TYPE A EVAPORATORS	WETTEST	1,519
SCENARIO 3E			DRIEST	1,876
SCENARIO 3F			AVERAGE	1,813
ED1 COFFER DAM 450 ML AT BANK FULL				
SCENARIO 4A	NO WATER USE BY HERON	NO MECHANICAL EVAPORATORS	WETTEST	1,663
SCENARIO 4B			DRIEST	2,014
SCENARIO 4C			AVERAGE	1,856

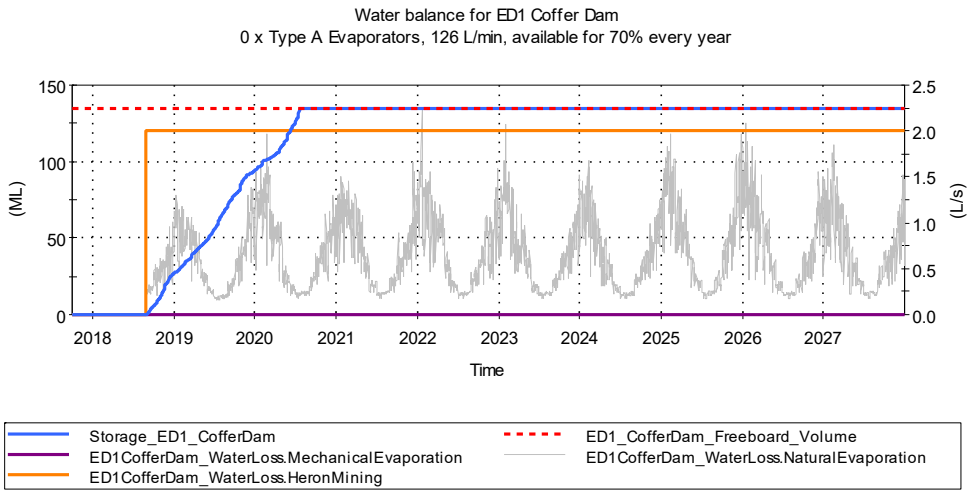


Figure 7.1 Simulated daily time series for the 150 ML ED1 Coffer Dam Scenario 1A

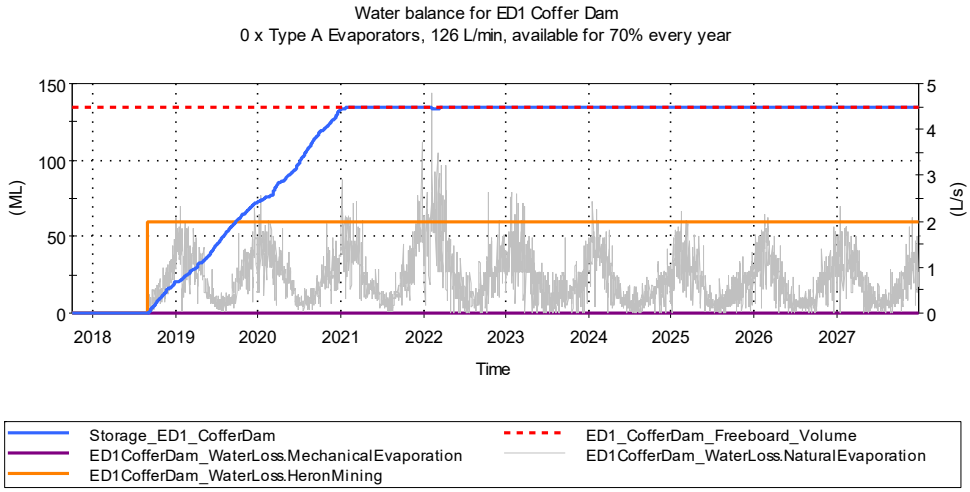


Figure 7.2 Simulated daily time series for the 150 ML ED1 Coffer Dam Scenario 1B

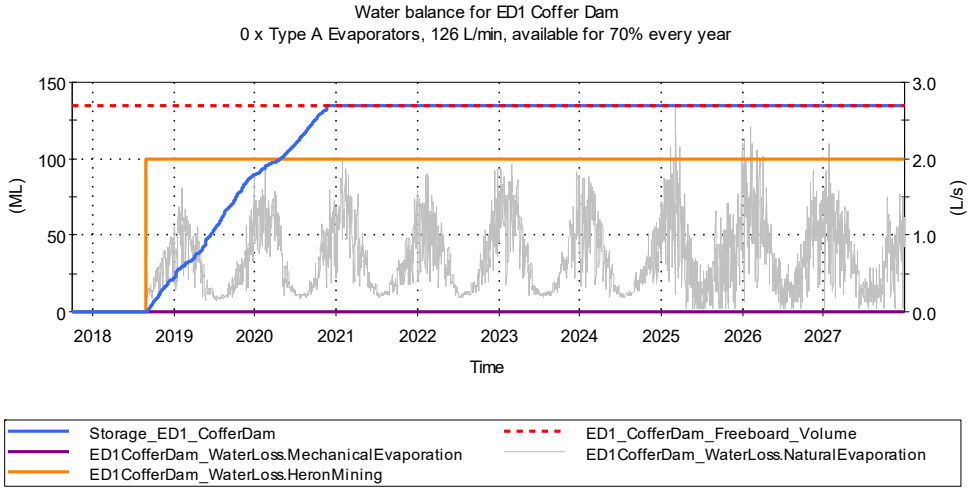


Figure 7.3 Simulated daily time series for the 150 ML ED1 Coffer Dam Scenario 1C

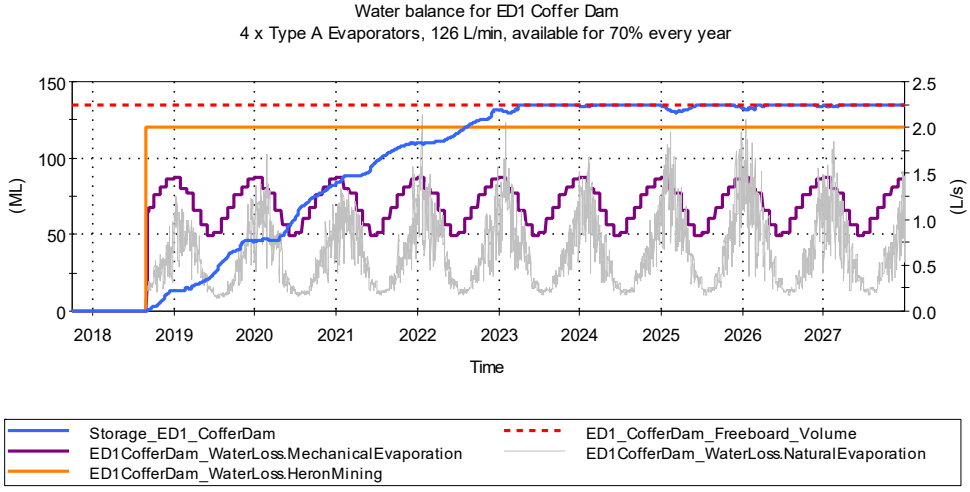


Figure 7.4 Simulated daily time series for the 150 ML ED1 Coffer Dam Scenario 1D

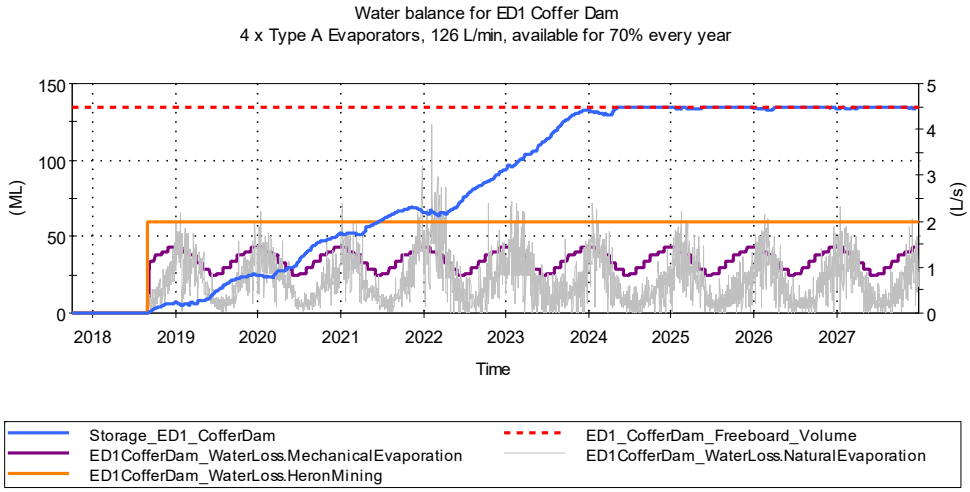


Figure 7.5 Simulated daily time series for the 150 ML ED1 Coffer Dam Scenario 1E

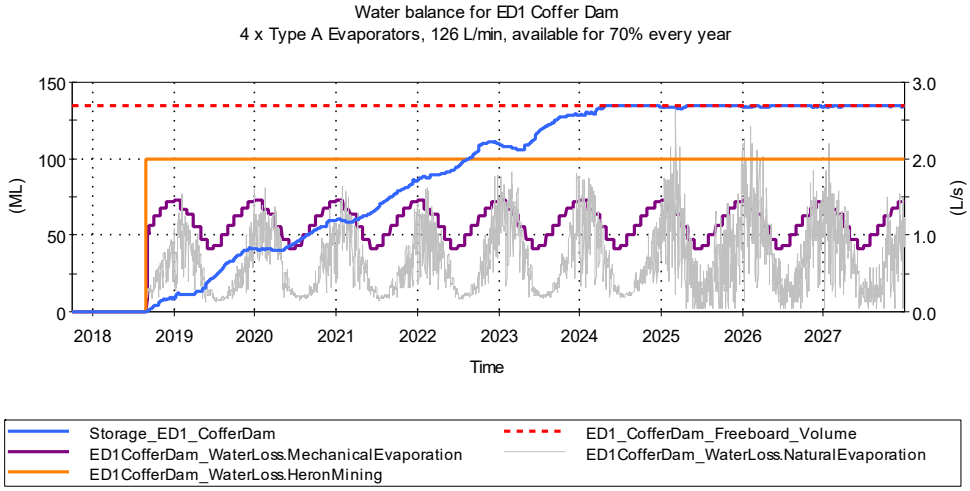


Figure 7.6 Simulated daily time series for the 150 ML ED1 Coffer Dam Scenario 1F

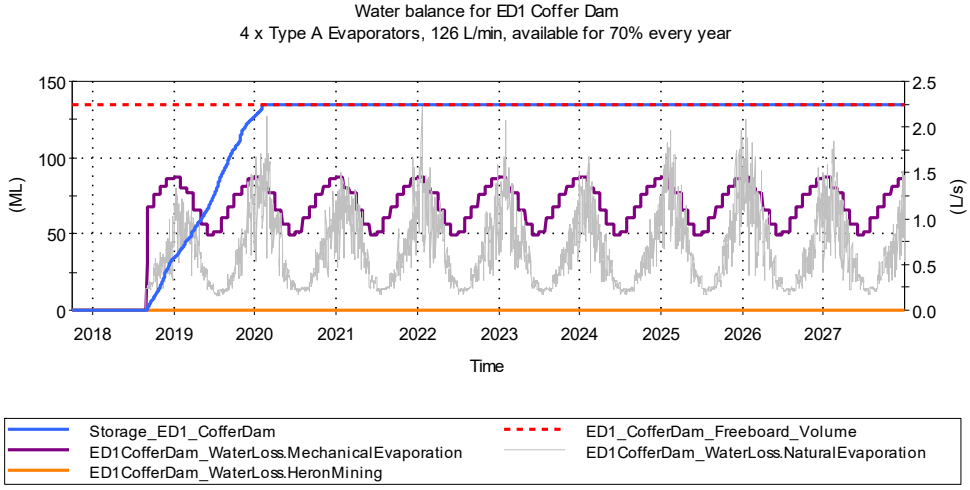


Figure 7.7 Simulated daily time series for the 150 ML ED1 Coffer Dam Scenario 2D

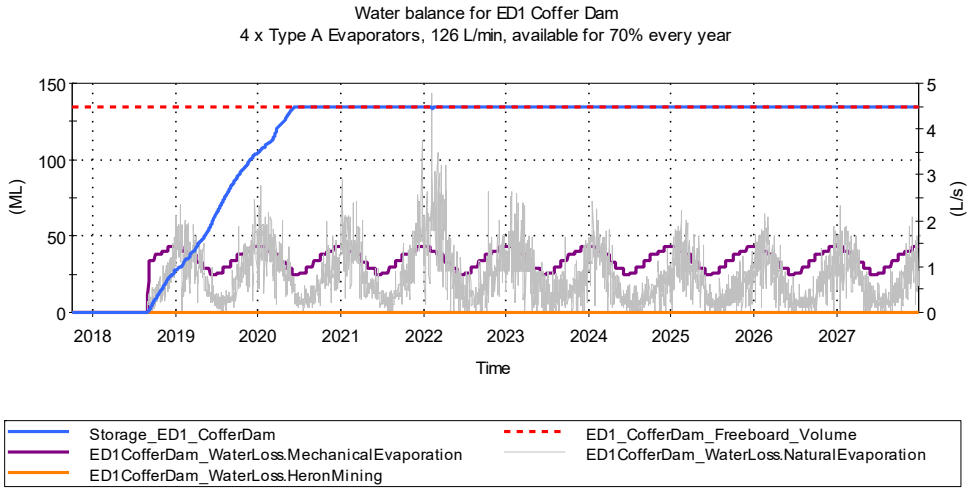


Figure 7.8 Simulated daily time series for the 150 ML ED1 Coffer Dam Scenario 2E

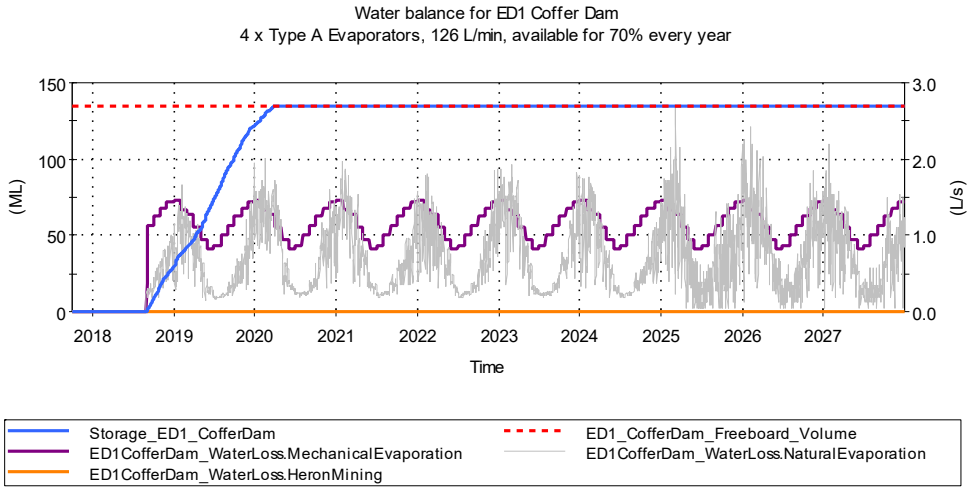


Figure 7.9 Simulated daily time series for the 150 ML ED1 Coffer Dam Scenario 2F

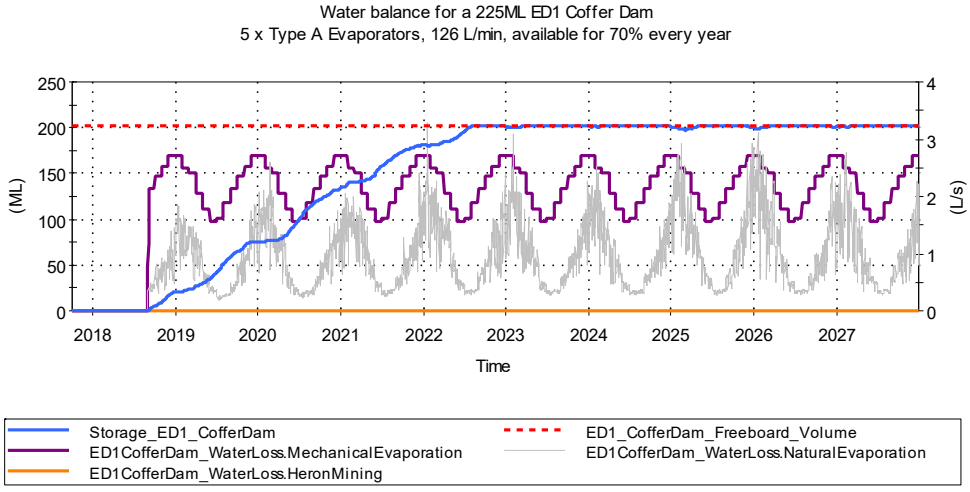


Figure 7.10 Simulated daily time series for the 225 ML ED1 Coffer Dam Scenario 3D

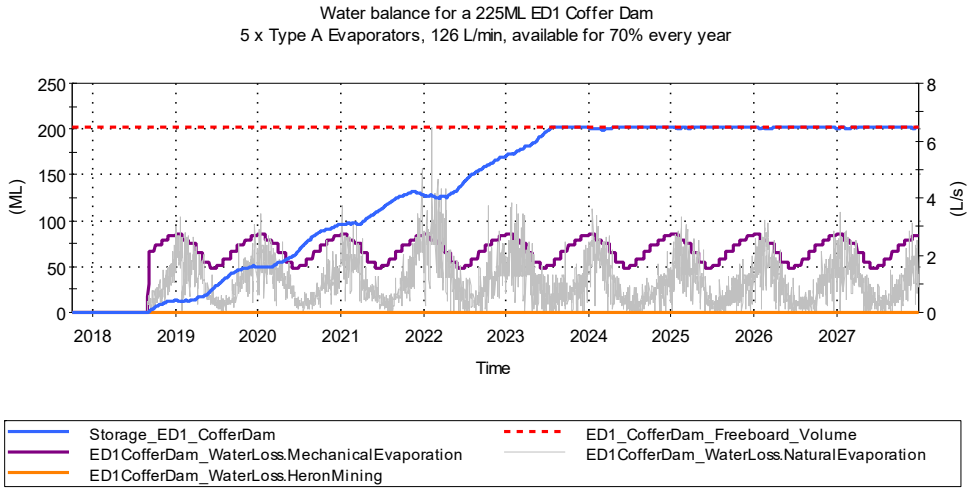


Figure 7.11 Simulated daily time series for the 225 ML ED1 Coffer Dam Scenario 3E

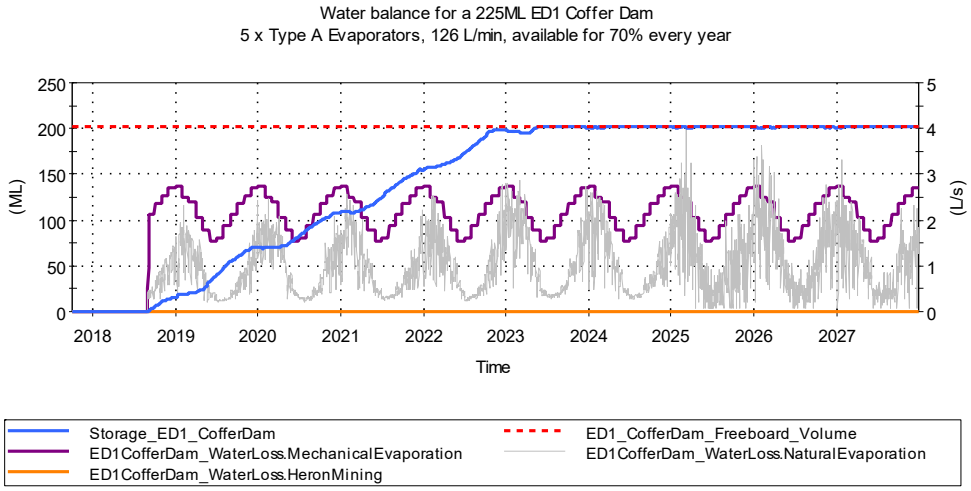


Figure 7.12 Simulated daily time series for the 225 ML ED1 Coffer Dam Scenario 3F

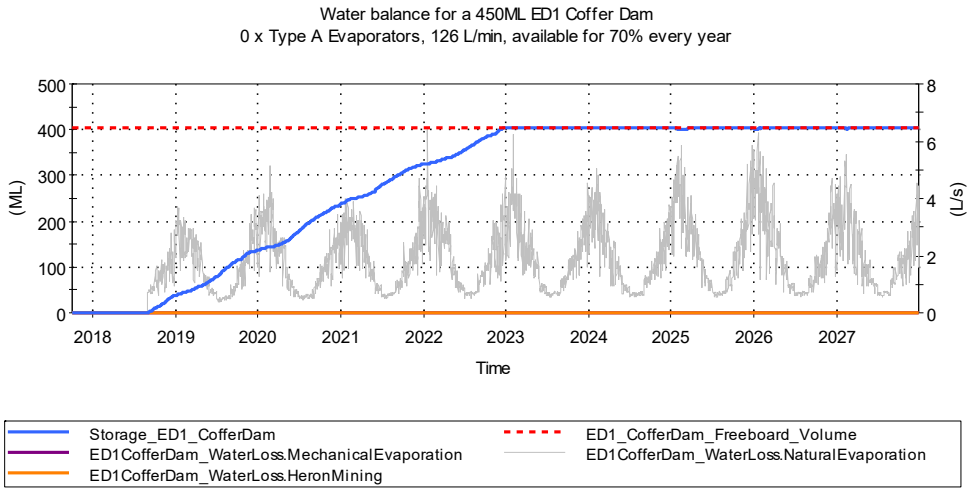


Figure 7.13 Simulated daily time series for the 450 ML ED1 Coffer Dam Scenario 4D

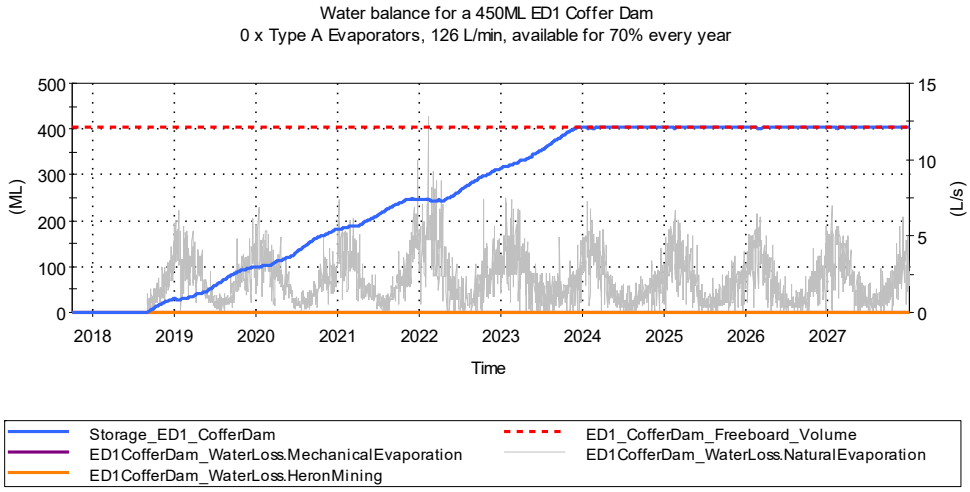


Figure 7.14 Simulated daily time series for the 450 ML ED1 Coffer Dam Scenario 4E

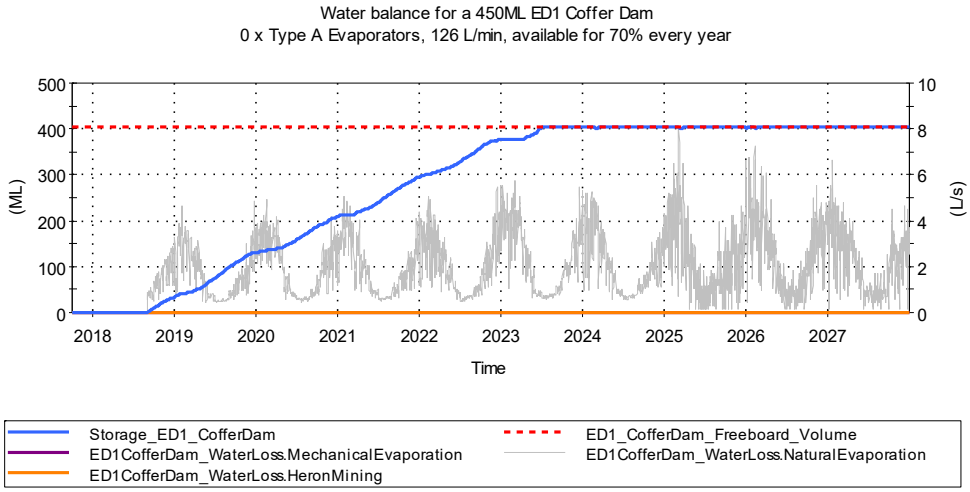


Figure 7.15 Simulated daily time series for the 450 ML ED1 Coffer Dam Scenario 4F

7.2 ED1 NORTH DAM

The objective of the simulation was to estimate how many units of a commercially available evaporators will be required to dry up the water volume currently stored in the dam. This dam has an external catchment of approximately 14.7 ha in addition to its foot print area of 54.3 ha or a net footprint area of 51 ha, if a 150 ML coffer dam is constructed. Given that the rainfall-runoff will still occur from the external catchment into ED1 North Dam, complete drying of the dam may not be possible. The number of evaporators have been estimated based on achieving a minimum water volume of 10 ML.

Results (refer to Table 7.2, Figure 7.16, Figure 7.17 and Figure 7.18) from the simulations indicate that 2 units of Minetek 75kw Evaporator with 1500 L/min flow operating for at least 34% every year will be able to dry up the ED1 North Dam to 10 ML within:

- 6 years in the wettest climate
- 2 year in the driest climate
- 3 years in the average climate used in the simulation.

Table 7.2 Modelled scenarios for ED1 North Dam

SCENARIOS	WATER LOSS IN ADDITION TO THE NATURAL EVAPORATION		CLIMATE	TIME TO EMPTY TO 10 ML VOLUME (DAYS)
SCENARIO D	NO WATER USE BY HERON	2 X MINETEK EVAPORATORS	WETTEST	2,058
SCENARIO E			DRIEST	707
SCENARIO F			AVERAGE	1,036

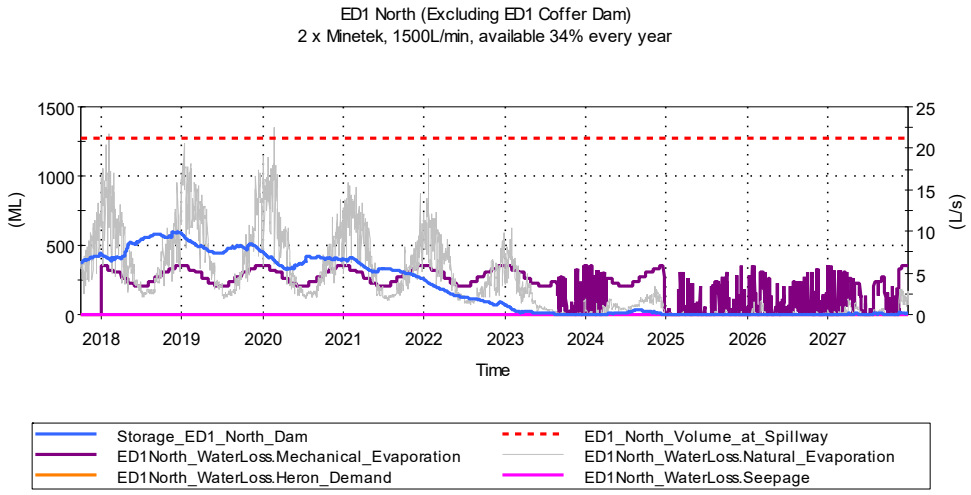


Figure 7.16 Simulated daily time series for ED1 North Dam Scenario D

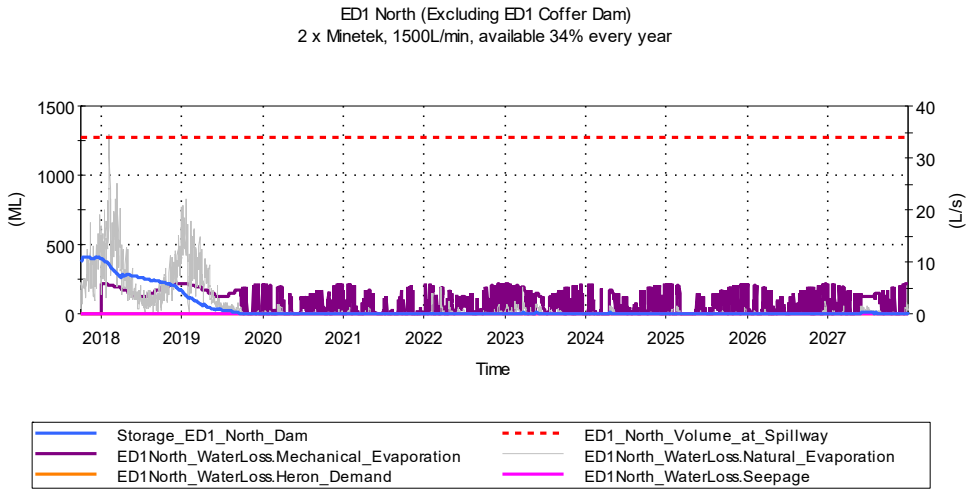


Figure 7.17 Simulated daily time series for ED1 North Dam Scenario E

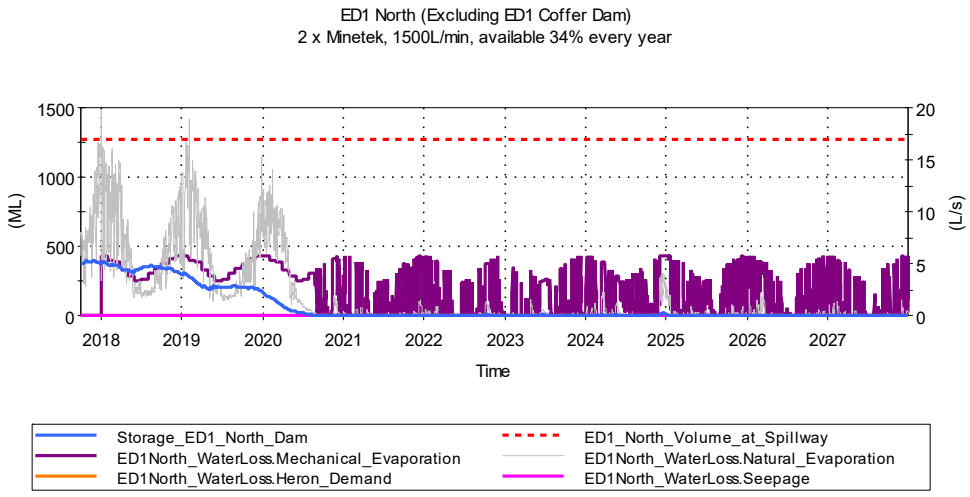


Figure 7.18 Simulated daily time series for ED1 North Dam Scenario F

7.3 ED3 NORTH AND ED3SS DAMS

There were two main objectives of the simulations undertaken for EDN3 and ED3SS dams:

- to estimate number of locally developed evaporators (Type A and Type B) required to maintain water volume below freeboard levels so that leachate disposal can be continued until the end of 2019.
- to estimate duration in days until the dams would become empty, if the evaporators were to continue operating in these dams.

Simulations were undertaken by varying the number of evaporators in the dams until the objectives were achieved.

Leachate input to ED3N and ED3SS will be managed by utilising available volumes below the freeboard level in each dam. Available storages above the freeboard levels to the dam crests are reserved for direct rainfall and local runoffs from the embankment slopes only. Note that freeboard level is 0.5m below the lowest dam crest level at each dam.

Veolia already has 5 x Mechanical Evaporators at ED3N4 and plans to install additional 3 x Type A floating evaporators. Veolia also plans to install 1 x Type A evaporator each at other lagoons of ED3N and 3 x Type B evaporators at ED3SS.

Available storage volume (as of 30 August 2017) below the freeboard level is the largest in ED3N4 and the second largest in ED3SS and the third largest in ED3N1, however altogether the remaining volume to the freeboard is 170 days without accounting for any evaporation (Table 2.1).

For simulation purpose, it was assumed that Veolia will continue to supply leachate to ED3N4 while the evaporators are operating. If required, the leachate will be diverted to other dams in the following order of priority: ED3N1, ED3SS, ED3N3 and ED3N2.

Table 7.3 summarises the results for a revised configuration of evaporators that were found to achieve both objectives. The number of Type A evaporators (flow rate= 126 L/min) were increased from 3 to 11 for ED3N4, keeping the 5 x Existing Mechanical Evaporators (flow rate= 168 L/min). The remainder of the dams had the number and type of evaporators as per Veolia's proposal.

Daily simulated results for the wettest climate sequence (worst case for volume build up) are presented in Figure 7.19 for ED3SS, Figure 7.20 for ED3N1, Figure 7.21 for ED3N2, Figure 7.22 for ED3N3 and Figure 7.23 for ED3N4.

The simulated results presented in Figure 7.23 for ED3N4 illustrates that the leachate during 2018 and 2019 can be supplied to ED3N4 and managed via the proposed number of evaporators operating as per the specification outlined in Table 3.1.

Even without the leachate supply and despite 3 x Type B evaporators operating at ED3SS dam 70% each year, Figure 7.19 illustrates likelihood of volume in ED3SS exceeding the freeboard level if the wettest sequence of climate similar to that from 1950 to 1959 occur in future.

Figure 7.21 for ED3N2 illustrates that the volume in ED3N2 is also likely to exceed the freeboard level as this dam is at freeboard level as of 30 August 2017.

Water volumes in ED3N3 and ED3N4 did not exceed the freeboard level in the simulation for the wettest climate sequence (refer to Figure 7.22 for ED3N3 and Figure 7.23 for ED3N4).

All ED3 dams, except ED3SS, are expected to dry up within 5 years if the proposed mechanical evaporators are kept in operation (Table 7.3). The days to empty the ED3N dams varies from the lowest 839 days for ED3N4 to 1,611 days for ED3N1 dam for the wettest climate sequence

Daily simulated results for other scenarios are presented in charts from Figure 7.24 through to Figure 7.33.

The total number of evaporators required at ED3N4 is 16, which may not be physically feasible to install and operate. The result of this simulation was discussed with Veolia for an alternative strategy. Veolia advised that the alternative strategy would be to increase flow rates through the existing mechanical evaporators. These evaporators are rated at 350 L/min, however, the flow through the evaporators have been limited to 168 L/min due to pump capacity. Veolia may consider increasing the pump capacity as well as increasing the evaporator availability from 34% to as high as 70% if required.

To test the impact of increased flow rate on reduction in number of required Type A evaporators for ED3N4, Scenario D was repeated by doubling the flow rates through the Existing Mechanical Evaporators, increasing the availability to 40% but limiting the number of Type A evaporators to 3. Results for the wettest climate simulation for ED3N4 is presented in Figure 7.34 that achieves similar outcomes as Scenario D results presented in Table 7.3. ED3N4 dam is expected to dry up in 885 days instead of 839 days for Scenario D in Table 7.3.

Figure 7.34 illustrates that by doubling the flow rate through Existing Mechanical Evaporators at ED3N4 has advantage in reducing Type A Evaporator requirement from 11 units to 3 units only.

Table 7.3 Modelled scenarios for ED3 and ED3SS Dams

SCENARIOS	WATER LOSS IN ADDITION TO THE NATURAL EVAPORATION		CLIMATE	TIME TO EMPTY TO 10 ML VOLUME (DAYS)	TIME TO FILL UP TO FREEBOARD (DAYS)	SIMULATED OFFURRENCE OF VOLUME TO DAM CREST (DAYS)
SCENARIO D	ED3SS	3 X TYPE B EVAPORATORS	WETTEST	NOT ACHIEVED	211 (REFER TO FIGURE 7.19)	0
SCENARIO E			DRIEST	NOT ACHIEVED	0	0
SCENARIO F			AVERAGE	NOT ACHIEVED	0	0
SCENARIO D	ED3N1	1 X TYPE A EVAPORATOR	WETTEST	1,611	0 (REFER TO FIGURE 7.20)	0
SCENARIO E			DRIEST	731	0	0
SCENARIO F			AVERAGE	941	0	0
SCENARIO D	ED3N2	1 X TYPE A EVAPORATOR	WETTEST	1,482	8 (REFER TO FIGURE 7.21	0
SCENARIO E			DRIEST	745	0	0
SCENARIO F			AVERAGE	921	0	0
SCENARIO D	ED3N3	1 X TYPE A EVAPORATOR	WETTEST	1,267	87 (REFER TO FIGURE 7.22	0
SCENARIO E			DRIEST	552	0	0
SCENARIO F			AVERAGE	826	0	0
SCENARIO D	ED3N4	11 X TYPE A EVAPORATOR AND 5 X EXISTING MECHANICAL EVAPORATORS	WETTEST	839	0 (REFER TO FIGURE 7.23	0
SCENARIO E			DRIEST	549	0	0
SCENARIO F			AVERAGE	743	0	0

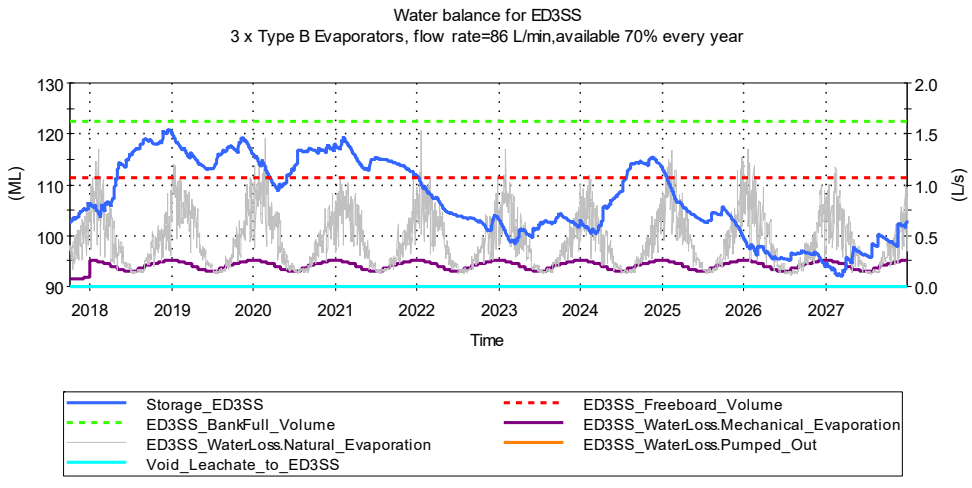


Figure 7.19 Simulated result for ED3SS in the wettest climate sequence

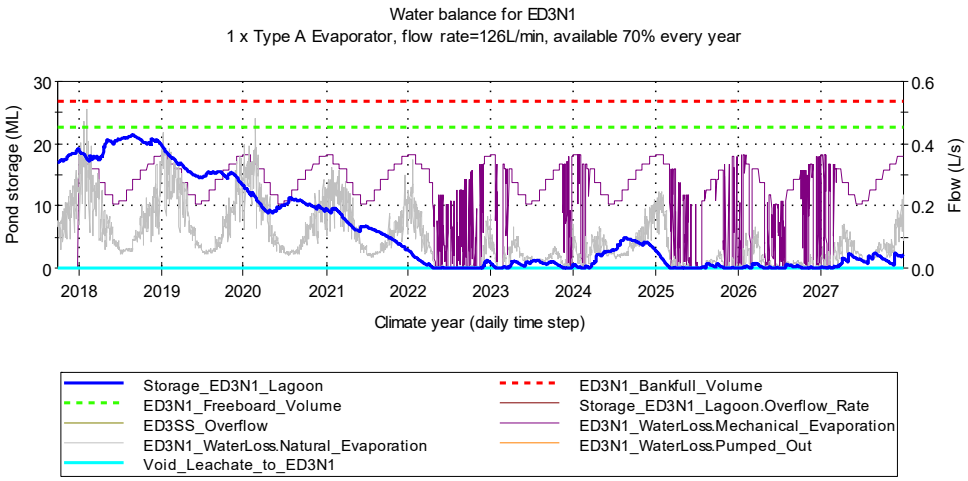


Figure 7.20 Simulated result for ED3N1 in the wettest climate sequence

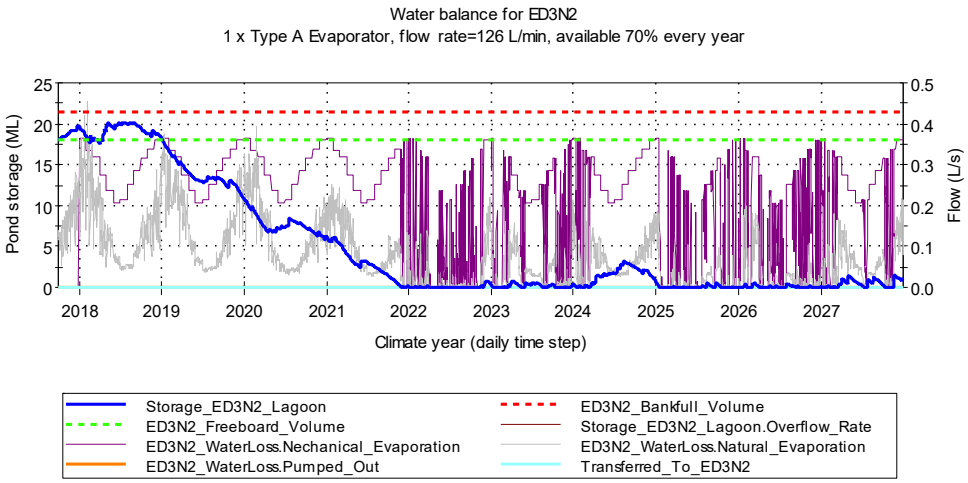


Figure 7.21 Simulated result for ED3N2 in the wettest climate sequence

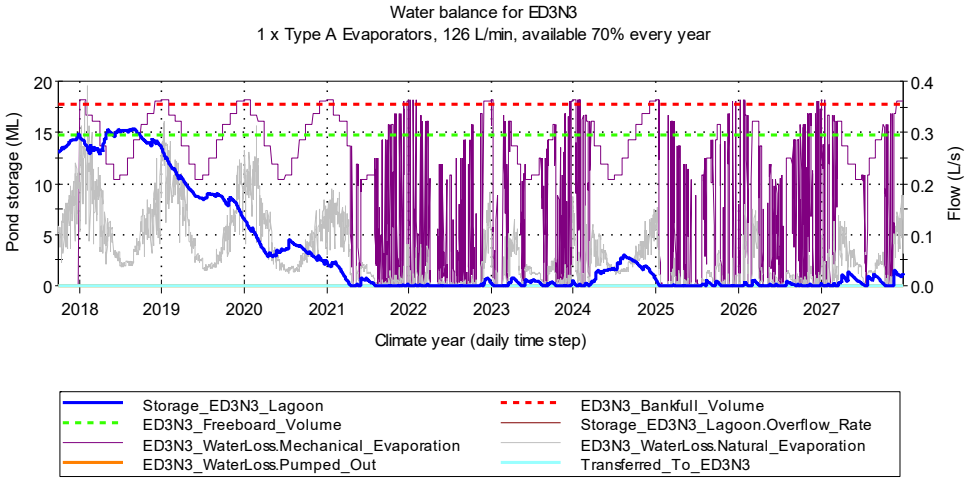


Figure 7.22 Simulated result for ED3N3 in the wettest climate sequence

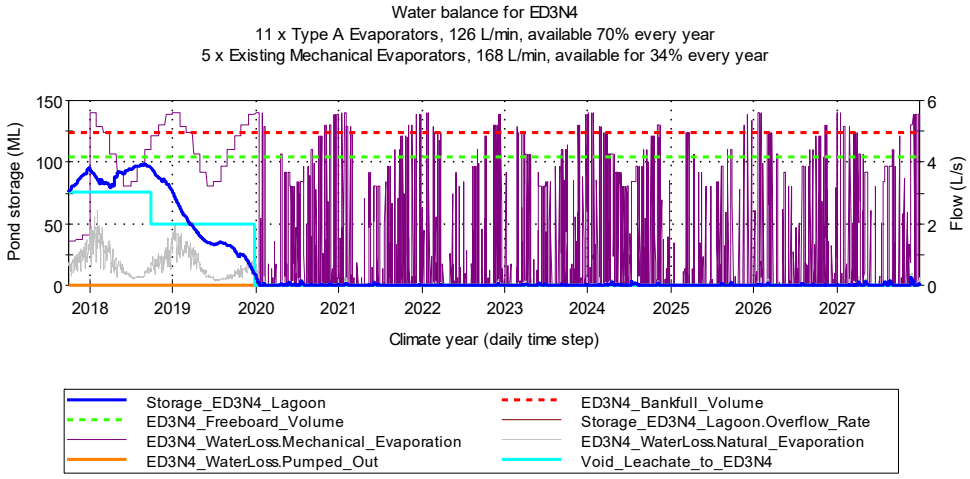


Figure 7.23 Simulated result for ED3N4 in the wettest climate sequence

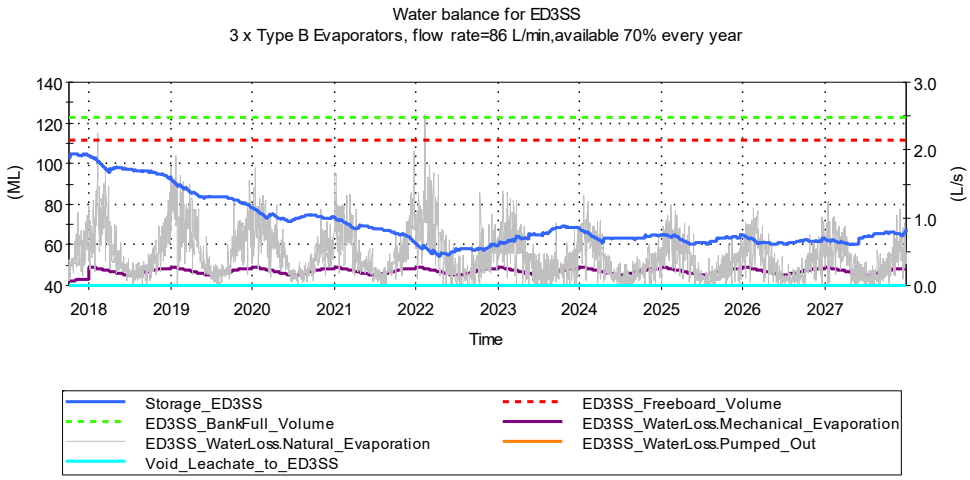


Figure 7.24 Simulated result for ED3SS in the driest climate sequence

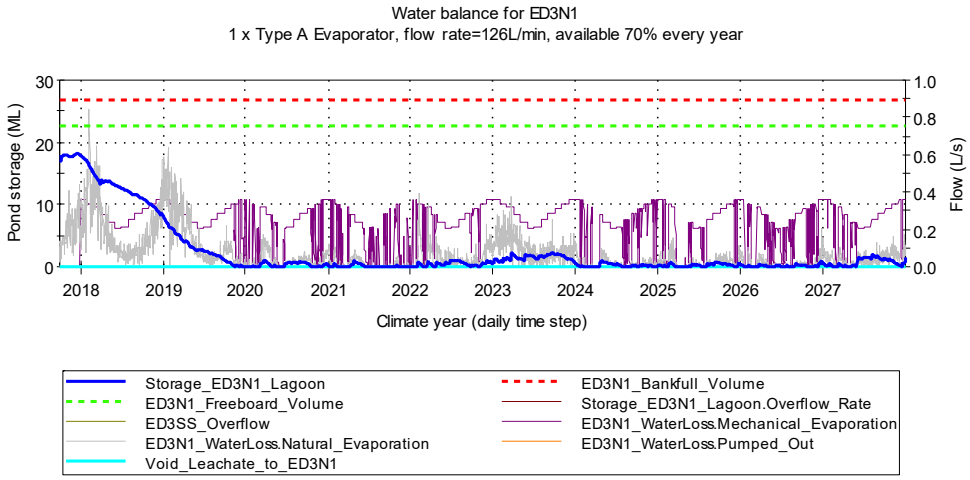


Figure 7.25 Simulated result for ED3N1 in the driest climate sequence

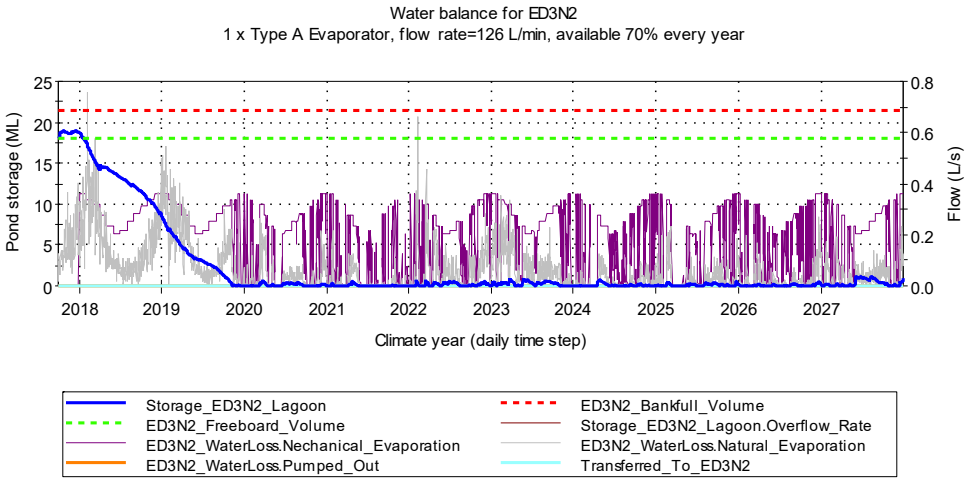


Figure 7.26 Simulated result for ED3N2 in the driest climate sequence

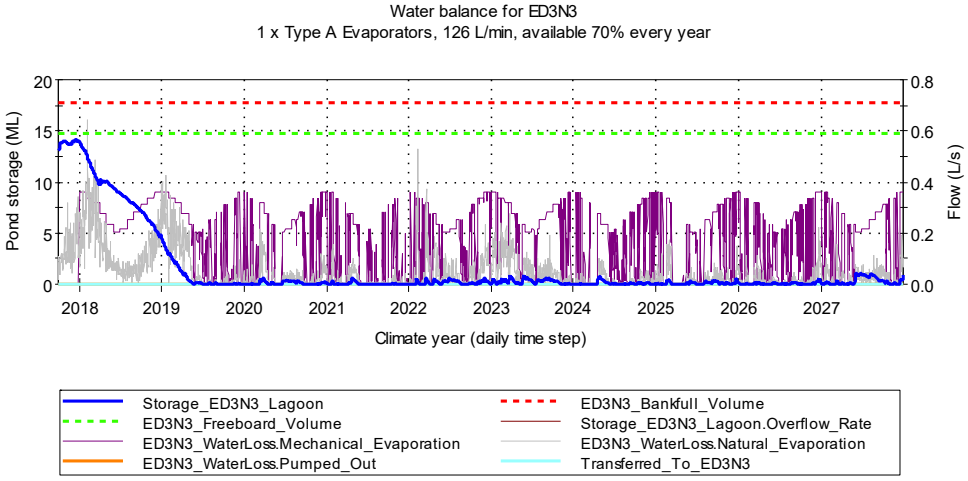


Figure 7.27 Simulated result for ED3N3 in the driest climate sequence

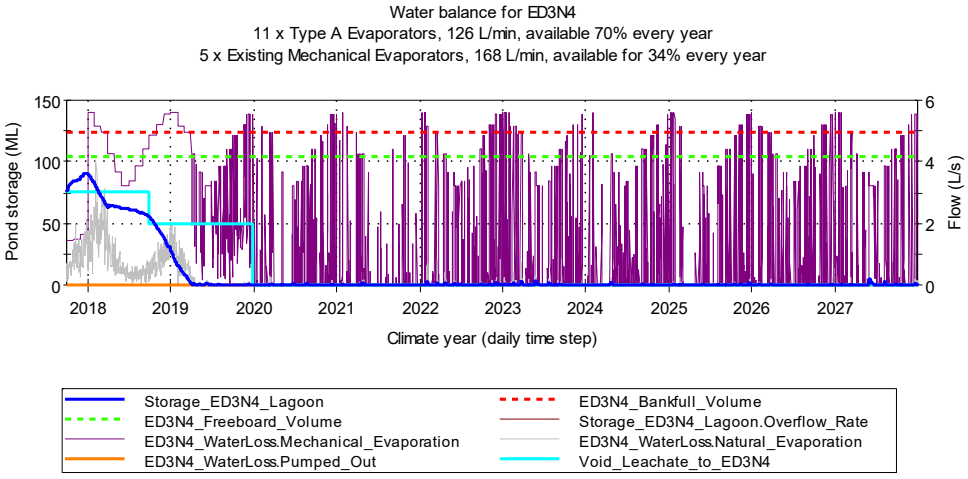


Figure 7.28 Simulated result for ED3N4 in the driest climate sequence

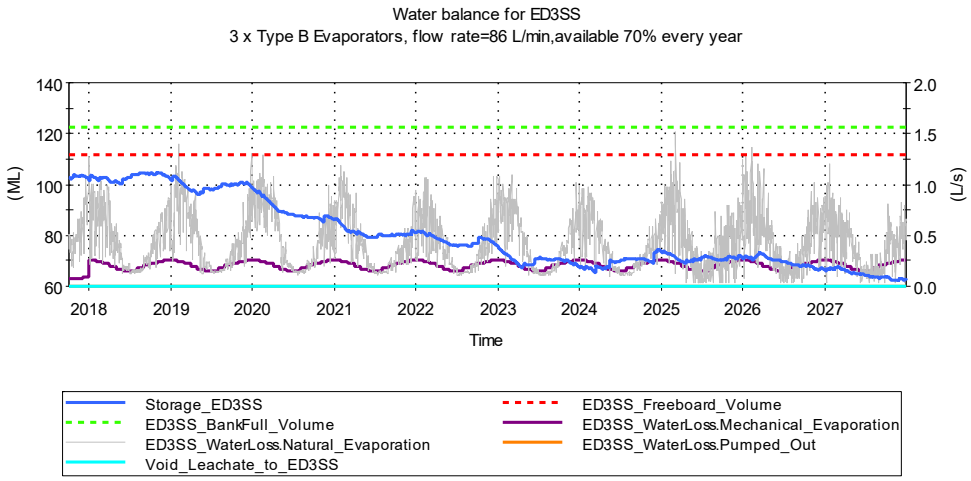


Figure 7.29 Simulated result for ED3SS in the average climate sequence

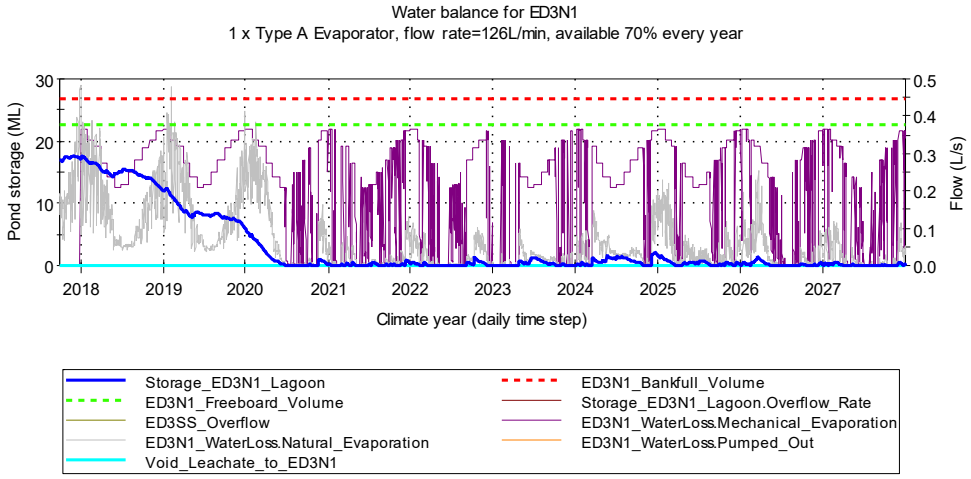


Figure 7.30 Simulated result for ED3N1 in the average climate sequence

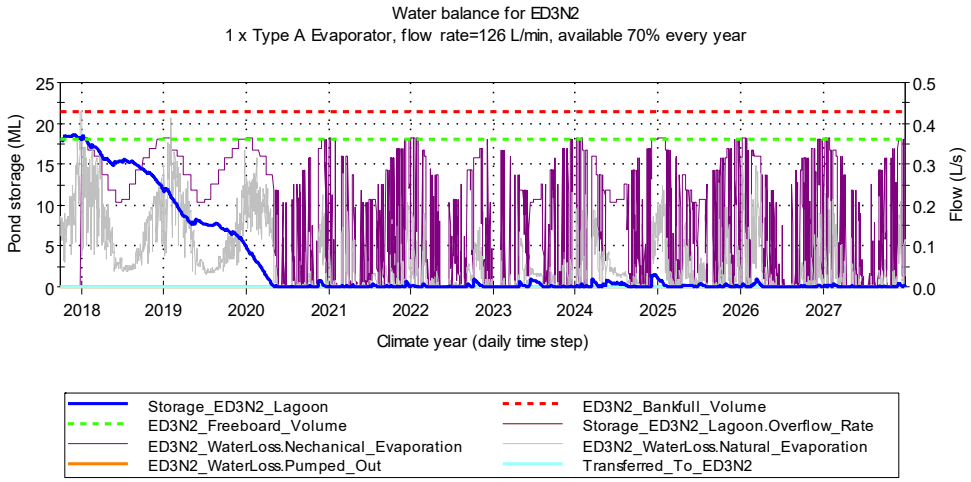


Figure 7.31 Simulated result for ED3N2 in the average climate sequence

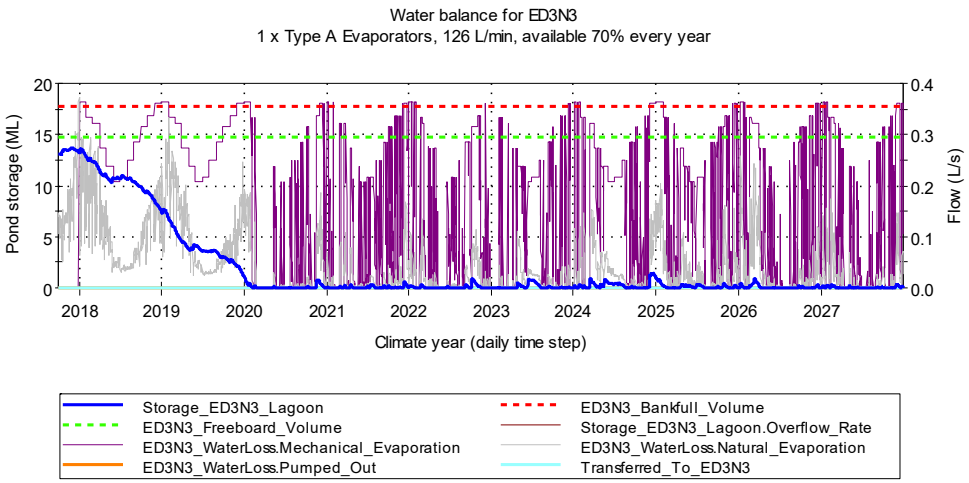


Figure 7.32 Simulated result for ED3N3 in the average climate sequence

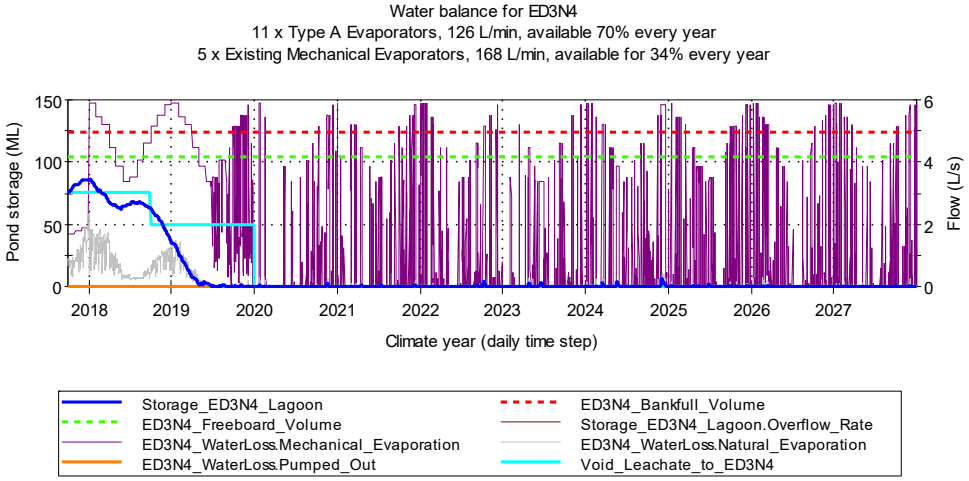


Figure 7.33 Simulated result for ED3N4 in the average climate sequence

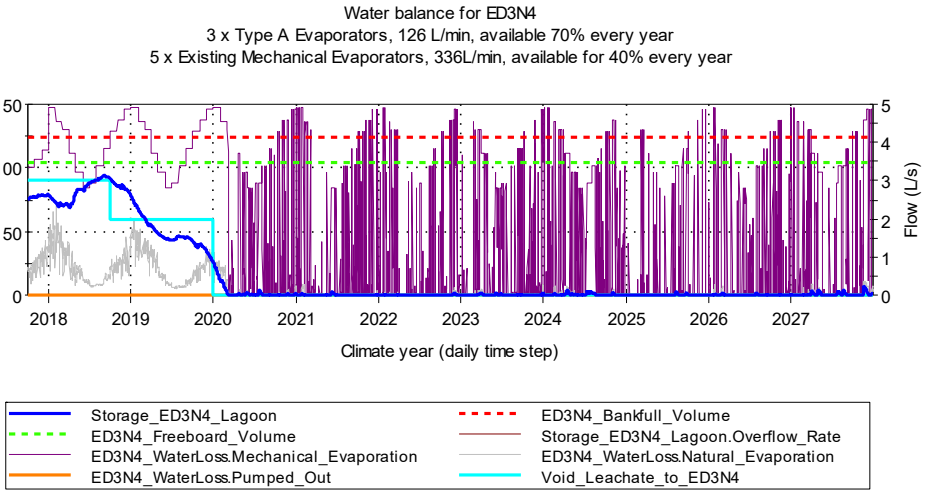


Figure 7.34 Simulated result for ED3N4 in the wettest climate sequence with increased flow rates through Existing Mechanical Evaporators

8. SUMMARY

Water balance assessments were undertaken by WSP for Veolia to estimate:

- required number of proposed mechanical evaporators to manage leachate from September 2017 through to December 2019 using ED3SS and ED3N lagoons. If Leachate were supplied at 3 L/s from September 2017 to August 2018 and at 2 L/s from September 2018 to December 2019, the following number and type of evaporators were found to meet the requirements:
  - 1 x Type A at ED3N1, ED3N2, ED3N3 operating for 70% of the year at a flow rate of 126 L/min
  - 3 x Type B at ED3SS operating for 70% of the year at a flow rate of 86 L/min
  - 5 x Existing Mechanical Evaporator operating for 34% of the year at a flow rate of 168 L/min and 11 x Type A operating for 70% of the year at a flow rate of 126 L/min at ED3N4 or
  - 5 x Existing Mechanical Evaporator operating for 40% of the year at a flow rate of 336 L/min and 3 x Type A operating for 70% of the year at a flow rate of 126 L/min at ED3N4.
- size of proposed ED1 Coffer Dam.
  - The proposed 150 ML Coffer Dam may be able to service for the intended 4-year period, if Heron uses water from the coffer dam at a rate of 2 L/s and 4 x Type A Evaporators are used simultaneously for 70% of the time every year.
  - One and a half cells of 150 ML Coffer Dam may be required to service the intended 4-year period, if Heron does not use water from the coffer dam and a total of 5 x Type A Evaporators are used simultaneously for 70% of the time every year.
  - Three cells of 150 ML Coffer Dam may be required to service the intended 4-year period, if Heron does not use water from the coffer dam and evaporators are not used.
- required number of Mintek mechanical evaporator units to dry up ED1 North Dam in ten years. Two units of Minetek 75kw Evaporator with 1500 L/min flow operating for at least 34% every year will be able to dry up the ED1 North Dam to 10 ML within:
  - 6 years in the wettest climate
  - 2 year in the driest climate
  - 3 years in the average climate used in the simulation.

These results are subject to the climatic sequences, dam and mechanical evaporator characteristics data used in water balance modelling.

Yours sincerely

Aditya Jha
Principal Water Resources Engineer

Carl Kopke
General Manager, Resources West

The Water balance simulation done by WSP at Sep. 2017 stated that the ED3N 1 - 4 will be dry at the middle of 2020. To fully use the evaporation system in the ED3N dams, leachate stored in ED3SS will be pumped into ED3N system (ED3N1 - 4) since mid-2020. The evaporation system in all the dams is presented in Table 1.

Table 1 Leachate storage dams and evaporation system

Dams	Storage capacity (ML)[a]	Area of rain catchment (m^2)[b]	Rain water catchment per year (ML)[c]	Evaporation system	Evaporation (assisted + natural) (L/s)[a]	Evaporation per year (ML)
ED1 effluent dam	135[d]	33,011	23	4 * floating evaporators (type A)	1.2	37.8
ED3N1	22.6	11,483	8.0	1 * floating evaporators (type A)	0.3	9.5
ED3N2	18.1	9,300	6.5	1 * floating evaporators (type A)	0.3	9.5
ED3N3	14.8	8,900	6.2	1 * floating evaporators (type A)	0.3	9.5
ED3N4	104.2	45,900	32.0	3 * floating evaporators (type A) 5 * mechanical evaporators	3.5	110.4
ED3SS	111.4	25,900	18	3 * floating evaporators (type B)	0.6	18.9
Total	406.1	134,494	93.7	10 * floating evaporators (type A) 5 * mechanical evaporators 3 * floating evaporators (type B)	6.2	195.5
Notes	a. With 0.5 m freeboard b. Based on the simulation done by WSP in Sep. 2017 c. Based on the average rain fall from 2014 - 2016, 696.6 mm per year					

d. The proposed ED1 effluent dam has a 150 ML volume at bank full. So the 135 ML is the estimated volume with 0.5 m freeboard.

Based on the above status and the ability of the evaporation system, the net water loss (volume of evaporation - volume of rain water catchment) from ED3 leachate storage dams (ED3N1 - 4 and ED3SS) is about **80 ML per year**. The ED3N dams will be empty by the end of 2022 and the rest of leachate will be transferred into ED3SS. The leachate in the ED3 leachate storage dams (90 ML in total) will be emptied by the end of 2023. As a result, at the beginning of 2024, ED1 effluent dam will be full and all the ED3 leachate storage dams (ED3N1 - 4 and ED3SS) will be empty and ready to receive effluent from LTP.

ED3 leachate storage dams will be considered as one whole dam for this calculation. From Jan. 2024, effluent from LTP will be discharged into ED3 leachate storage dams at the rate of 4 L/s and Heron will use the effluent at the rate of 2 L/s. The net inflow into the ED3 leachate storage dams will be 2 L/s till Dec. 2028. The status for the ED3 leachate storage dams is presented in the following Table 2.

Table 2 ED3 leachate storage dams till Dec. 2028

Storage capacity (ML)	Evaporation per year (ML)	Rain water catchment per year (ML)	Net inflow per year (ML)	Water accumulation per year (ML)
271.1	157.7	70.7	63.1	-23.9

When Heron will use the LTP effluent at 2 L/s (until Dec. 2028), the evaporation (assisted + natural) from all the ED3 leachate storage dams and ED1 effluent dam will be greater than the net inflow (rain water + 2 L/s LTP effluent), **6.2 L/s *vs.* 5.0 L/s**. Effluent from LTP in the ED1 effluent dam will be transferred into the ED3 leachate storage dams (after relining) and use the evaporation system to evaporate as much LTP effluent as possible. The total evaporation potential for all the evaporation systems is 195.5 ML/year, the total rainwater catchment in all the dams is 93.7 ML/year. The net LTP effluent (2 L/s) till Dec. 2028 is 63.1/year. The net water loss will be 38.7 ML/year. At this rate, the LTP effluent stored in ED1 effluent dam (135 ML) will also be evaporated in 3.5 years (Jan. 2024 to Jul. 2027).

However in the practice of operation, the evaporation system will not operate when the water level is really shallow. As a result, not all the leachate storage dam will be empty, especially when the LTP is still operating and discharge continuously. It is assumed that the last 20 ML will be left in the storage system.

At the beginning of 2029, Heron will stop using LTP effluent so the net inflow rate into the leachate storage dams will go up to 4 L/s. All the leachate storage dams will be considered as on whole dam, with the status shown in Table 3

Table 3 Leachate storage dams after Jan. 2029

Residual storage capacity (ML)	Evaporation per year (ML)	Rain water catchment per year (ML)	Net inflow per year (ML)	Water accumulation per year (ML)
386.1	195.5	93.7	126.2	24.4

It will take about 16 years to fully fill all the leachate storage dams (Jan. 2029 to Dec. 2044).

Another effluent dam within the ED1 footprint will need to be ready before **Jan. 2045**. Assuming the new effluent dam will be constructed exactly same as the previous ED1 effluent dam, as well as the evaporation system. The status for all the leachate storage dams is presented in Table 4

Table 4 Leachate storage dams after Jan. 2045

Residual storage capacity (ML)	Evaporation per year (ML)	Rain water catchment per year (ML)	Net inflow per year (ML)	Water accumulation per year (ML)
135	233.3	116.7	126.2	9.6

It will take about 14 years (Jan. 2045 - Dec. 2059) to fully fill all the evaporation dams.

More effluent dams will be needed be ready before Jan. 2060 if the LTP operation continues.

Note: This simulation is conducted based on the constant extraction rate from the LTP at 4L/s.

Borehole/Monitoring Bore
ENVIRONMENTAL FIELD LOG

Woodward-Clyde

Borehole No: **MB1**

Sheet: 1 of 1

CLIENT:	**DENEHURST LIMITED**	JOB NUMBER:	**A3100321/0002**
PROJECT:	**Hydrogeological Assesment**	DATE COMMENCED:	**2 DEC 96**
LOCATION:	**Woodlawn Mines**	DATE COMPLETED:	**3 DEC 96**
DRILL CONTRACTOR:	**SLADE DRILLING**	LOGGED BY:	**BRC**

Drill Model: **NA** Hole Angle: **Vert** deg. Bore Size: **129 mm** RL: **2797.512 TOC**

Drilling Fluid: **NA** Orientation: **NA** deg. Co-ords: E **9735.00** N **9752.10**

Drilling Info.

Method: Air Hammer

Casing: 50mm PVC Class 12 Caisng

Low resistance Penetration Refusal

Water: WL at 29.26m on DEC 96

Depth (m)

Material Properties

Graphic Log

Classification: Dol

Material Description — type, plasticity/particle size, colour, secondary/minor components

0–5m: DOLERITE, highly weathered, orange/brown, with clay, moderate plasticity.

grades to moderately weathered, rusty brown dolerite.

5–10m: DOLERITE, fresh, blue/grey.

20–25m: fracture zone at 21.5m (approx 0.1 thick), slightly weathered.

25–30m: DOLERITE, fresh blue/grey.

End of bore hole at 32.2m.

Moisture Condition

Consistency Rel. Density: S

Field Records/Construction Information

Scale

Sampling

Testing PID (ppm)

Comments/Construction

Protective steel casing

Top of PVC casing 0.34m AGL

Cement surface seal.

50mm PVC casing threaded Class 12

Backfill

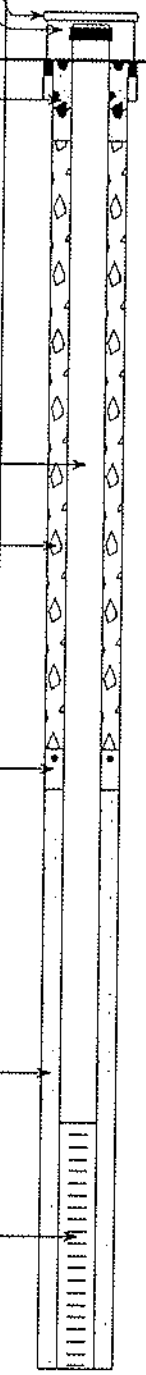
Bentonite

Hole left over night, at 18m, no water made in hole

Gravel pack

Factory slotted casing.

Well Diagram



Produced By: MJC

Checked By: BRC

Document No: S:/A31/00321/0002/LOGS/MB3.LOG:mjc

Borehole/Monitoring Bore
ENVIRONMENTAL FIELD LOG

Woodward-Clyde

Borehole No: **MB2**

Sheet: 1 of 1

CLIENT:	**DENEHURST LIMITED**	JOB NUMBER:	**A3100321/0002**
PROJECT:	**Hydrogeological Assesment**	DATE COMMENCED:	**5 DEC 96**
LOCATION:	**Woodlawn Mines**	DATE COMPLETED:	**5 DEC 96**
DRILL CONTRACTOR:	**SLADE DRILLING**	LOGGED BY:	**BRC**

Drill Model:	**NA**	Hole Angle:	**Vert**	deg.	Bore Size:	**129 mm**	RL: **2781.86 TOC**
Drilling Fluid:	**NA**	Orientation:	**NA**	deg.	Co-ords: E	**9502.90**	N **10201.80**

Drilling Info.

Method: Blade Bit; Air Hammer

Casing: 50mm PVC Class 12 Casing

Penetration (m/hr, 3f)

Water: WL at 1.14m on 5 DEC 96

Depth (m): 5, 10, 15, 20, 25, 30, 35

Material Properties

Graphic Log	Classification	Material Description (type, plasticity/particle size, colour, secondary/minor components)	Moisture Condition	Consistency Rel. Density
	CM	CLAY,moderate to high plasticity, dark brown, stiff, minor of shale (<2mm in size).		
	CH	CLAY, colour change brown/black, gravel material present, moderate to highly weathered dolerite.		
	Dol	CLAY, low plasticity, dark brown, slightly moist.		
		DOLERITE, slightly weathered to fresh.		
		End of bore hole at 13.2m.		

Field Records/Construction Information

Scale; Sampling; Testing; PID (ppm)

Comments/Construction

Protective steel casing

Top of PVC casing 0.28m AGL.

Cement surface seal.

50mm PVC casing threaded Class 12

Backfill

Bentonite

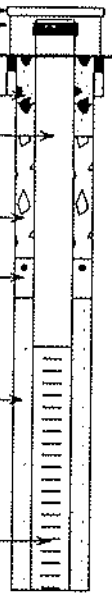
Gravel pack

Factory slotted casing.

End of bore hole making 0.5-1 l/sec

Note: SWL 1.40m below top of casing, Dec 1996.

Well Diagram



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Document No: S:/A31/00321/0002/LOGS/MB3.LOG:mjc

Borehole/Monitoring Bore
ENVIRONMENTAL FIELD LOG

Woodward-Clyde

Borehole No: **MB3**

Sheet: 1 of 1

CLIENT:	**DENEHURST LIMITED**	JOB NUMBER:	**A3100321/0002**
PROJECT:	**Hydrogeological Assesment**	DATE COMMENCED:	**5 DEC 96**
LOCATION:	**Woodlawn Mines**	DATE COMPLETED:	**5 DEC 96**
DRILL CONTRACTOR:	**SLADE DRILLING**	LOGGED BY:	**BRC**

Drill Model:	**NA**	Hole Angle:	**Vert**	deg.	Bore Size:	**129 mm**	RL: **2793.20 TOC**
Drilling Fluid:	**NA**	Orientation:	**NA**	deg.	Co-ords: E	**9762.30**	N **10850.50**

Drilling Info. | Material Properties | Field Records/Construction Information

Method	Casing	Penetration (mins/0.2m)	Water	Depth (m)	Graphic Log	Classification	Material Description (type, plasticity/particle size, colour, secondary/minor components)	Moisture Condition	Consistency Rel. Density	Scale	Sampling	Testing	PID (ppm)	Comments/Construction	Well Diagram
Blade Bit	50mm PVC Class 12 Casing		WL at 3.01m on DEC 96	0		CM	FILL, dolerite road base.		HW					Protective steel casing; Top of PVC casing 0.30m AGL	
							CLAY, Silty, moderate plasticity, red/brown, moderately stiff.							Cement surface seal.	
				5		Shl	SILTSTONE, highly weathered Shale, tan/brown, moist.	M	S						
						CH	CLAY, high plasticity, clean, soft, moist.	W						at 7m returns to very wet.	
				10			highly weathered Shale, with minor quratz in a clay matrix.							50mm PVC casing threaded Class 12	
														Backfill	
				15										Bentonite	
				20		GP	GRAVEL, angular of quartz/shale and tuff, unsorted 1-50mm, generally 2-8mm in size, very minor silt content, clean.	W						making approx. 1L/sec; Gravel pack	
				25			End of bore hole at 25.8m.							Factory slotted casing. at 25m bore making 2-3L/sec, hole begining to collapse	
				30											
				35											

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Checked By: BRC

Document No: S:/A31/00321/0002/LOGS/MB3.LOG:mc

Borehole/Monitoring Bore
ENVIRONMENTAL FIELD LOG

Woodward-Clyde

Borehole No: **MB4**

Sheet: 1 of 1

CLIENT:	**DENEHURST LIMITED**	JOB NUMBER:	**A3100321/0002**
PROJECT:	**Hydrogeological Assesment**	DATE COMMENCED:	**3 DEC 96**
LOCATION:	**Woodlawn Mines**	DATE COMPLETED:	**3 DEC 96**
DRILL CONTRACTOR:	**SLADE DRILLING**	LOGGED BY:	**BRC**

Drill Model:	**NA**	Hole Angle:	**Vert**	deg.	Bore Size:	**129 mm**	RL: **2786.50 TOC**
Drilling Fluid:	**NA**	Orientation:	**NA**	deg.	Co-ords: E	**10333.5**	N **9263.2**

Drilling Info.					Material Properties					Field Records/Construction Information					
Method	Casing	Top resistance penetration (min/0.1m)	Water	Depth (m)	Graphic Log	Classification	Material Description: type, plasticity/particle size, colour, secondary/minor components	Moisture Condition	Consistency Rel. Density	Scale	Sampling	Testing PID (ppm)	Comments/Construction	Well Diagram
Air Hammer	50mm PVC Calss 12 Casing		WL at 9.39m on DEC 96	5 10 15 20 25 30 35		Fil	FILL, compacted cobbles of dolerite and tuff.						Protective steel casing Top of PVC casing 0.30m AGL Cement surface seal high dusting high penetration rate 50mm PVC casing threaded Class 12 reduction in dusting Backfill high penetration rate Bentonite becoming moist at 18m Gravel pack Factory slotted casing. hole making small volumes of water during development	
						Shl	SHALE, moderately weathered, grey/blue, soft, friable. weathered zone 12-12.5m brown colouration, returns to the slightly harder material, siliceous content in the shale. soft SHALE. SHALE, dark red/brown. End of bore hole at 25.8m.							

Produced By: MC
Checked By: BRC

Document No: S:/A31/00321/0002/LOGS/MB4.LOG:mc

Borehole/Monitoring Bore ENVIRONMENTAL FIELD LOG

Woodward-Clyde

Borehole No: **MB6**

Sheet: 1 of 1

CLIENT:	DENEHURST LIMITED	JOB NUMBER:	A3100321/0002
PROJECT:	Hydrogeological Assesment	DATE COMMENCED:	5 DEC 96
LOCATION:	Woodlawn Mines	DATE COMPLETED:	5 DEC 96
DRILL CONTRACTOR:	SLADE DRILLING	LOGGED BY:	BRC

Drill Model: NA — Hole Angle: Vert deg. — Bore Size: 129 mm — RL: 2796.205

Drilling Fluid: NA — Orientation: NA deg. — Co-ords: E 9224.90 N 9181.90

Drilling Info.					Material Properties					Field Records/Construction Information				
Method	Casing	Ins. resistance/ Penetration rate/air	Water	Depth (m)	Graphic Log	Classification	Material Description: type, plasticity/particle size, colour, secondary/minor components	Moisture Condition	Consistency Rel. Density	Scale	Sampling	Testing PID (ppm)	Comments/Construction	Well Diagram

Air Hammer

50mm PVC Class 12 Casing

WL at 11.38m on

Fill — FILL, dolerite/shale.

Shl — SHALE, highly weathered, brown, with minor clay. — H

CH — CLAY, high plasticity, red/brown.

Shl — SHALE, moderately weathered, white/grey, shale/siltstone. — M

Shl — SHALE, blue/grey, shale/slate, harder band, well laminated/cleavage. — H

End of bore hole at 25.8m.

Comments/Construction:

- Protective steel casing
- Top of PVC casing 0.36m AGL
- Cement surface seal
- 50mm PVC casing threaded Class 12 high dusting high penetration rate
- Backfill
- Bentonite
- Gravel pack starts to make water at 17m
- Factory slotted casing.

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Checked By: BRC

Document No: S:/A31/00321/0002/LOGS/MB6.LOG:mjc

Borehole/Monitoring Bore
ENVIRONMENTAL FIELD LOG

Woodward-Clyde

Borehole No: **MB7**

Sheet: 1 of 1

CLIENT:	**DENEHURST LIMITED**	JOB NUMBER:	**A3100321/0002**
PROJECT:	**Hydrogeological Assesment**	DATE COMMENCED:	**2 DEC 96**
LOCATION:	**Woodlawn Mines**	DATE COMPLETED:	**2 DEC 96**
DRILL CONTRACTOR:	**SLADE DRILLING**	LOGGED BY:	**BRC**

Drill Model:	**NA**	Hole Angle:	**Vert**	deg.	Bore Size:	**129 mm**	RL: **2789.07 TOC**
Drilling Fluid:	**NA**	Orientation:	**NA**	deg.	Co-ords: E	**8532.40**	N **9283.10**

Drilling Info.					Material Properties						Field Records/Construction Information				
Method	Casing	Low resistance Penetration (relative)	Water	Depth (m)	Graphic Log	Classification	Material Description type, plasticity/particle size, colour, secondary/minor components	Moisture Condition	Consistency Rel. Density		Scale	Sampling Testing PID (ppm)	Comments/Construction	Well Diagram
Air Hammer	50mm PVC Casing		WL at 1.35m on DEC 96	0 5 10 15 20 25 30 35		CH	CLAY, Silty, moderate to high plasticity, yellow/brown.						Protective steel casing Top of PVC casing 0.27m AGL Cement surface seal	
						Shl	SHALE, moderately soft, foliated, brown/grey, high dusting.		S				50mm PVC casing threaded Class 12 Backfill	
							SHALE, dark brown/grey, well laminated.						Bentonite Gravel pack Factory slotted casing.	
						Tuf	TUFF, Silicious, course grained, white with minor green speckles, distinct cleavage. drill breaks, fractures.		H					
							End of bore hole at 29m.							

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Document No: S:/A3I/00321/0002/LOGS/MB3.LOG:mjc

Borehole/Monitoring Bore
ENVIRONMENTAL FIELD LOG

Woodward-Clyde

Borehole No: **MB10**

Sheet: 1 of 1

CLIENT:	DENEHURST LIMITED	JOB NUMBER:	A3100321/0008
PROJECT:	WOODLAWN MINES ED1 ASS	DATE COMMENCED:	11 DEC 96
LOCATION:	ED1	DATE COMPLETED:	11 DEC 96
DRILL CONTRACTOR:	SLADE DRILLING	LOGGED BY:	SAB

Drill Model: **NA** Hole Angle: **Vert** deg. Bore Size: **125 mm** RL: **2783.80 TOC**

Drilling Fluid: **NA** Orientation: **NA** deg. Co-ords: E **9200.9** N **10163.90**

Drilling Info.					Material Properties						Field Records/Construction Information				
Method	Casing	Penetration Resistance (Blows per 0.3m)	Water	Depth (m)	Graphic Log	Classification	Material Description: type, plasticity/particle size, colour, secondary/minor components	Moisture Condition	Consistency Rel. Density	Scale	Sampling	Testing PID (ppm)	Comments/Construction	Well Diagram
Mud Rotary	50mm PVC Casing		WL at 0.3m on 11 DEC 96	0		CH	CLAY, brown and light brown mottled, soft to firm, some very fine sand, minor gravel.	M	M				Protective steel casing Top of PVC casing 1.70m AGL	
						GC	CLAY, dark grey, firm to stiff, minor gravel.	W	W				Cement grout to surface. Wet returns. Caving at change of rod from 2.0 to 6.5m.	
				5		SC	GRAVEL (clayey), light grey, coarse, sub-angular, minor fine gravel.	M/W					Making bore water at 2.0m.	
							SAND, yellow fine, sub-rounded, some soft clay (almost clayeye sand in sections), minor gravel.							
				10			GRAVEL, with a higher clay content than above.							
						GW	Hard silicious band; light green, subangular cuttings.						Bentonite.	
				15			GRAVEL, rounded to sub-angular, well sorted.						Gravel pack Bore making abundant water in gravels. Water flowing surface at at completion of drilling.	
				20			DOLERITE, grey, moderately weathered.						Screen.	
							End of bore at 20.8 m.							
				25									Note:SWL 0.30m below top of casing, Dec 1996.	
				30										
				35										

Produced By: MJC

Checked By: BRC

Document No: S:/A31/0032I/0008/LOGS/MB10.LOG:mj

AECOM

Monitoring Well MB28

Level 2, 60 Marcus Clarke Street, Canberra
(02) 6201 3000

Drilling Contractor: **Numac Drilling**

Project No.: **60528427**

Project Reference: **Woodlawn Evaporation Dams Seepage Assessment**

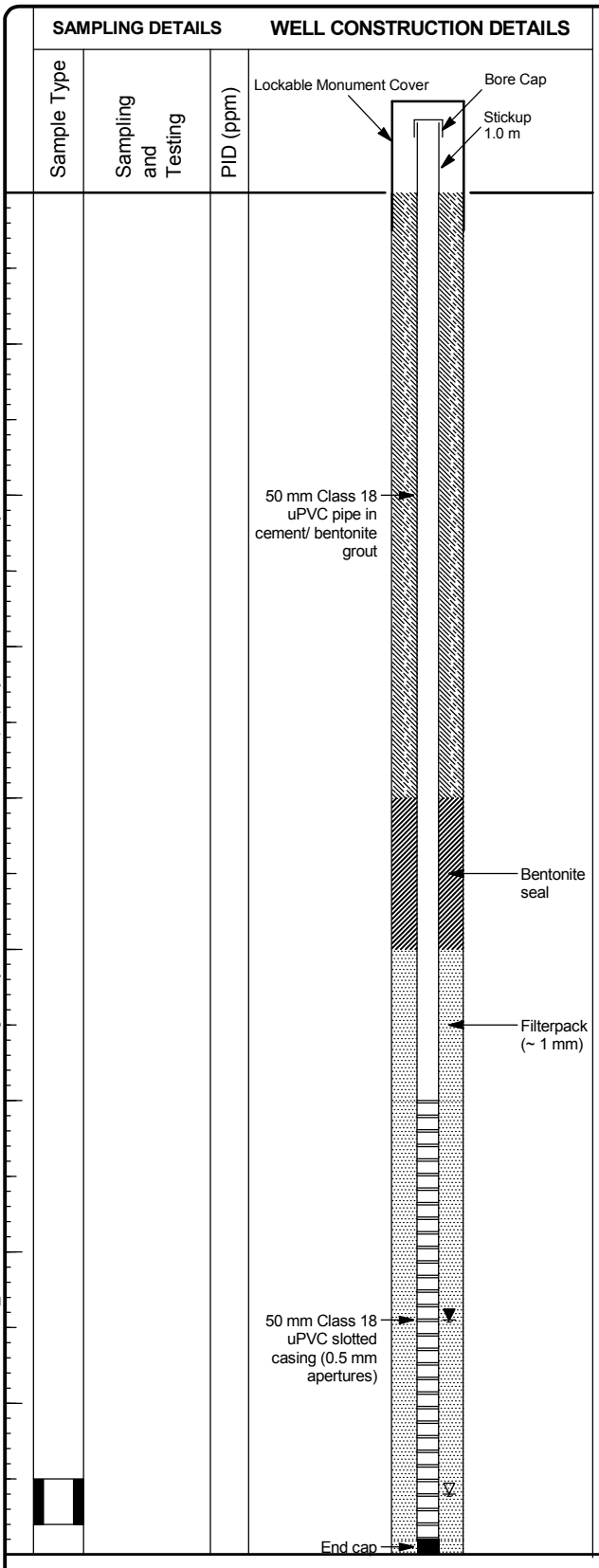
Drilling Method: **Sonic**
Drill Model: **Geoprobe-8140LS**

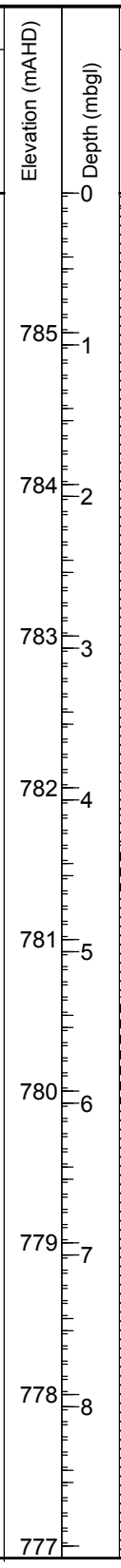
Logged By: **JB**
Checked By: **CG**
Date Started: **17-12-16**
Date Finished: **17-12-16**

Elevation: **785.92 mAHD**
Coordinates: **734322.17 mE**
6117778.21 mN
Permit No: **N/A**

Client: **Veolia Environmental Services**

Total Depth: **9.00 m**





DESCRIPTION OF STRATA

Legend

TOPSOIL, dark grey brown, moist, soft to firm.

(Cl): CLAY, medium plasticity, grey mottled orange-brown, moist, stiff to firm

(CL): CLAY, low plasticity, grey mottled red-brown, slightly moist, firm to stiff

Loose, friable clay at 2.3-2.5m

Mottled green-grey from 2.5-3.7m

(CL): CLAY, low plasticity, grey mottled red brown, moist, soft

(CL-Cl): CLAY, low to medium plasticity, orange-red brown mottled grey, moist, soft

(CL): CLAY, low plasticity, green-grey, red brown mottled clasts/cobbles, slightly moist, soft. RESIDUAL SOIL

(CL-Cl): CLAY, low to medium plasticity, orange-red brown mottled grey, moist, soft

(CL): Gravelly CLAY, low plasticity, dark brown, with hard blue grey gravel/cobbles, moist

Becoming very moist to wet at 8.0m
Water strike at 8.60m

Becoming moist at 8.8m

REMARKS:

GROUNDWATER MONITORING WELL

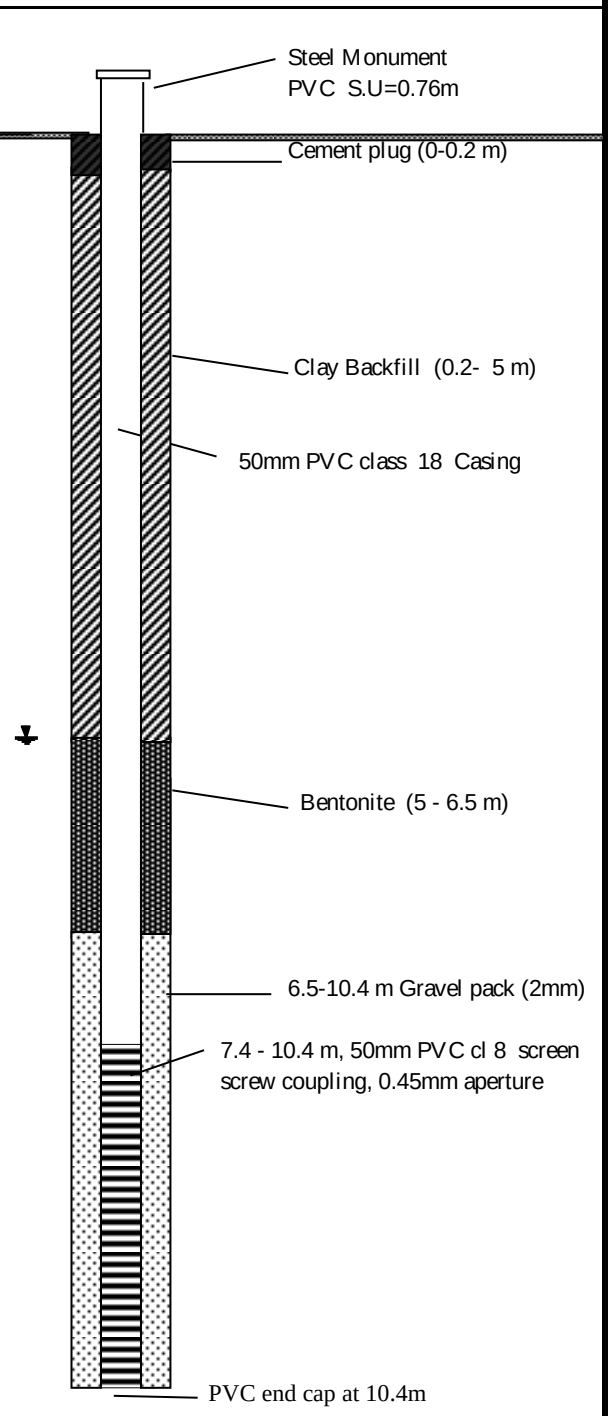
PROJECT :	Woodlawn Bioreactor	**JOB NO:**	**E2W-083 Earth2Water Pty Ltd**
LOCATION:	MW-8D Next to ED3N/lagoon	**DATE STARTED:**	6/11/2007
SUPERVISOR:	Dino Parisotto	**DATE COMPLETED:**	6/11/2007

Contractor: Mulligan Drilling PL Method: RAB- 120mm bit + Air
Rig: Truck Mounted-edson Depth: 10.4 m R.L. Ground (m):
Datum: Ground level Water Level: R.L. WL (m):

Well ID: MW-8D

Lithological Log	**Sample**	**Depth (m)**
Clay Pad- next to embankment		
0-1.5 m Gravelly Clay: brown, 10% gravel-tuff cohesive, firm, moist.	visual logging of cutting returns	0.5
		1.0
1.5- 10.4m Tuff/Siltstone: light to med brown, weathered- hard to soft, some silty clay layers, variable moisture		1.5
		2.0
		2.5
3m- dusty, hard bedrock (no fractures) predominantly siltstone- med brown		3.0
		3.5
		4.0
		4.5
		5.0
		5.5
		6.0
		6.5
		7.0
		7.5
		8.0
		8.5
no water, dusty drill cutings		9.0
		9.5
soft bedrock, weathered, wet (possible fractures/water bearing)		10.0
10.4m Target depth		10.5
		11.0

Bore Construction Details



Prepared By: DP
Checked By: .

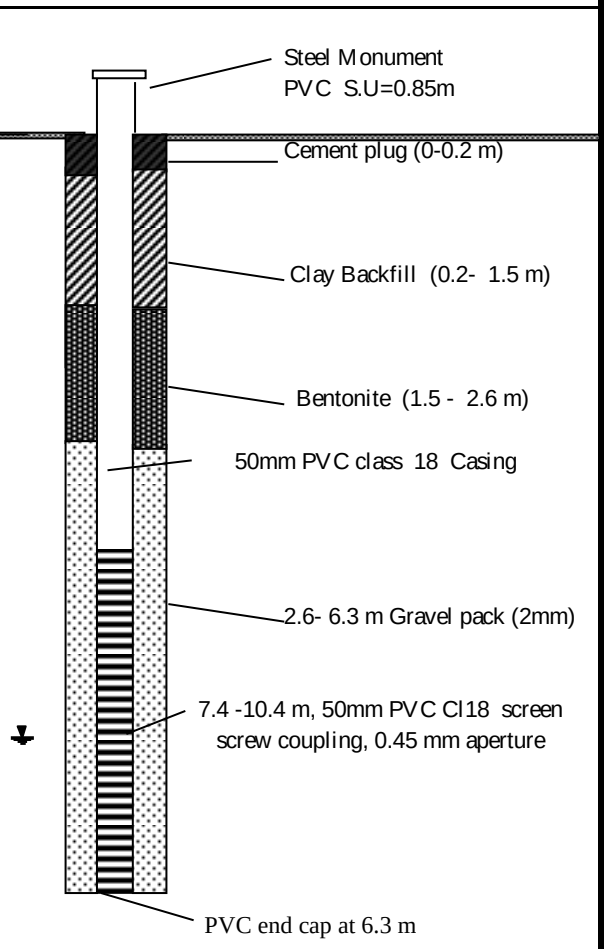
GROUNDWATER MONITORING WELL

PROJECT :	Woodlawn Bioreactor	**JOB NO:**	**E2W-083 Earth2Water Pty Ltd**
LOCATION:	MW-8S Next to ED3N/lagoon	**DATE STARTED:**	2/10/2007
SUPERVISOR:	Dino Parisotto	**DATE COMPLETED:**	2/10/2007

Contractor: Mulligan Drilling PL Method: SFA- 110mm
Rig: Gemco- auger rig Depth: 6.5 m R.L. Ground (m):
Datum: Ground level Water Level: R.L. WL (m):

Well ID: MW-8 S

Lithological Log	Sample	Depth (m)	Bore Construction Details
Clay Pad- next to embankment			
0-2 m Gravelly Clay: brown, 10% gravel-tuff cohesive, firm, moist.	visual logging of cutting returns	0.5 1.0 1.5	
2- 6.5m Tuff/Siltstone: light to med brown, weathered- hard to soft, some silty clay layers, variable moisture		2.0 2.5 3.0 3.5	
4 m- dusty, hard bedrock (no fractures) predominantly siltstone- med brown		4.0 4.5	
very hard layer		5.0	
softer layer- siltstone- light brown		5.5 6.0	
no water, dusty drill cutinggs		6.5	
6.5m Target depth		7.0 7.5 8.0 8.5 9.0 9.5 10.0 10.5 11.0	



Prepared By: DP
Checked By: .

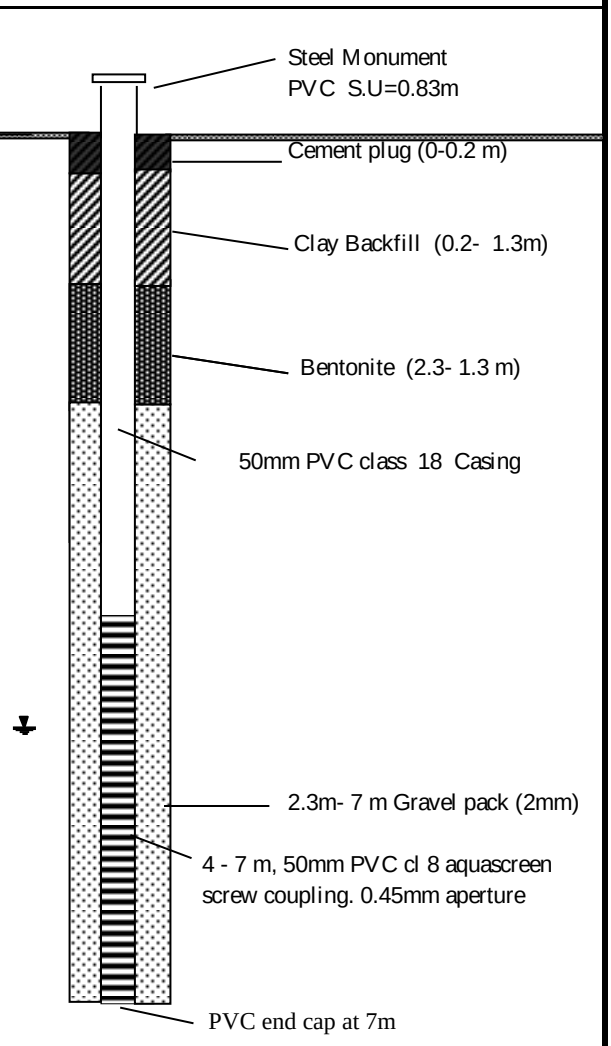
GROUNDWATER MONITORING WELL

PROJECT :	Woodlawn Bioreactor	**JOB NO:**	**E2W-083 Earth2Water Pty Ltd**
LOCATION:	MW-9S North of ED3N	**DATE STARTED:**	6/11/2007
SUPERVISOR:	Dino Parisotto	**DATE COMPLETED:**	6/11/2007

Contractor: Mulligan Drilling PL Method: RAB- 120mm bit + Air
Rig: Truck Mounted-edson Depth: 7 m R.L. Ground (m):
Datum: Ground level Water Level: 4m R.L. WL (m):

Well ID: MW-9S

Lithological Log	**Sample**	**Depth (m)**	**Bore Construction Details**
Soil Cover- gentle slope			
0-0.4 m Gravelly Clay: brown, 20% gravel-tuff cohesive, moist.	visual logging of cutting returns	0.5	
0.4- 7m Tuff/Siltstone: light to med brown, weathered- hard to soft, some silty clay layers, variable moisture		1.0	
		1.5	
2m gritty, thin layer qtz rich tuff		2.0	
		2.5	
3m- dusty, hard bedrock (no fractures) predominantly siltstone- med brown some quartzite- white/hard		3.0	
		3.5	
		4.0	
		4.5	
		5.0	
		5.5	
		6.0	
		6.5	
no water, dusty drill cutings		7.0	
7m Target depth		7.5	
		8.0	
		8.5	
		9.0	
		9.5	
		10.0	
		10.5	
		11.0	



Prepared By: DP
Checked By: .

GROUNDWATER MONITORING WELL

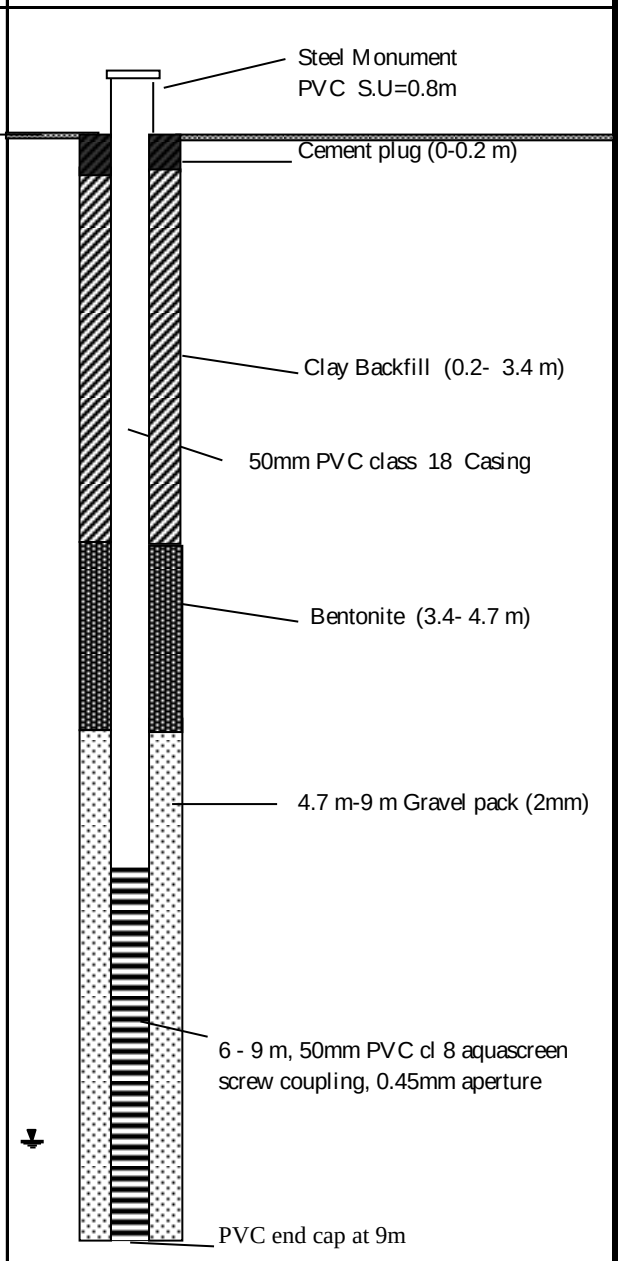
PROJECT :	Woodlawn Bioreactor	**JOB NO:**	**E2W-083 Earth2Water Pty Ltd**
LOCATION:	MW-10S North of Void/ED3N	**DATE STARTED:**	7/11/2007
SUPERVISOR:	Dino Parisotto	**DATE COMPLETED:**	7/11/2007

Contractor: Mulligan Drilling PL Method: RAB- 120mm bit + Air
Rig: Truck Mounted-edson Depth: 9.1 m R.L. Ground (m):
Datum: Ground level Water Level: R.L. WL (m):

Well ID: MW-10S

Lithological Log	**Sample**	**Depth (m)**
Soil Cover- gentle slope		
0-0.5 m Gravelly Clay: brown, 20% gravel-tuff cohesive, moist.	visual logging of cutting returns	0.5
0.5- 9.1m Tuff/Siltstone: light to med brown, weathered- hard to soft, some silty clay layers, variable moisture		1.0
		1.5
		2.0
		2.5
3m- dusty, hard bedrock (no fractures) predominantly siltstone- med brown		3.0
		3.5
		4.0
		4.5
		5.0
		5.5
		6.0
		6.5
		7.0
		7.5
		8.0
		8.5
no water, dusty drill cuttings		9.0
9.1m Target depth		9.5
		10.0
		10.5
		11.0

Bore Construction Details



Prepared By: DP
Checked By: .

SITE CODE	Location Description	Required by	RL (top of casing)	Date Installed	DEPTH (from top of casing) m	Geology	Well Screen Interval (mbgl)	Bentonite Seal (mbgl)	Notes
ED3B	Evaporation Dam 3 Piezometer	EPA	786.800		5.900				GW - no log
MB1	1 Monitoring Bore	EPA	797.510		32.200	Bedrock Dolerite = 0 - 32 m	26 - 32 m	18 - 19 m	GW
MB10	10 Monitoring Bore	EPA	783.800		20.800	Clay (Brown) = 0 -1 m, Clay (Grey) = 1 - 1.8 m, Gravel = 1.8 - 3.2 m, Sand (Gravel) = 3.2 - 12.2 m, Hard Silicious Band = 12.2 - 12.6 m, Gravel = 12.6 - 19.8 m, Dolerite = 19.8 - 20.8 m	19 - 20.8 m	12.6 - 13 m	GW
MB2	2 Monitoring Bore	EPA	781.860		13.200	Clay = 0 - 9 m, Dolerite = 9 - 13 m	7.2 - 13.2 m	5.2 - 6 m	GW
MB3	3 Monitoring Bore	EPA	793.200		25.800	Fill = 0 - 0.2 m, Clay = 0.2 - 3.5 m, Siltstone = 3.5 - 6 m, Clay = 6 - 18.5 m, Gravel = 18.5 - 25.8 m	20 - 25.8 m	14 - 16 m	GW
MB4	4 Monitoring Bore	EPA	786.500		25.800	Fill = 0 - 2.5 m, Shale (Grey to Red) = 2.5 - 25.8 m	19.8 - 25.8 m	14 - 16 m	GW
MB6	6 Monitoring Bore	EPA	796.210		25.800	Fill (Dolerite & Shale) = 0 - 2.5 m, Shale = 2.5 - 11 m, Clay = 11 - 11.5 m, Shale (Siltstone) = 11.5 - 19 m, Shale = 19 - 25.8 m	19.8 - 25.8 m	13.2 - 15 m	GW
MB7	7 Monitoring Bore	EPA	789.070		29.000	Clay = 0 - 2 m, Shale = 2 - 25 m, Tuff = 25 - 29 m	25 - 29 m	22 - 23 m	GW

SITE CODE	Location Description	Required by	RL (top of casing)	Date Installed	DEPTH (from top of casing) m	Geology	Well Screen Interval (mbgl)	Bentonite Seal (mbgl)	Notes
WM1	1 Monitoring Well	EPA	781.270	5/06/2003	115.000	Dolerite = 0 - 115 m	NA	NA	GW
WM5	5 Monitoring Well	EPA	786.730	7/06/2003	6.000	Clay = 0 - 1 m, Crystal Tuff = 1 - 6 m	NA	NA	GW - no log
WM6	6 Monitoring Well	EPA	790.340	7/06/2003	6.000	Clay = 0 - 2 m, Tuff = 2 - 4 m, Yellow Brown Silicified Volcanics = 4 - 6 m	NA	NA	GW - no log