



APPLICATION ON NOTIFICATION – CROWN DEVELOPMENT

Applicant:	Willunga Basin Water Company Pty Ltd
Development Number:	145/V004/19
Nature of Development:	Construction of a 600ML treated water storage dam with associated bulk earthworks, stormwater detention basin, inlet-outlet pipe (buried), landscape mounding and screening, security fencing, and signage
Type of development:	Public Infrastructure
Zone / Policy Area:	Primary Production Zone & Deferred Urban Zone
Subject Land:	Bakewell Drive and Ostrich Farm Road, Seaford Heights
Contact Officer:	Laura Kerber
Phone Number:	08 7109 7073
Start Date:	13 February 2019
Close Date:	12 March 2019
During the notification period, hard copies of the application documentation can be viewed at the Department of Planning, Transport and Infrastructure, Level 5, 50 Flinders Street, Adelaide during normal business hours. Application documentation may also be viewed at the Noarlunga Office of the Onkaparinga Council.	

Written representations must be received by the close date (indicated above) and can either be posted, hand-delivered, faxed or emailed to the State Commission Assessment Panel (SCAP). A representation form is provided as part of this pdf document.

Any representations received after the close date will not be considered.

Postal Address:

The Secretary
State Commission Assessment Panel
GPO Box 1815
ADELAIDE SA 5001

Street Address:

Planning and Land Use Services
Department of Planning, Transport and Infrastructure
Level 5, 50 Flinders Street
ADELAIDE

Email Address: scapreps@sa.gov.au

Fax Number: (08) 8303 0753



DEVELOPMENT ACT 1993

SECTION 49 - PUBLIC INFRASTRUCTURE

NOTICE OF APPLICATION FOR CONSENT TO DEVELOPMENT

Notice is hereby given that an application has been made by the **Willunga Basin Water Company Pty Ltd** (previously sponsored as public infrastructure by the Minister for Transport, Infrastructure and Local Government under Section 49 of the *Development Act 1993*) for consent to construct a 600ML treated water storage dam with associated bulk earthworks, stormwater detention basin, inlet-outlet pipe (buried), landscape mounding and screening, security fencing, and signage. **Development Number: 145/V004/19.**

The subject land is situated at Bakewell Drive and Ostrich Farm Road, Seafood Heights (being Allotment 108, DP80592: CT 6034/589; and Allotment 102, DP46795: CT 5829/936). Access to the land will be achieved from Bakewell Drive.

The development site is located within both the Primary Production Zone and the Deferred Urban Zone of the Onkaparinga Development Plan (Consolidated 20 December 2018).

The application may be examined during normal office hours at the office of the State Commission Assessment Panel (SCAP), Level 5, 50 Flinders Street and at the office of the Onkaparinga Council, Ramsay Place, Noarlunga Centre. Application documentation may also be viewed on the SCAP website http://www.saplanningcommission.sa.gov.au/scap/public_notices.

Any person or body who desires to do so may make representations concerning the application by notice in writing delivered to the Secretary, State Commission Assessment Panel, GPO Box 1815, Adelaide SA 5001 **NOT LATER THAN 12 MARCH 2019**. Submissions may also be emailed to: scapreps@sa.gov.au

Each person or body making a representation should state the reason for the representation and whether that person or body wishes to be given the opportunity to appear before the SCAP to further explain the representation.

Submissions may be made available for public inspection.

Should you wish to discuss the application and the public notification procedure please contact **Laura Kerber** on **7109 7073** or laura.kerber@sa.gov.au

Alison Gill
SECRETARY
STATE COMMISSION ASSESSMENT PANEL

**DEVELOPMENT ACT, 1993
S49/S49A – CROWN DEVELOPMENT
REPRESENTATION ON APPLICATION**

Applicant: Willunga Basin Water Company Pty Ltd
Development Number: 145/V004/19
Nature of Development: Construction of a 600ML treated water storage dam with associated bulk earthworks, stormwater detention basin, inlet-outlet pipe (buried), landscape mounding and screening, security fencing, and signage
Zone / Policy Area: Primary Production Zone & Deferred Urban Zone
Subject Land: Bakewell Drive and Ostrich Farm Road, Seaford Heights
Contact Officer: Laura Kerber
Phone Number: 08 7109 7073
Close Date: 12 March 2019

My Name: _____ My phone number: _____

Primary method(s) of contact: _____ Email: _____
Postal Address: _____ Postcode: _____

You may be contacted via your nominated PRIMARY METHOD(s) OF CONTACT if you indicate below that you wish to be heard by the State Commission Assessment Panel in support of your submission.

My interests are: _____
(please tick one)
☐ owner of local property
☐ occupier of local property
☐ a representative of a company/other organisation affected by the proposal
☐ a private citizen

The address of the property affected is: _____
Postcode: _____

My interests are: _____
(please tick one)
☐ I support the development
☐ I support the development with some concerns
☐ I oppose the development

The specific aspects of the application to which I make comment on are: _____

I: _____
(please tick one)
☐ wish to be heard in support of my submission
☐ do not wish to be heard in support of my submission
(Please tick one)

By: _____
(please tick one)
☐ appearing personally
☐ being represented by the following person
(Please tick one)

Signature: _____
Date: _____

SECTION 49 & 49A – CROWN DEVELOPMENT DEVELOPMENT APPLICATION FORM

PLEASE USE BLOCK LETTERS

COUNCIL: City of Onkaparinga
 APPLICANT: Willunga Basin Water Co. Pty Ltd
 ADDRESS: Suite 1005, 147 Arie Street
SA 5000
 CROWN AGENCY: Department of Planning Transport & Infrastructure

FOR OFFICE USE

DEVELOPMENT No: _____
 PREVIOUS DEVELOPMENT No: _____
 DATE RECEIVED: / /

CONTACT PERSON FOR FURTHER INFORMATION

Name: Richard Dwyer (Ekistics Planning & Design)
 Telephone: (08) 7231 0286 [work] _____ [Ah] _____
 & 0402 344 401
 Fax: _____ [work] _____ [Ah] _____
 Email: rdwyer@ekistics.com.au

NOTE TO APPLICANTS:

(1) All sections of this form must be completed. The site of the development must be accurately identified and the nature of the proposal adequately described. If the expected development cost of this Section 49 or Section 49A application exceeds \$100,000 (excl. fit-out) or the development involves the division of land (with the creation of additional allotments) it will be subject to those fees as outlined in Item 1 of Schedule 6 of the *Development Regulations 2008*. Proposals over \$4 million (excl. fit-out) will be subject to an advertising fee. (2) Three copies of the application should also be provided.

- ☐ Complying
☐ Merit
☐ Public Notification
☐ Referrals

Decision: _____
 Type: _____
 Finalised: / /

	Decision required	Fees	Receipt No	Date
Planning:	_____	_____	_____	_____
Land Division:	_____	_____	_____	_____
Additional:	_____	_____	_____	_____
Minister's Approval	_____	_____	_____	_____

EXISTING USE: Agriculture/Primary Production

DESCRIPTION OF PROPOSED DEVELOPMENT: Public infrastructure in the form of a 600ML water storage dam

LOCATION OF PROPOSED DEVELOPMENT: Bakewell Drive, Seaford Heights

House No: _____ Lot No: 108 & 102 Street: Bakewell Drive Town/Suburb: Seaford Heights
 Section No [full/part] _____ Hundred: Willunga Volume: 6034 Folio: 589
 Section No [full/part] _____ Hundred: Willunga Volume: 5829 Folio: 936

LAND DIVISION:

Site Area [m²] _____ Reserve Area [m²] _____ No of existing allotments _____
 Number of additional allotments [excluding road and reserve]: _____ Lease: YES ☐ NO ☐

DEVELOPMENT COST [do not include any fit-out costs]: \$ 5,400,000

POWERLINE SETBACKS: Pursuant to Schedule 5 (2a)(1) of the *Development Regulations 2008*, if this application is for a building it will be forwarded to the Office of the Technical Regulator for comment unless the applicant provides a declaration to confirm that the building meets the required setback distances from existing powerlines. The declaration form and further information on electricity infrastructure and clearance distances can be downloaded from sa.gov.au.

I acknowledge that copies of this application and supporting documentation may be provided to interested persons in accordance with the *Development Act 1993* and meet the requirements for lodgement under s.49 of the *Development Act 1993*.

SIGNATURE: _____

Dated: 25 / 01 / 2019

DEVELOPMENT REGULATIONS 2008
Form of Declaration (Schedule 5 clause 2A)



Government
of South Australia

To: Brett Fundak
Senior Infrastructure Co-ordinator
Department of Planning, Transport and Infrastructure
From: Willunga Basin Water Company Pty Ltd
Suite 1005, 147 Pirie Street, SA, 5000

Date of Application: 25 / 01 / 2019

Location of Proposed Development: _____

House No: _____ Lot No: 108 & 102 Street: Bakewell Drive

Town/Suburb: Seaford Heights

Section No (full/part): _____ Hundred: Willunga

Volume: 6034 Folio: 589 (Lot 108)

& Volume: 5829 Folio: 936 (Lot 102)

Nature of Proposed Development:

Public infrastructure in the form of a 600ML water storage dam

I CRAIG HEIDENREICH being the applicant/ a person acting on behalf of the applicant (delete the inapplicable statement) for the development described above declare that the proposed development will involve the construction of a building which would, if constructed in accordance with the plans submitted, not be contrary to the regulations prescribed for the purposes of section 86 of the Electricity Act 1996. I make this declaration under clause 2A(1) of Schedule 5 of the Development Regulations 2008.

Signed: _____

Date: 25 / 01 / 2019



Note 1

This declaration is only relevant to those development applications seeking authorisation for a form of development that involves the construction of a building (there is a definition of 'building' contained in section 4(1) of the Development Act 1993), other than where the development is limited to –

- a) an internal alteration of a building; or
- b) an alteration to the walls of a building but not so as to alter the shape of the building.

Note 2

The requirements of section 86 of the Electricity Act 1996 do not apply in relation to:

- a) an aerial line and a fence, sign or notice that is less than 2.0 m in height and is not designed for a person to stand on; or
- b) a service line installed specifically to supply electricity to the building or structure by the operator of the transmission or distribution network from which the electricity is being supplied.

Note 3

Section 86 of the Electricity Act 1996 refers to the erection of buildings in proximity to powerlines. The regulations under this Act prescribe minimum safe clearance distances that must be complied with.

Note 4

The majority of applications will not have any powerline issues, as normal residential setbacks often cause the building to comply with the prescribed powerline clearance distances. Buildings/renovations located far away from powerlines, for example towards the back of properties, will usually also comply.

Particular care needs to be taken where high voltage powerlines exist; or where the development:

- is on a major road;
- commercial/industrial in nature; or
- built to the property boundary.

Note 5

An information brochure: 'Building Safely Near Powerlines' has been prepared by the Technical Regulator to assist applicants and other interested persons.

This brochure is available from council and the Office of the Technical Regulator. The brochure and other relevant information can also be found at sa.gov.au/energy/powerlinesafety

Note 6

In cases where applicants have obtained a written approval from the Technical Regulator to build the development specified above in its current form within the prescribed clearance distances, the applicant is able to sign the form.

25 January 2019

REF No.: 00664-004

Department of Planning, Transport & Infrastructure
Level 7, 50 Flinders Street
ADELAIDE SA 5000

Attention: Brett Fundak – Senior Infrastructure Coordinator

By email: brett.fundak@sa.gov.au

Dear Brett,

RE: DEVELOPMENT APPLICATION FOR PUBLIC INFRASTRUCTURE IN THE FORM OF A 600ML WATER STORAGE DAM AT BAKEWELL DRIVE, SEAFORD HEIGHTS

I refer to our meeting held today in relation to the lodgement of a Development Application for ‘public infrastructure’ in the form of a 600ML water storage dam at Allotment 102 and Allotment 108, Bakewell Drive, Seaford Heights.

The *attached* documentation is provided to the Department of Planning Transport & Infrastructure for lodgement with the State Commission Assessment Panel (SCAP). The documentation provided in support of this Development Application includes a completed ‘Crown Development Application Form’ and ‘Electricity Declaration Form’ together with a ‘Planning Statement’ prepared by Ekistics Planning and Design. The Planning Statement also includes the following appended documentation and reports that have been prepared in support of the proposed development:

- **Appendix 1:** Certificates of Title
- **Appendix 2:** DPTI Sponsorship of Application as Public Infrastructure
- **Appendix 3:** Development Deed
- **Appendix 4:** Legal Opinion – Stuart Henry SC
- **Appendix 5:** Land Management Agreement (LMA)
- **Appendix 6:** Concept Plans for Development (Hydroplan)
- **Appendix 7:** Geotechnical Investigation Report (SMEC)
- **Appendix 8:** Construction Report (SMEC)
- **Appendix 9:** Odour Assessment (ERM)
- **Appendix 10:** SA Health Approval for use of Recycled Water
- **Appendix 11:** SA Health Correspondence
- **Appendix 12:** Arborist Report (Arborman)
- **Appendix 13:** Visual Impact Assessment (WAX Design)

- **Appendix 14:** Stormwater Management Plan (Tonkin)

We understand that this documentation will now be issued to SCAP to commence the assessment process and that a taxation invoice will be generated by SCAP for the requisite lodgement and planning assessment fees. This taxation invoice should be directed to the 'Willunga Basin Water Co. Pty. Ltd.' at Suite 1005, 147 Pirie Street, SA 5000.

We would like to take this opportunity to thank you for the assistance and advice you have provided in association with the preparation and collation of this application. Please do not hesitate to contact the undersigned on (08) 7231 0286 or direct on 0402 344 401 should you have any questions or queries, or should you require any additional information in support of this development application for public infrastructure.

Yours Sincerely

A handwritten signature in black ink, appearing to read 'Richard Dwyer', is positioned above the printed name.

Richard Dwyer
Managing Director



WATER STORAGE DAM

BAKEWELL DRIVE, SEAFORD HEIGHTS

Crown Development Planning Report

Prepared for:
**Willunga Basin Water Authority
Pty. Ltd.**

Date:
06.02.2019



Proprietary Information Statement

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Document Control

Revision	Description	Author	Date
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V3	Draft Planning Statement - edits	RAD	20/12/18
V4	Draft Planning Statement - edits	RAD	23/01/19
V5	Revised Planning Statement - edits	JR	06/02/19

Approved by:



Managing Director

Date: 06/02/2019

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1. Introduction

This Planning Statement has been prepared on behalf of the Willunga Basin Water Company Pty. Ltd. [“WBWC”] which operates a large reclaimed water scheme in South Australia servicing the McLaren Vale, Willunga and Sellicks regions. WBWC is owned and operated by Water Utilities Australia Pty. Ltd. [“WUA”].

WBWC is licensed to take treated water from SA Water’s Christies Beach Wastewater Treatment Plant [“WWTP”] and pumps it via a network of more than 120 kilometres of pipelines to more than 220 irrigators in the McLaren Vale region. The treated water is principally used for drip irrigation of vines, fruit trees, nut crops and flowers (primary production) within the McLaren Vale region.

WBWC wish to expand their water storage network and are seeking to obtain Development Plan Consent for a new 600 ML Water Storage Dam on land located at Lot 108 in Deposited Plan 80592 and Lot 102 in Deposited Plan 46795 (Bakewell Drive, Seaford Heights).

This Planning Statement seeks to provide relevant information about the subject land and locality, describes the nature of the proposed development and provides an assessment of the development application against the relevant provisions of the Onkaparinga Council (City) Development Plan. This Statement has been prepared to assist the State Commission Assessment Authority (SCAP) in its assessment and determination of the development application.

For the purposes of this statement, the Onkaparinga Council (City) Development Plan (Consolidated 20 December 2018) will be referred to as the ‘Development Plan’, the *Development Act, 1993* will be referred to as the ‘Act’ and the *Development Regulations, 2008* will be referred to as the ‘Regulations’.

2. Background

2.1 Willunga Basin Water Company

The Willunga Basin Water Company (WBWC) was founded in 1997 and operates as a subsidiary of Water Utilities Australia (WUA).

WBWC is signatory of the '*Christies Beach Wastewater Re-use deed*' with the South Australian Water Corporation ['SA Water'] dated 15 January 1998 which provides license for WBWC to divert treated waste water from the Christies Beach WWTP for irrigation use in the Willunga Basin and Environs (subject to certain terms and conditions). Pursuant to this deed, SA Water licenses WBWC to use the entire volume of water (summer and winter) flowing from the Plant however WBWC is not required to divert any of the treated water.

The historical source of water for vineyard irrigation in McLaren Vale was predominantly native regional groundwater. Concerns around over-extraction resulted in the regional groundwater resource in McLaren Vale being proclaimed which led to regulation of groundwater extraction via individual bore specific water allocation. These allocations were capped with a maximum quantity of underground water available for allocation (taking and holding) in the McLaren Vale Prescribed Wells Area (PWA) of 6,600 ML/annum.

WBWC was established by a consortium of irrigators in McLaren Vale to provide an additional source of irrigation water to support the growing demand for water from the region's expanding wine industry. Starting with an initial customer base of 2,100ML of treated water, WBWC has expanded consistently to a current customer base of 6,500ML of customers. The growth in demand for treated water is a result of a number of factors including the deterioration of regional groundwater, growth of the local wine sector and in response to the effects of climate change. Currently more than 10,000ML of water is used for irrigation in the region. The demand for additional water is on-going and WBWC is experiencing strong demand from the Blewitt-Springs region due to deterioration in local groundwater salinity.

The Blewitt Springs region is to the north-east of McLaren Vale and WBWC does not currently have pipework in this region. WBWC expanded its network into McLaren Flat (east of McLaren Vale and south of Blewitt Springs) in 2015/16 which was in response to strong demand in this region for treated water as a result of deteriorating regional groundwater salinity. This expansion incorporated the capacity to expand into Blewitt Springs in the future. Existing aquifers in Blewitt Springs are also experiencing declining ground water quality with increased salinity and the proposed water storage facility will act as a catalyst for WBWC to expand its pipe network into the Blewitt Springs region which will give these irrigators access to a sustainable, good quality, alternate water source.

The capacity of WBWC to supply additional customers is currently limited by the availability of water to meet the peak summer demands. The proposed treated water storage dam will enable an additional 600ML of treated water to be distributed by WBWC in summer. Completion of the water storage dam will provide WBWC a sufficient amount of additional treated water to enable expansion of its pipeline into Blewitt Springs, thereby

providing an alternate water source to irrigators in this region who are suffering from deteriorating groundwater salinity. Given the location of the proposed water storage facility WBWC could also supplement water supply to existing customers in the region.

2.2 Role & Purpose of Proposed Water Storage Dam

WBWC currently sources the majority of its treated water from the Christies Beach WWTP operated by SA Water. SA Water subjects the sewerage entering the Christies Beach WWTP to sequential treatment (sedimentary sedimentation / settling / filtration and chlorination) and the treated water is then either discharged to the sea at Christies Beach, or it is diverted by pipe to a storage dam operated by WBWC.

The annual treated volume of the Christies Beach WWTP is around 10,000 ML, of which around 55% is used by WBWC with the balance of treated water (minus a small amount used by SA Water) discharged to Gulf St Vincent.

The treated water purchased from SA Water is pumped several kilometres from WBWC's dam at the Christies Beach WWTP to WBWC's site at Quarry Road, Seaford Heights. The Quarry Road site includes a small 13ML storage dam and a pump station. From the Quarry Road site, WBWC distributes the recycled water at pressure to customers in McLaren Vale via an existing network of pipes.

Figure 2.1 WBWC Existing Dam at Quarry Road, Seaford Heights.



The proposed new dam is conveniently located near the WBWC's Quarry Road dam and pump station which is a key factor in the selection and suitability of the subject site for the proposed water storage dam. Recycled water received at Quarry Road is proposed to be pumped to the proposed new dam for storage in winter, and gravity fed back to the Quarry Road site when it is needed for distribution to customers in summer. Accordingly, the purpose of the dam is to take and store recycled water purchased from SA Water at the Christies Beach WWTP at times when there is low demand for irrigation water (winter), and then distribute that recycled water to customers in times of high demand (summer).

WBWC have an existing pipe that crosses Victor Harbour Road in the road reserve adjacent to the proposed dam site which delivers treated water to customers in summer. A separate transfer pipe will be installed to fill the dam and then transfer the water back to the existing Quarry Road dam by gravity for pumping to customers by the existing Quarry Road Pump Station. This avoids the need for pumping of water from the proposed dam site.

The Quarry Road Pump Station has the capacity to pump 28-32ML/d of treated water but is constrained by the existing availability of treated water from the CBWWTP which is 22-24ML/d. This means there is 6-8ML/d of pumping capacity that is not being fully utilised. The peak irrigation period in McLaren Vale lasts for around 3-4 months (100 days) and the pump station could deliver an additional 600ML of water if it is available. The storage dam has therefore been designed to ensure the optimal use of WBWC's existing supply infrastructure at the Quarry Road site.

The proposed storage dam represents an appropriate and economic use of land that acts as an effective 'buffer' between residential development within the 'Vista' estate and the ongoing land fill operations on the adjacent SRWRA site to the south-east. The land will therefore be utilised for more productive purposes than existing cropping by providing a buffer separation between incompatible land uses whilst also providing public infrastructure for the supply and distribution of water that will support and intensify higher value agricultural use of surrounding primary production land.

3. Procedural Matters

3.1 Trigger for Development Approval

Pursuant to Schedule 2 and 3 of the *Development Regulations, 2008*, the excavation and filling of land for the purposes of a water storage dam is classified as development, where the levee bank is greater than three (3) metres in height (above the natural surface of the land) and where the dam has a capacity exceeding 5.0 ML.

The proposed new water storage dam will also require a new 500mm buried inlet-outlet pipe to be built between the new pipe and the Quarry Road pump station. Notwithstanding, as 'Public Infrastructure' the construction, reconstruction, alteration, repair or maintenance of any drains, pipe or underground cable is likely to be State Agency development that is exempt from approval pursuant to Section 49(3) of the *Development Act, 1993* and pursuant to Section 67(1) and Schedule 14 of the *Development Regulations, 2018*.

Further, it is noted that WBWC is signatory to a Deed with the City of Onkaparinga which gives WBWC authority to install infrastructure in Council roads, reserves and other land vested in Council. WBWC has more than 120km of pipelines already installed in the City of Onkaparinga area pursuant to this Deed and any pipework associated with the proposed treated water storage will be installed in accordance with this existing Deed.

3.2 Nature of Development

The proposed development constitutes Crown 'development' pursuant to Section 49 (2)(c) of the Act as the project has been supported by the Department of Planning Transport and Infrastructure (DPTI) for the purpose of the provision of 'public infrastructure'.

Pursuant to Section 49 of the *Development Act, 1993* 'public Infrastructure' is defined as follows:

Public Infrastructure means –

(a) the infrastructure, equipment, structures, works, and other facilities used in or connection with the supply of water or electricity, gas or other forms of energy, or the drainage or treatment of waste water or sewerage;

[our emphasis]

A proposed dam for the storage, supply and distribution of treated water to customers engaged in primary production within the McLaren Vale region is therefore public infrastructure for the purposes of Section 49 of the *Development Act, 1993*.

Correspondence confirming the Department's support of the Development Application as 'Public Infrastructure' is attached in **Appendix 2**.

3.3 Planning Authority

Given the development application has been supported as 'public Infrastructure' pursuant to Section 49(2)(c) of the Act, the development application must be lodged with the State Commission Assessment Authority (SCAP) for assessment.

Pursuant to Section 49(12) of the Act, the **Minister for Planning** is the Relevant Authority to determine the development application following receipt of a report from the SCAP pursuant to Section 49(7e) of the Act.

3.4 Public Notification

Pursuant to Section 49(7)(d), a development proposed, initiated or supported by the State, involving work exceeding \$4 million will be subject to public notification.

The proposed water storage dam will be fully funded by WBWC and is estimated to cost approximately \$5.4M to construct.

Given the proposed development involves works exceeding \$4 million, the proposed development must be publicly notified to adjoining owners and interested parties.

3.5 Referrals

Pursuant to Section 49(4)(a) & Section (7)(a) of the Act as well as Schedule 8 of the Regulations, the application may require referral to the following authorities:

- **Onkaparinga Council;**
- **State Heritage Branch**
 - » If, in the opinion of the relevant authority, the development materially affects the context of the adjoining State Heritage Place recognised as the '*Former Noarlunga Ostrich Farm, including Prior's Court Homestead and (1850's section only) and Barn*'.
- **Department for Environment and Water ['DEW']**
 - » The proposed development is located within the '*Western Mount Lofty Ranges Prescribed Water Resources Area*' and may:
 - take water from a surface water prescribed area (i.e. Onkaparinga River and Pedler Creek); and/or
 - involve the construction of a dam in a part of the State within the ambit of a notice under Section 132 of the *Natural Resources Management Act 2004*.

- The **Department of Planning Transport and Infrastructure (DPTI)** –
 - » DPTI has advised that the subject site is affected by a road widening requirement shown on the Metropolitan Adelaide Road Widening Plan. The plan shows a possible requirement for a strip of land up to 35 metres in width from the Victor Harbor Road frontage of this site for future road purposes. This requirement caters for a possible future duplication of Victor Harbor Road at this location. Although the exact nature and timing of this proposal has yet to be determined (and no funding has been committed), the consent of the Commissioner of Highways under the *Metropolitan Adelaide Road Widening Plan Act, 1972* is required to all building works on or within 6m of the possible requirement.

A referral to the Commissioner of Highways is also required for any development which, in the opinion of the Relevant Authority, would encroach within a road widening setback under the *Metropolitan Adelaide Road Widening Plan Act, 1972*. The Commissioner of Highways has the power of ‘Direction’ in respect of a proposed development that would encroach on land shown on the Metropolitan Adelaide Road Widening Plan as potentially required for road widening or would be undertaken within 6 metres of the boundary of such land. Importantly, the proposed dam and associated landscape batter slopes are not located within the 35 metre road winding strip adjacent Victor Harbor Road however a proposed stormwater swale and a buried inlet-outlet pipe to the quarry road pump station is located within the road widening requirement and therefore referral may be required to DPTI.

In addition, we understand that the Department may possibly seek informal referral advice from the following State Agencies:

- Environment Protection Authority (EPA); and
- SA Health.

4. Subject Site and Locality

4.1 Description of the Subject Site

The subject site is located on Bakewell Drive, Seaford Heights and comprises Certificate of Title Volume 6034 Folio 589 (Allotment 108 of Deposited Plan 80592) and Certificate of Title Volume 5829 Folio 936 (Allotment 102 Deposited Plan 46795). A copy of the relevant Certificates of Title are attached in **Appendix 1**.

An aerial photograph of the subject site is provided in **Figure 4.1** over page.

The subject site measures an area of 30.03 hectares and is formed by a wide, gently sloping hilltop and ridgeline that extends in a north-south direction, parallel to the coastline. There are no discernible features and the land contains few topographic or vegetation elements. The existing land cover is arable cropping which results in seasonal variations in vegetation retention, harvesting and other agricultural operations on the land.

The subject site contains a belt of mature olive trees toward the southern boundary. Given these olive trees within the site have been planted for the purpose of fruit production they are not recognised as Regulated or Significant Trees pursuant to the *Development Act, 1993*. Further, as the trees are planted specimens they are not identified as native vegetation. Accordingly, the trees are not controlled by the *Development Act, 1993* or the *Native Vegetation Act, 1991*.

In addition, there are approximately 200 juvenile trees located within a windbreak towards the south-eastern boundary of these site. The juvenile trees are planted specimens and are all less than two metres in circumference and therefore these trees are not controlled by the *Development Act, 1993* or the *Native Vegetation Act, 1991*.

Figure 4.1 Aerial Photograph of Subject Site



4.2 Land Ownership / Tenure

The land is currently owned by Southern Regional Waste Resource Authority ['SRWRA']. WBWC have entered into a lease with SRWRA to build and operate the dam on the subject site. The 20-year lease commences from 1 January 2019 and has an opportunity for a 20-year renewal (40 years in total).

4.2.1 Development Deed

Importantly, SRWRA purchased the land from the South Australian Housing Trust and the Urban Renewal Authority in 2017 and at the time of purchase the vendors and SRWRA executed a 'Development Deed' dated 7 November 2017. The deed recites that its purpose is to limit the impact of any development of the land on the amenity of nearby land that is used for residential purposes (or that is proposed to be used for residential purposes). A copy of this Development Deed is Attached at **Appendix 3**.

Under the terms of the Lease with SRWRA, WBWC will effectively take on the obligations of the Development Deed.

Pursuant to Clause 3 of this Deed *‘SRWRA must not cause, suffer or permit the receipt, handling, storage or disposal of waste on the Land’*.

An independent legal opinion has been obtained from Stuart Henry SC (Barrister) dated 5 July 2018 and addresses the question of whether the storage of treated water sourced from the Christies Beach WWTP in a dam to be constructed on the subject site would be contrary to Clause 3 of the Development Deed (i.e. whether or not the treated water is ‘waste’ as defined in the Development Deed).

The Legal opinion confirms that upon delivery from SA Water to WBWC, the treated water becomes a product, and is no longer waste. The Legal opinion is attached at **Appendix 4** and concludes that *‘The recycled water is not, in my view, a form of ‘waste’ for the purposes of the Development Deed’*.

4.2.2 Land Management Agreement

A Land Management Agreement (LMA) between the Minister for Planning and the land Owner (SRWRA) also applies to the land and is attached at **Appendix 5**.

The purpose of this agreement (executed as a Deed applying to the whole of Certificate of Title Volume 6034 Folio 589) is to ensure that the land owner does not cause, suffer or permit interference with, damage or removal or destruction of a landscaped and vegetated area of the site that has been established as a ‘Buffer Zone Landscaping Area’ to screen urban development from Victor Harbor Road. In addition, the deed identifies separate ‘Buffer Land’ which is to be maintained as primarily a passive vegetated area to screen development and interrupt site lines from Victor Harbor Road.

Under the LMA the land owner must ensure that the ‘Buffer Zone Landscaping Area’ is maintained as primarily a passive vegetated area to screen development and interrupt sight lines from Victor Harbor Road. The land owner must also obtain the consent of Fairmont Land Holdings Pty. Ltd. (adjacent residential developer) for any change in the use of the ‘Buffer land’ as described and defined in the LMA.

The ‘Buffer Zone Landscaping Area’ and the ‘Buffer Land’ are demonstrated spatially in **Figure 4.2** and **Figure 4.3** respectively.

Under the terms of the Lease with SRWRA, WBWC will effectively take on the obligations of Clause 5 (Management of Land) of this LMA and therefore must not breach this LMA.

Importantly, the proposed development has been designed so that it will *‘not cause, suffer or permit interference with, damage to or removal or destruction of the Buffer Zone Landscaping’* in the ‘Buffer Zone Landscaping Area’ as defined in Annexure B of the LMA nor will it result in the change of the use of the ‘Buffer Land’ as defined within Annexure C of the LMA.

Figure 4.2 Buffer Zone Landscape Area

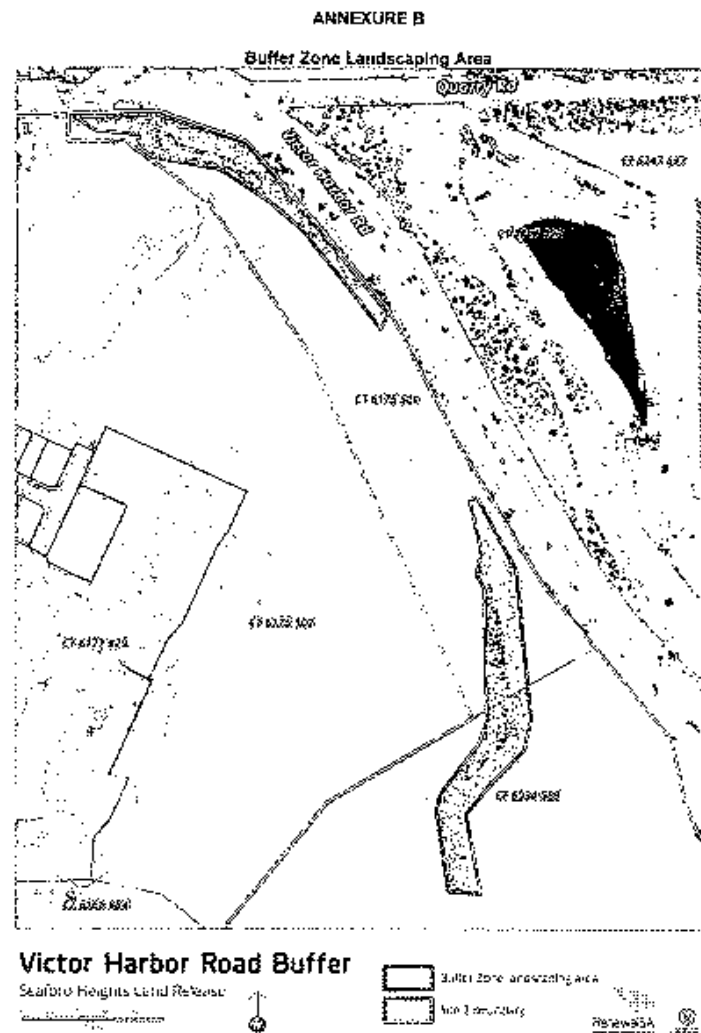
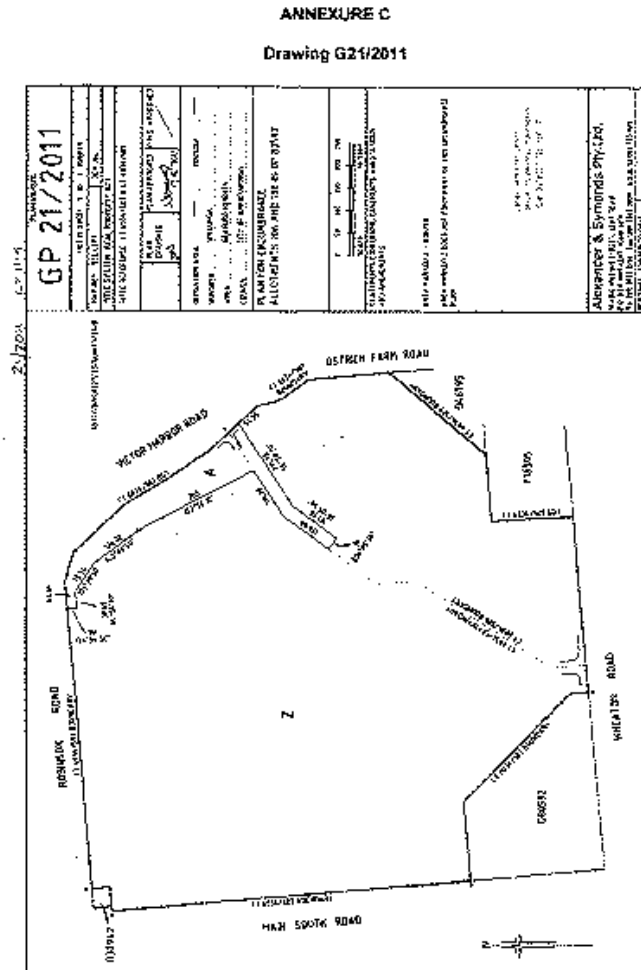


Figure 4.3 Buffer Land (Area Marked 'A')



4.3 Development Locality

An aerial photograph of the subject site and surrounds was provided previously in *Figure 4.1*.

The existing landscape character of the locality is defined by the undulating agricultural landscape which contains vineyards, fields, valleys and significant belts of vegetation located on large allotments that follow the underlying topography of the hills environment. Allotments typically include areas of vegetation along the cadastral boundaries with cleared land to allow for cropping or wine production.

The northern edge of the locality falls away to form the Onkaparinga River Valley resulting in panoramic views to the ocean and the suburbs of Old Noarlunga and Seaford.

To the immediate south and east of the subject site is an existing dwelling on the corner of Bakewell Drive and Ostrich Farm Road (refer to **Figure 4.4**). The homestead and barn are recognised as a State Heritage Place and are sited on an allotment of approximately 4 hectares.

Further to the south and east of the site, over Bakewell Drive and Ostrich Farm Road, is the Southern Regional Waste Resource Authority (SRWRA) which is one of the State's major landfill operations currently receiving over 100,000 tonnes of waste annually (refer to **Figure 4.5**). The SRWRA landfill site is responsible for providing and operating waste management operations for the Onkaparinga, Marion and Holdfast Bay Councils.

To the immediate west of the subject site is the Vista Seaford Heights estate, currently developed by Fairland (Fairmont Land Holdings Pty. Ltd.). The Vista development is a master planned residential community set on approximately 88 hectares of land and will include over 1,100 allotments of various sizes as well as areas of public open space and a neighbourhood centre. The underlying topography of the Vista estate has resulted in the construction of high retaining walls and fencing (up to 4m) across the eastern half of the site as well as benching to allow for level residential allotments. Retaining walls are located on the boundary between the subject site and the Vista development. This limits views from the Vista Estate into the subject land with residential rooflines, retaining walls and fencing at the boundary interface with the subject site. An image of existing fencing and the retaining wall adjacent the western boundary of the subject site is provided in **Figure 4.6**.

Figure 4.4 State Heritage Place, Ostrich Farm Road



Figure 4.5 SRWRA Land Fill and Waste Transfer



Figure 4.6 Fencing & retaining walls on property boundary with Vista Seaford Heights



5. Description of Proposal

5.1 Overview

The development will comprise a nominal 600 ML treated water storage dam located centrally on the site at Lot 102 & 108 Bakewell Drive Seaford Heights. The proposed dam will measure approximately 330 metres in length, 265m in width and 9.3 metres in depth (from the top of crest to dam floor with a proposed water depth of 8.3m).

The dam will be a 'turkey's nest' dam with the top of the dam banks elevated above the natural ground level and as such there will be no natural runoff into the dam. Due to the variable ground level across the site the fill height of the dam walls above ground level varies from 4.6m to 7.6m.

The dam will be constructed with a 1 in 3 internal batter which will be lined with a high-density polyethylene (HDPE) liner manufactured from UV stabilised material placed on a low-permeability subgrade. There will be an external 1 in 3 slope surrounding the dam which will be constructed with compacted earth. At the base of this dam embankment will be an access road, security fencing and a swale to collect stormwater runoff.

The proposed storage dam will include an underdrain system to enable leakage to be readily identified and managed.

Adjacent the dam embankment and access road will be a series of constructed earth mounds of varying heights (depending on existing ground level) between 1.5m – 7.8m at a slope of 1 in 4. These will be constructed using the excess fill excavated for the dam and will be vegetated with plants and trees in order to minimise visual impacts of the dam embankment. At the base of the mounds opposite the dam embankment, there will be a 3m wide swale which will collect stormwater runoff and direct it towards a proposed detention basin and discharge points (and ultimately off of the subject site).

The proposed mounds will be vegetated with site appropriate plant species which are currently present within the existing landscape buffer. These will grow to a mature height which will help to facilitate the visual management of the development and will significantly improve and enhance the existing landscape buffer that has been established on the site to screen urban development (Vista Estate) from Victor Harbor Road.

The dam embankment is proposed to incorporate the following setback from adjoining roads and property boundaries:

- 58.5 metres (approx.) from the crest of the dam to adjoining residential property to the south;
- 79 metres (approx.) from the crest of the dam to allotments that have been created on the adjoining Vista Estate to the west;
- 47 metres (approx.) from the crest of the dam to the kerb of Ostrich Farm Road to the east;

- 185 metres (approx.) from the crest of the dam to the existing kerb of Victor Harbor Road to the north-east; and
- 247 metres (approx.) from the crest of the dam to the existing kerb of Bakewell Drive to the south.

Access to the site is proposed from a single 4.0 metre wide driveway access and crossover on Bakewell Drive that will be designed to ensure adequate clearance and sight lines for vehicles entering and exiting the site.

Importantly, the proposed development will not impact or in any way conflict with the existing 'Buffer Zone Landscaping Area' or the 'Buffer Land' that has been established as a landscape 'buffer' to screen urban development in the adjoining Vista Estate from Victor Harbor Road.

Proposed site works are summarised as follows:

- Excavation of 280,000 m³ of soil to construct a water storage dam with a capacity of 600 ML;
- Excess fill to be utilised to form the dam wall embankments as well as vegetated earth mounds developed around the dam to assist to screen the structure from Victor Harbor Road, the Adelaide Plains and adjoining properties including the Vista Estate;
- A stormwater detention basin (to limit peak flows from the southern catchment);
- A proposed 500mm buried inlet-outlet pipe connecting the proposed dam to the quarry road dam pump station (over Victor Harbor Road);
- A new compacted rubble access driveway measuring 4.0 metres in width to provide access for a maintenance utility vehicle from Bakewell Drive to the dam and around the upper circumference of the dam wall;
- 1.8 metre high chain wire security mesh fencing around the base perimeter of the dam wall embankment and set behind proposed vegetated mounds so that it is effectively screened from the adjoining road network;
- Appropriate signage to prevent access to the dam infrastructure; and
- Landscape planting utilising native tree and shrub species (including species currently present within the existing 'Buffer Zone Landscaping Area' on site).

Proposed concept plans for the proposed development are provided at **Appendix 6**.

5.2 Site Amenities & Infrastructure

As a static water storage dam there are no proposed amenities on site with no requirement for a site office, store or other ancillary structures and facilities.

The proposed dam will be filled and emptied using the existing pumping infrastructure at the existing WBWC site at Quarry Road. On this basis, the development application for the new dam will not require new pumping infrastructure.

A 1.8 m high chain wire mesh fence and associated signage is proposed around the perimeter of the dam to prevent public access to the dam but to also restrict access by animals and wildlife (to prevent any damage to the membrane liner). The fencing will be set behind proposed vegetation mounds so that it is effectively screened from the adjoining road network.

Whilst it will be necessary to install a new 500mm inlet / outlet pipeline between the treated water storage and WBWC's Quarry Road dam it is noted that this 'public infrastructure' (involving the construction, reconstruction, alteration, repair or maintenance of a drain or pipe) is likely to be State Agency development that is exempt from approval pursuant to Section 49(3) of the *Development Act, 1993* and pursuant to Section 67(1) and Schedule 14 of the *Development Regulations, 2018*.

5.3 Dam Construction

5.3.1 Geotechnical Considerations

A 'Geotechnical Investigation Report' has been prepared by SMEC and is attached at **Appendix 7**.

This report has been prepared to provide a broad understanding of the foundation, excavation and earthworks conditions for the proposed water storage dam. Investigations included drilling four (4) boreholes to a target depth of 8.0 metres. The boreholes were positioned to provide a broad coverage of the proposed storage area. The field investigation was completed in general accordance with AS1726:2017 *Geotechnical Site Investigations*, and the position of the boreholes was recorded on site using a hand-held GPS unit and has been reported on engineering logs. Samples were collected for laboratory testing and were submitted for testing at the NATA registered Golder laboratory in Adelaide. The purpose of the testing was to assess the physical and dispersive properties of the soil.

SMC confirmed that the regional geology map (1:50,000 Noarlunga Sheet) shows undifferentiated Quaternary deposits at the surface including Hindmarsh Clay, Ngalinga Clay and a lower sand unit equivalent to the Carisbrook Sand, Ochre Cove Formation and Seaford Formation. The Hindmarsh/Ngalinga Formations comprise brown, red and olive clays and sandy clays with sand and gravel lenses.

The geology map indicates the upper clay soils are underlain by Proterozoic bedrock including:

- SEACLIFF SANDSTONE: Pale grey and red sandstone, quartzite and red siltstone
- BRACHINA FORMATION: Red and green siltstone and fine-grained sandstone
- REYNELLA SILTSTONE MEMBER: Mostly massive siltstone with small rock fragments
- WILMINGTON FORMATION: Massive, green-grey, fine-grained sandstone

The subsurface conditions encountered in the boreholes were broadly consistent with the expected regional geology. **Table 5.1** over page identifies the soil units encountered on site. No groundwater was encountered within the depth investigated.

Table 5.1 Summary of Encountered soil units (Source: SMEC)

Topsoil (A Horizon):	Silty CLAY, dark brown with roots and other organics, trace to some sand
Upper Clays (B Horizon)	Silty and Sandy CLAY, medium plasticity, pale brown mottle, with some sand and gravel
Hindmarsh / Ngalinga Clays	CLAY, high plasticity, grey mottled orange-brown and red-brown
Residual Soils	CLAY and CLAYEY SAND and with extremely-to-highly weathered fragments of the parent rock
Siltstone	Siltstone, red brown, orange brown and pale grey, indistinct fabric. Highly weathered and low strength at the top of the stratum, becoming moderately to slightly weathered and medium strength with depth. Encountered BH2 only.
Sandstone	Sandstone, orange brown, very low strength, highly to extremely weathered. Encountered BH4 only.

Emerson Class laboratory testing was completed on three samples of the clays soils and indicated that the soils below 2.0 m depth may be dispersive.

The soil classification testing indicated the following soil properties:

- Clay soils with fines content (clays and silts) greater than 76%;
- High to very high plasticity, increasing with depth; and
- Soils are highly reactive with respect to change in moisture content (linear shrinkage > 15%).

The geotechnical investigations have revealed that the natural clay soils encountered in the boreholes are expected to be generally excavatable using conventional machinery such as excavators and dozers. Slower production rates would be expected in the residual soils and the very low strength weathered rocks. Should the medium strength siltstone soils be encountered, the use of specialist rock breaking equipment may be required. However, the need for the use of drill and blast techniques for excavation is not considered likely. It is anticipated that the type of construction equipment used on site will be similar in nature to the equipment undertaking excavation on the adjacent 'Vista Estate'.

SMEC have recommended that temporary batter slopes or benches in the clay soils shall be cut at no steeper than 1H to 1V. For permanent works a 3H to 1V batter is considered suitable, provided the clays are protected from erosion caused by concentrated flows.

SMEC have also confirmed that the natural clay soils at this site have high plasticity, with plasticity increasing with depth. Such soils are reactive in response to seasonal moisture changes (high shrink-swell potential) which may cause large surface movements and development of shrinkage cracks following desiccation. Pipe connections and shallow foundations will need to be designed with appropriate articulation to allow for surface movements.

5.3.2 Dam Design & Construction

The proposed water storage dam does not require an EPA license, however the facility will be designed in accordance with the *'EPA Guideline EPA509/14 – Wastewater Lagoon Construction'*.

In addition, a *'Geotechnical Inspection and Testing Authority'* (GITA) will provide Level 1 supervision on-site during construction in accordance with AS3798:2007 to provide appropriate CQA (Construction Quality Assurance) consistent with the requirements of the guidelines.

The design of the proposed dam will also follow appropriate elements of the ANCOLD (Australian National Commission on Large Dams) Guidelines on Consequence Categories for Dams (2012).

Seismic Performance

The design of the dam and overflow structures including the foundation would include seismic loading. The structures will be designed to meet the Operating Basis Earthquake (OBE) and Safety Evaluation Earthquake (SEE) seismic load conditions in accordance with ANCOLD (1998).

Flood Performance Review

The water storage dam is a turkey's nest configuration, with the proposed dam crest level several metres above surrounding ground levels and located at a high point in the regional topography. On this basis, inflows due to flood are effectively excluded from the storage.

Foundation Design

The foundation design for the dam will be based on the geological/geotechnical model.

Consideration would be given to the adequacy of the existing foundation condition and the performance of the dam under the various flooding conditions and treatments required to ensure adequate stability and integrity of the structure. Assessment for the design would include aspects such as deformations, seepage, piezometric conditions and the like.

The foundation design will ensure compatibility between the various storage structures, that differential movements are not excessive and that potential for excessive seepage and associated erosion/piping is appropriately managed.

Embankment Design:

Freeboard Assessment

The level of freeboard for the embankment will be assessed in accordance with the procedure outlined in the *USBR Design Standards 13 – Embankment Dams*. However, as this dam type is a turkey's nest and hence there is no run-off into the dam, it is typical to adopt a freeboard equivalent to rainfall depth for the extreme rainfall event. Design rainfall storm events based on Intensity Frequency Duration (IFD) data for this site location would be sourced from Bureau of Meteorology

Embankment Stability

The slope stability of the embankment will be assessed for various load cases including normal operating conditions, flood, seismic and rapid drawdown. The acceptance criteria for the dams would be based on ANCOLD recommendations. The outcomes of this assessment will set the dimensions and slopes of the embankment.

The internal stability of the embankment would be considered as part of the design, using the filter criteria detailed in Fell et al (2015). Filters (if required) will be designed to meet material compatibility and permeability requirements. Potential for segregation of the filters would also be taken into consideration during the design of the filters

Camber

A settlement assessment would be undertaken as part of the design of the embankment to determine the requirements for camber

Inlet / Outlet works

Design of the inlet/outlet works will incorporate the design of the embankment penetration protection detail and is likely to comprise concrete encasement of the inlet/outlet pipe(s).

Overflow

An overflow structure is required to allow for controlled discharge of water (if in the unlikely event that this is ever required). The overflow structure will be designed to ensure that the adopted arrangement provides the requisite performance up to and including the maximum discharge. The assumed maximum discharge would be taken to be equivalent to 1.5 x the peak inflow rate of 24ML/day.

The design of the overflow will comprise both hydraulic and structural aspects of the structure. The design will consider the hydraulic capacity of the structure, as well as requirements for energy dissipation and erosion

potential. This design would be undertaken using empirical formulas. The various overflow components would then be sized to meet stability and structural requirements in accordance with ANCOLD Guidelines and Australian Standards with consideration given to sliding and overturning stability and include bearing pressure and compressive strength assessments. Aspects such as uplift loading and drainage would be incorporated into the assessment.

The overflow structure would be designed to ensure positive contact with the embankment to accommodate likely settlement of the embankment and overflow structure.

Access Road

The dam crest access track would be designed with cross fall to direct surface water away from the storage.

Instrumentation

Design of the instrumentation system for the storage will be designed in accordance with ANCOLD (2003) and relevant EPA and SA Health requirements. As a minimum the instrumentation system will include storage level detection, seepage monitoring and ground water piezometers.

Dam Access

Access to the storage would be required for inspection and maintenance of the liner and storage generally.

It is envisaged that access would require the provision of ladders and or platforms. These elements will be designed in accordance with the requirements of AS1657-2018.

Signage

Required site signage will be designed to meet the requirements of AS1319 (Safety Signs for the Occupational Environment.)

Safety in Design

Hazard identification and risk assessment will be undertaken throughout the design process.

Where possible, occupational health and safety risks would be eliminated or reduced to an acceptable level for each component of the structure to ensure that structures being used by people at work *“are safe and without risks to health when properly used”*.

Design considerations include safety requirements relating to operation and maintenance, the choice of materials and products, methods and sequence of construction and OH&S issues relating to dam safety monitoring

5.3.3 Construction Environmental Management Plan

It is envisaged that a Construction Environmental Management Plan (CEMP) will be prepared following receipt of Development Approval and will describe how activities undertaken during the construction phase of development will be managed to avoid or mitigate negative environmental impacts on the site and how those environmental management requirements will be implemented.

Accordingly, the applicant would accept a suitable condition of approval requiring the preparation of a CEMP to the satisfaction of SCAP prior to commencement of construction.

It is anticipated that the CEMP will demonstrate how possible air emissions (dust management), noise, waste, water quality and traffic will be managed to prevent impacts on the land subject to development, and on nearby land uses and the natural environment.

5.3.4 Traffic Management Plan

Earthmoving equipment and other construction and delivery vehicles will access the site during construction.

Excavated fill will be used to create the dam wall batters and therefore construction materials are not proposed to be removed from the site during construction. On this basis, there will be a relatively low traffic generation associated with the construction of the facility.

Notwithstanding, once a contractor is engaged for the construction activity, it is anticipated that a Traffic Management Plan will be prepared as part of an overall 'Construction Environmental Management Plan' (CEMP) and will outline how vehicles are to access the site. This plan would consider the need to install work zone traffic management along Bakewell Drive to manage the interface between construction traffic and through traffic.

The applicant would accept a suitable condition of approval requiring the preparation of a CEMP and associated Traffic Management Plan to the satisfaction of SCAP, prior to commencement of construction.

5.4 Dam Operations

The operation of the dam will be undertaken by WBWC who has experience in the operations of similar dams including three (3) treated water storage dams adjacent to the Willunga Community Wastewater Management Scheme on Little Road, Willunga.

The dam will be filled in winter and emptied in summer.

WBWC maintains an Irrigation Risk Management Plan (IRMP) in accordance with the 'Australian Guidelines for Water Recycling' and EPA's Recycled Water Guidelines. The IRMP provides for reporting of water use and operations to relevant regulatory authorities. WBWC constantly monitors water consumption using data loggers on each customer meter, as well as 24x7 monitoring of water flows in the network via their 'Supervisory, Control and Data Acquisition' (SCADA) system. This enables WBWC to monitor the balance of water across their network and to identify water losses which is not apparent under WBWC's current operations.

WBWC maintains a network of shallow observation wells for monitoring leakage or runoff from storage dams or irrigation sites.

5.5 Environmental Management

5.5.1 Air Quality / Odour

The EPA Guideline titled *'Evaluation distances for effective air quality and noise management'* dated August 2016 clearly states that *'There is no recommended evaluation distance for recycled water storage lagoons, so a site-specific assessment is recommended'*.

An 'Odour Assessment' of the water storage dam has therefore been undertaken by ERM (refer to **Appendix 9**) which was based on field odour observations at current treated water storage facilities in the area of the proposed dam location. The results from the observations were evaluated against the separation distance to the nearest sensitive receptors, general settings of the area as well as wind data. ERM advised that dispersion modelling was not performed for the assessment since it is difficult to characterise emissions from low level non-offensive odour sources (given odour impacts from low level non-offensive odour sources typically produce over predictions in separation distance requirements in dispersion modelling).

The field odour observations methodology applied for the assessment was a modified version of the German Standard VDI 3490 (1993) method for odour surveys. The method standardises the odour logging approach by the adoption of a standard scale for describing odour intensity, as detailed in the German Standard VDI 3882, which relates to odour measurement. This method was selected as it enables the evaluation of odour over time rather than single point in time with discrete observations.

Locations for the field odour observations were selected to cover one upwind location for reference of background odour and downwind locations at various distances from the targeted odour source. In addition to recording odour intensity observations, wind conditions (wind direction and wind speed) were also recorded for each observation.

Based on field odour observations from other dams (i.e. The Aldinga Storage Dam, Quarry Road Treated water storage dam and Little Road treated water storage dams) ERM noted that odour from the treated water storage dams is recognisable, but not perceived as offensive, and typically present intermittently at low levels even very close to the dams. While the treated water is a product from a wastewater treatment plant, the odour from the storage dams is not perceived as wastewater related. The character of the odour of the treated water is closer in resemblance to muddy lake or pond water.

The field odour observations undertaken by ERM showed the following:

- There is odour associated with treated water storage dams. However, the character of the odour is not perceived as offensive, and it is not a wastewater related odour;

- The levels of odour observed were mostly low level and intermittent, especially at distance from the sources;
- At most locations no odour was observed for most of the time; and
- No distinct or strong intensity odours were observed.

The ERM assessment also incorporated an analysis of local wind data as this indicates where impacts will occur. Wind data from the Noarlunga BoM weather station (the nearest weather station to the site) was used to identify prevailing wind directions. ERM observed that Noarlunga BoM station is located in a windy location (very low frequency of low wind speeds) and that the proposed water storage dam is proposed on a hill top at a higher elevation than the Noarlunga weather station, which should give greater exposure. This means that the site location can be expected to be windier than Noarlunga and this provides good dispersion conditions.

ERM state that *‘While there is potential exposure of the nearby sensitive receptors (with prevailing SE and N winds for part of the year), dispersion conditions at the elevated site location should be good and the residential receptors are not in locations, relative to the storage dam, that would pose any particular exposure risk.’*

Based on the field odour observations and the assessment, ERM noted that it cannot be concluded that there will be no odour at the nearest sensitive receptor locations at the Seaford Heights residential development as a result of the construction of the treated water storage dam as proposed. However, ERM concluded that the assessment shows that any odour would be very low level (low odour concentration and intermittent) and not of an offensive nature.

ERM recommend that an ‘Operations Management Plan’, that includes odour management, be developed for the treated water storage dam. Accordingly, the applicant will prepare an Operations Management Plan in association with the detailed design of the dam and this will include a requirement for routine water quality monitoring protocols and site inspections specifically targeting observation of odour for monitoring of performance. The Operations Management Plan will also provide information on preventative measures for maintenance of water quality and an incident response plan (should an odour event occur).

ERM conclude that *‘With an effective Operations Management Plan in place, there is a low risk of elevated odour from the proposed treated water storage’.*

5.5.2 Noise

The proposed dam will be filled and emptied using the existing pumping infrastructure at the existing WBWC site at Quarry Road. On this basis, the new dam will not require pumping infrastructure to transfer water to and from the existing Quarry Road dam. Accordingly, no noise will be generated on site during the ongoing operation of the dam.

5.5.3 Vectors

The supply of recycled water is governed by SA Health and WBWC holds an approval from SA Health for the use of recycled water through the Willunga Basin Pipeline network pursuant to the *South Australian Public Health (Wastewater) Regulations, 2013*. A copy of the approval granted by SA Health to WBWC is attached at **Appendix 10**. This approval includes, amongst other things, the provision for the storage of the treated water which includes (in Clause 9) the following requirement:

The storages are not to provide a source of offensive odours or nuisance conditions including breeding of vectors such as mosquitos.

WBWC have consulted with SA Health on the construction of the dam and SA health advised that the design of the dam was consistent with SA Health's requirements for minimising impacts associated with nuisance vectors such as mosquitos. (Refer to correspondence from SA Health Attached at **Appendix 11**).

The design of the proposed dam has been informed by the 'South Australian Integrated Mosquito Management Resource Package, 2006' which has been prepared by SA Health as an informative guide for Mosquito Management Practitioners.

The guide includes criteria to be considered in the design and construction of artificial or man-made 'wetland' systems commonly constructed to control and treat stormwater and waste water and are not specifically tailed to a Dam for the storage of recycled water. Importantly wetlands comprise land or areas (such as marshes or swamps) that are covered often intermittently with shallow water or have soil saturated with moisture. A wetland is very different to a functional water storage dam that is designed with steep bank slopes, deep water and the absence of grasses and vegetation that is often used in wetlands to filter and improve water quality.

Notwithstanding, the design of the water storage dam has taken into consideration the following key design considerations for wetlands to assist with the management of mosquitos:

1. Where possible and to avoid any potential conflict between people and wetlands construction should occur away from 'people intensive' areas such as high density residential area, schools and aged care facilities. The location of the wetland should also take into account the possible dispersal of mosquitos species present in the area.

The proposed Water Storage Dam is located on 'adjacent land' to the Vista Estate which is a master planned residential development. The guide does not include a recommended separation distance to a wetland and simply seeks to avoid any potential conflict. Given the water storage dam is not a wetland and includes the adoption of proposed design techniques to manage and control mosquitos, there is no outward impact arising from the proximity of this infrastructure to residential properties.

2. Wetlands should be constructed in open areas subject to wind action. Wind produces surface waves that aid in the disruption of larval respiration/adult oviposition and reduce the growth of algae and plants that provide protection for both adults and larvae.

The topography of the subject site forms a rolling hilltop that is open with good wind dispersion conditions at the elevated site.

Wind data for the subject site is located within the Odour Assessment prepared by ERM (attached at **Appendix 9**). Wind data from the Noarlunga BoM weather station was utilised to inform the odour assessment and this weather station is located approximately 4km to the north of the proposed water storage dam. The Odour Assessment states 'However, it should be observed that Noarlunga BoM station is located in a windy location (very low frequency of low wind speeds) and that the proposed SRWRA storage dam site is located on hill top at a higher elevation than the Noarlunga weather station which should give greater exposure. This means that the site location can be expected to be windier than Noarlunga and this provides good dispersion conditions.'

3. Shallow water and dense vegetation is attractive to mosquitoes whereas deeper, open water bodies with steep margins free from vegetation are less appealing as a habitat source.

The proposed dam will measure approximately 330 metres in length, 265m in width and 9.3 metres in depth and will be constructed with a 1 in 3 internal batter which will be lined with a high-density polyethylene (HDPE) liner manufactured from UV stabilised material. There will be an external 1 in 3 slope surrounding the dam which will be constructed with compacted earth and not vegetated with landscaping. The proposed dam is therefore a relatively large, deep and open water body with steep margins free from vegetation and therefore will not be attractive to mosquitoes.

4. Wetlands should be greater than 60cm in depth overall and with steep sides to discourage mosquito breeding. Increased water depth will also enable fish predator species to inhabit the area.

As discussed, the proposed water storage dam is a deep (up to 8.5m) and relatively open water body with steep banks to discourage mosquitoes breeding

5. Maintain good water movement through the wetland to promote low mosquito populations, e.g. still water is more attractive to mosquitoes and prevents water from becoming stagnant (certain species are attracted to stagnant/polluted water).

A major operational feature of the dam is that it will be recurrently filled and emptied which will assist to enhance water quality and prevent the water from becoming stagnant and attractive to mosquitoes.

6. The use of sprinkler systems which may inhibit or reduce adult oviposition and aeration systems to disturb the water surface making it unsuitable for larvae.

Given the design features of the proposed water storage dam and the recurrent filling and emptying of the dam it will not be necessary to install other aeration systems to disturb the water surface and make it unsuitable for larvae.

7. Removal or the periodic control of excess vegetation from areas such as drains, dams and wetlands will in many cases provide increased water movement, predator access for larval control and a reduction in shelter for both adults and larvae.

The proposed water storage dam and internal embankments will remain free from vegetation that could offer shelter for both adults and larvae.

8. Choose vegetation that will not vigorously invade the water body or the surrounding banks and requires minimal maintenance.

The proposed water storage dam and embankments will remain free from vegetation.

9. Drains should be designed so that silt is prevented from building up and water is unable to pond.

Not relevant to the proposed water storage dam.

10. Any maintenance required to the wetland system including drainage systems should be undertaken in a manner that ensures further mosquito habitats are not created, e.g. wheel ruts.

The proposed water storage dam would be regularly accessed for monitoring and maintenance with a weekly inspection and a biannual program of vegetation control.

11. Regular surveillance and monitoring of the wetland and surrounding area (pre and post wetland establishment) to determine mosquito abundance and species type (Department of Medical Entomology (b), 1998).

The proposed water storage dam would be regularly accessed for monitoring and maintenance with a weekly inspection and a biannual program of vegetation control.

5.5.4 Water Quality

Daphnia

Experience with other wastewater storage dams indicates that daphnia is the most likely water quality issue of concern. Daphnia are small crustaceans that live off natural occurring algae in all types of water storages. Daphnia do not pose a public health concern but cause problems in irrigation systems as they block drippers and filters.

WBWC filters the water supplied to customers from the dam on-site with the backwash water returned to the dam. The most effective control is to ensure the dam is filled and emptied on a regular cycle as refilling the lagoon introduces water which is free from daphnia.

This is consistent with the normal operating approach adopted by WBWC for its water storage facilities.

Filamentous Algae

Filamentous algae are colonies of microscopic plants that link together to form threads or mesh-like filaments. These primitive plants normally grow on the surface of hard objects or other substrates under the water, but they can break loose and form floating mats. Whilst unsightly, they are not a threat to public health particularly given the secure environment of the proposed water storage facility preventing public access to the algae.

The algae generally becomes a food source for Daphnia and as such an algal event is more likely to lead to a Daphnia event which will be managed as outlined above.

5.6 Traffic and Access

Traffic considerations associated with the proposed development include road widening requirements to Victor Harbor Road, proposed access arrangements to the site as well as traffic generation and the capacity of the existing road network to accommodate the traffic generated by the proposed development.

5.6.1 Road Widening (Victor Harbor Road)

The Department of Planning Transport and Infrastructure (DPTI) have advised that the subject site is affected by a road widening requirement shown on the Metropolitan Adelaide Road Widening Plan. The plan shows a possible requirement for a strip of land up to 35m in width from the Victor Harbor Road frontage of this site for future road purposes. This requirement caters for a possible future duplication of Victor Harbor Road at this location. Although the exact nature and timing of this proposal has yet to be determined (and no funding has been committed), the consent of the Commissioner of Highways under the Metropolitan Adelaide Road Widening Plan Act is required to all building works on or within 6m of the possible requirement.

The proposed dam wall batters and landscape batter slopes are all setback further than 35m from the Victor Harbor Road reserve and therefore it is not anticipated that the proposed development will impact on potential future road widening of this road.

5.6.2 Traffic Generation

General Operations

Existing traffic volumes on both Bakewell Drive and Ostrich Farm Road are low and are likely to be in the order of 100 vehicles per day and comprising mainly refuse type vehicles accessing the adjacent SRWRA site.

During general operations, it is anticipated that a single utility vehicle would access the site of the proposed water storage dam a few times per week for general site security and maintenance.

The traffic volume generated by the proposed development would therefore be insignificant, even considering the relatively low existing traffic volumes on the adjoining road network. On this basis, the traffic volume

generated by the proposed development is not likely to impact the current operation of the adjoining road network or its intersections.

During Construction

During construction, earthmoving equipment and other construction and delivery vehicles will access the site. Given the earth excavated to create the dam will be used to form the dam wall batters and on-site landscaping (i.e. a neutral balance of cut and fill) it is not anticipated that material will be removed from the site and large construction equipment will remain on-site for the duration of construction works. On this basis, relatively low traffic generation associated with the construction of the facility is expected. Once a contractor is engaged for the construction activity, as part of a Site Management Plan the contractor will be required to prepare a Traffic Management Plan which outlines how vehicles are to access the site. Where required, this plan could consider the need to install work zone traffic management along Bakewell Drive to manage the interface between construction traffic and through traffic.

5.6.3 Proposed Vehicle Access

Proposed vehicle access to the site is via a single crossover to Bakewell Road which is located adjacent the eastern boundary of the site. This access crossover is approximately 235m west of the vehicle access driveway into the SRWRA and will be designed to ensure adequate clearance and sight lines for vehicles entering and exiting the site. The proposed access will cater for vehicle movements in all directions and has been designed to accommodate access and egress for a standard utility vehicle.

5.7 Landscaping

5.7.1 Arboriculture & Native Vegetation Assessment

Arborman Tree Solutions undertook an inspection of the site on Monday 24 September 2018 to determine the presence of possible Regulated or Significant Trees on site pursuant to the *Development Act, 1993* and to determine if any vegetation clearance on-site requires approval from the Native Vegetation Council pursuant to the *Native Vegetation Act, 1991*.

The report prepared by Arborman (**Appendix 12**) confirms that there are no Regulated or Significant Trees on site and therefore Development Plan Consent is not required for the removal (tree damaging activity) of any existing trees on site.

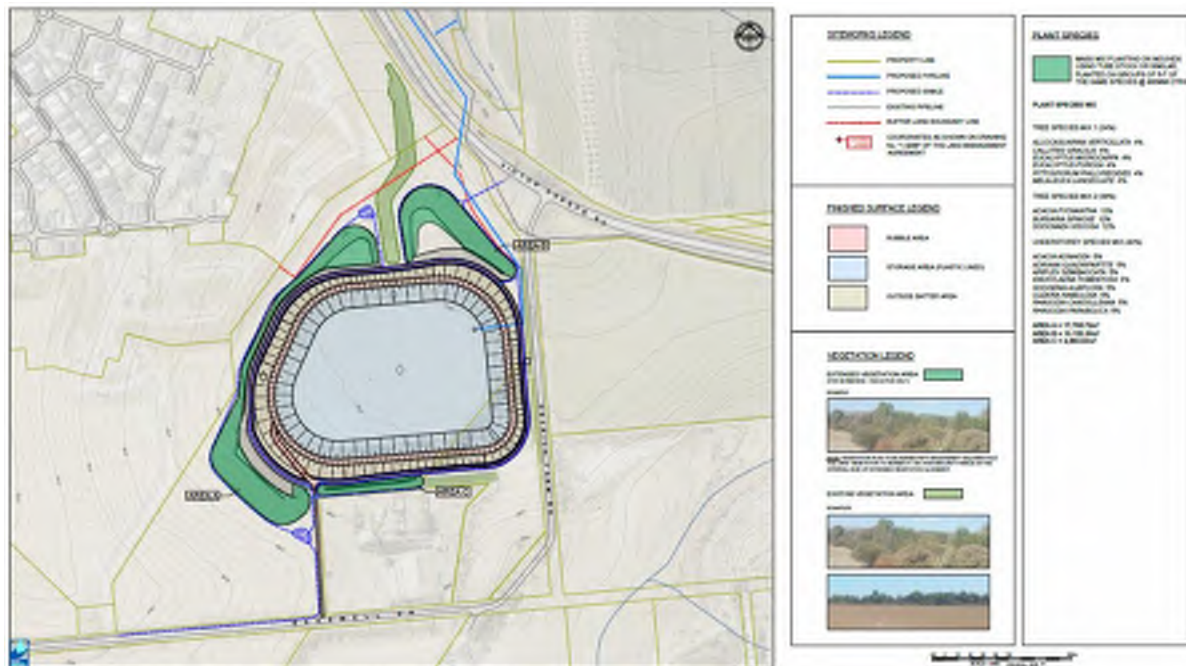
In addition, Arborman Tree Solutions have confirmed that the trees planted in a wind break adjacent the southern boundary of the site are juvenile planted specimens and their clearance is not controlled under the *Native Vegetation Act, 1991*.

Accordingly, no approval is required for the removal of any existing vegetation on site to accommodate the proposed new dam.

5.7.2 Landscape Design

A landscape plan has been prepared by Wax Design Pty. Ltd. and is reproduced in **Figure 5.1** below and also attached with the 'Visual Impact Assessment' dated 17 October 2018 (refer to **Appendix 13**).

Figure 5.1 Landscape Master Plan (Wax Design dated 17 October 2018)



As described in Section 5.1 above, adjacent the proposed dam embankment will be a series of constructed earth mounds of varying heights (depending on existing ground level) between 1.5m – 7.8m at a slope of 1 in 4. These will be constructed using the excess fill excavated for the dam and will be vegetated with site appropriate plant species. The plant species have been selected to match those planted within the existing 'Buffer Zone Landscaping Area' which was established on site (and will be retained) to screen urban development in the Vista Estate from Victor Harbor Road.

The Landscape Master Plan nominates a mix of landscape species to be established across approximately 3.08 hectares of the site on the constructed earth mounds surrounding the proposed dam. The approach replaces the existing arable cropping land with trees and shrubs to reflect the pockets of remnant vegetation east of Victor Harbor Road and will result in a significant improvement to the landscape character by returning native vegetation to the site.

The mix, composition and proportion of proposed landscape species to be planted on site is identified in **Table 5.1** below.

The proposed mass mix planting on mounds will be established using tube stock (or similar) planted in groups of 5-7 of the same species at 800mm centres.

Table 5.1 *Plant Species (Composition and Mix)*

Tree Species (Mix 1)	24%	Tree Species (Mix 2)	36%	Understorey Species Mix (40%)	40%
Allocasurina Verticillata	4%	Acacia Pycnantha	12%	Acacia Acinacea	5%
Callitris Gracilis	4%	Bursaria Spinose	12%	Adriana Quadripartite	5%
Eucalyptus Microcarpa	4%	Dodonaea Viscosa	12%	Ariplex Semibaccata	5%
Eucalyptus Porosa	4%			Enchylaena Tomentosa	5%
Pittosporum Phillyreoides	4%			Goodenia Albiflora	5%
Melaleuca Lanceolate	4%			Olearia Ramulosa	5%
				Rhagodia Candolleana	5%
				Rhagodia Prabolica	5%

5.8 Stormwater Management

A Stormwater Management Plan has been prepared by Tonkin Consulting and is attached at **Appendix 14**.

The proposed Stormwater Management Plan has been prepared taking into consideration the requirements of the City of Onkaparinga (Council) as well as other relevant authorities and policies including:

- The Onkaparinga Council Development Plan;
- The Western Mount Loft Ranges Water Allocation Plan; and
- McLaren Vale Water Allocation Plan.

Hydrological modelling was undertaken with sub-catchments defined and delineated using topographical data. The time of concentration for each sub-catchment were subsequently estimated based on flow path lengths and slopes and utilisation of an appropriate run-off coefficient. As expected, the steeper batter slopes and more formalised drainage paths (swales) associated with the proposed development resulted in lower times of concentration for the smaller catchments in the post-development scenario.

The results of this modelling demonstrated that:

- The post-development major and minor event flow rates for the north-east and north-west sub-catchments do not exceed the flow rates for the pre-development scenario (i.e. the slight increase in impervious area is off-set by the reduction in catchment size given the proposed dam will capture and retain all water that falls onto its surface); and
- The runoff for the southern catchment is higher for the post-development scenario and therefore a detention basin will be required to reduce the peak flows from this catchment.

A DRAINS model was then utilised to determine that a detention basin was required for the southern catchment comprising:

- A basin volume of 60 m³;
- A basin depth of 0.6m; and
- An outlet pipe diameter of 375mm.

The modelling indicates that the basin configuration described above reduces the 10% AEP peak flows from the southern catchment to 74L/s which is less than the pre-development peak flows (82 L/s).

In relation to Water Quality, Tonkin Consulting consider that the operation of the proposed water storage dam will not impact on the water quality of runoff from the site with the design of the proposed dam incorporating the following features that will reduce pollutant loads leaving the site:

- The batters of the storage dam will be grassed which will act as buffer strips;
- The grassed swales used to convey flows to the discharge points will provide further treatment of the flow; and
- The proposed detention basin will provide additional water quality improvement for flows from the southern catchment.

A MUSIC (Model for Urban Stormwater Improvement Conceptualisation) model was also developed to provide an understanding of the likely quality of stormwater runoff from the site and concluded that the development will not negatively impact the water quality of downstream receiving waters.

A Stormwater Management Plan (SMP) has been prepared detailing the measures to manage stormwater discharged from the site and is reproduced in **Figure 5.2** below.

The key features of the stormwater management strategy include:

- The use of grassed swales to convey flows to the discharge points;
- A detention basin to limit peak flow rates from the southern catchment; and
- Vegetated batters.

The modelling undertaken as part of the development of the SMP by Tonkin Consulting confirms that the proposed measures comply with the requirements of the City of Onkaparinga.

Figure 5.2 Stormwater Management Plan



5.8.2 Western Mount Lofty Ranges Prescribed Water Resources Area

The subject site is also located within the McLaren Vale Prescribed Wells Area and specifically within the Surface Water Management Zone (SWMZ) O_OM12 within the catchment of the Onkaparinga River. On this basis, the development is therefore subject to the requirements of the Western Mount Lofty Ranges Water Allocation Plan (WAP). The WAP sets the amount of water that will be available, how that water may be allocated to users, and the types of activities that are permitted with that water.

The WAP sets out the maximum amount of surface water and watercourse water that can be taken within an SWMZ. The limit aims to ensure sufficient flows for environmental water provisions as well as for downstream users. Each SWMZ also has a diversion limit which is the “total volume of surface water that can be collected or diverted by all dams and/or intercepted by existing and new commercial forests.”

Given the proposed dam is constructed in a 'Turkey nest' configuration and is not located within a watercourse, the dam will not capture any 'surface water' (water flowing across the ground surface) and is therefore not likely to require a licence for the operation of a new water storage facility under the Western Mount Lofty Ranges Water Allocation Plan.

5.8.3 McLaren Vale Water Allocation Plan

The site is also situated within the McLaren Vale Prescribed Wells Area and is therefore subject to the conditions of the McLaren Vale Water Allocation Plan. This WAP pertains to the taking and use of groundwater.

Given the proposed development does not involve the extraction of ground water, it is not anticipated that a licence would be required in association with the proposed operations of the water storage dam.

6. Project Benefits

6.1 Employment and Economic Value

According to University of Adelaide's Kym Anderson, "*Economic Contributions and Characteristics of Grapes and Wine in Australia's Wine Regions*" 2009, 719 people were employed in grape growing in McLaren Vale in 2006 and 1,803 in winemaking. We know there was about 9,000 ML of irrigation water used at that time to support about 6,250Ha of vines with a crush of 56,000 tonnes.

On this basis, we can interpolate that about 80 full time on farm jobs and 200 winery jobs per 1,000ML of irrigation water used.

Given the proposed water storage dam will be 600ML the regional benefits from this project would be:

1. Preserve/create 48 full time on farm jobs and 120 winery jobs.
2. Preserve/create 3,750 tonnes of premium grape production worth \$5.5M in farm gate revenue annually (average price of \$1,500/tonne),
3. Preserve/create 2.25M bottles of premium wine production annually, worth \$33.75M annually in bottled wine sales (average price of \$15/bottle)

This excludes the benefits to the tourism sector from the sustainable management of the regions water resources.

6.1.1 Employment Impact

In 2009 'Property Insights' examined the economic impact of investing one million dollars in property investment on behalf of the Urban Development Institute of Australia (UDIA). Whilst applying to property development more broadly, this report provides a useful guide to the economic value and impact of the proposed water storage dam.

6.1.2 Employment During Construction

According to Property Insights, every-one million dollars of development industry investment in South Australia generates 6.9 full time equivalent development industry jobs. Development industry investment also indirectly supports jobs in a range of other industries. For everyone million dollars of development industry investment, the combined direct and indirect employment impact is fourteen (14) full time equivalent jobs.

The proposed water storage dam represents development industry investment of approximately \$5.4M and applying the above metrics the direct employment impact of the development is estimated at approximately 37 development industry jobs. When indirect employment impacts are taken into account, the total employment impact of the development is estimated at approximately 76 full time equivalent jobs.

6.1.3 Employment Upon Operation

The treated water storage is a relatively passive operational asset and WBWC will not need to employ additional operational staff as a direct result of this development. Notwithstanding, the additional treated water supplied by this facility will enable or sustain significant regional employment in the wine industry in both grape and wine production.

As has been discussed the project also provides the catalyst for WBWC expanding its treated water pipeline network into Blewitt Springs as well as enabling additional customer connections to be made within the existing network. In total WBWC has a 5-year plan with an estimated \$10M in infrastructure investment including the treated water storage dam. The remaining expenditure is predominantly in pipeline installation which is currently performed by local contractors. This further adds to the potential for job creation arising from the proposed development.

6.1.4 Wages and Salaries

Property Insights estimates that a one million dollar investment in the development industry generates wages and salaries of \$256,287 within the development industry.

The indirect impact on wages and salaries arising from development industry activity is substantial, estimated at an additional \$344,997 for every one million dollars of investment. The combined direct and indirect impact on wages and salaries is therefore estimated at \$601,284 per million dollars of investment.

Applying the above metrics, the proposed water storage dam is estimated to generate direct wages and salaries of \$1.38M and total (direct and indirect) wages and salaries of \$3.25M.

6.1.5 State and Federal Taxes

Development industry activity attracts a range of State and Federal taxes. Property Insights estimates that for every million dollars of development industry investment, direct taxes of \$62,921 are generated. When indirect taxation impacts are considered, total taxes generated by one million dollars of development industry investment is estimated at \$143,281.

Applying these metrics, the direct tax impact of the proposed water storage dam is estimated at \$340K and the total tax impact, including direct and indirect impacts, is estimated at \$774K.

6.2 Environmental Benefits

6.2.1 Environmental Impact of Proposal

The proposed development will ensure a more efficient use of a limited resource and delivers strong environmental and community value by reducing the discharge of treated effluent to the Gulf St Vincent and by replacing water that would otherwise be taken from a stressed groundwater resources and the River Murray.

6.2.2 Sea Grass Preservation

Pursuant to the South Australian EPA seagrass is commonly lost when nutrient levels in the water increase. These nutrients cause a large number of epiphytes to grow on the seagrass leaves, causing them to become too heavy and to break off. The nutrients also encourage more microscopic algae to grow in the water, reducing the amount of light getting to the seagrass, particularly in the deeper regions. Over 50 km² of seagrass have been lost from the Adelaide metropolitan coastline. This has been attributed to the effects of discharges such as sewage effluent and sludge and also stormwater.

The Adelaide Coastal Water's Study (ACWS) was a large-scale scientific study undertaken from 2001 to 2007 on Adelaide's coastal waters investigating seagrass loss, decline in water quality and sea floor instability.

The study included the production of 20 technical reports and a final report which contained 14 recommendations was released in February 2008 (*Fox et al 2007*). The top two recommendations are summarised below:

Recommendation #1

As a matter of priority, steps must be taken to reduce the volumes of wastewater, stormwater, and industrial inputs into Adelaide's coastal environment. This should be done within the context of an overarching strategy designed to remediate and protect the metropolitan coastal ecosystem.

Recommendation #2

The total load of nitrogen discharged to the marine environment should be reduced to around 600 tonnes (representing a 75% reduction from the 2003 value of 2400 tonnes).

The proposed water storage dam will directly reduce the discharge of treated effluent to the Gulf St Vincent with concomitant benefits to marine ecology and biodiversity consistent with these two recommendations.

6.2.3 Reduced Ground Water Extraction

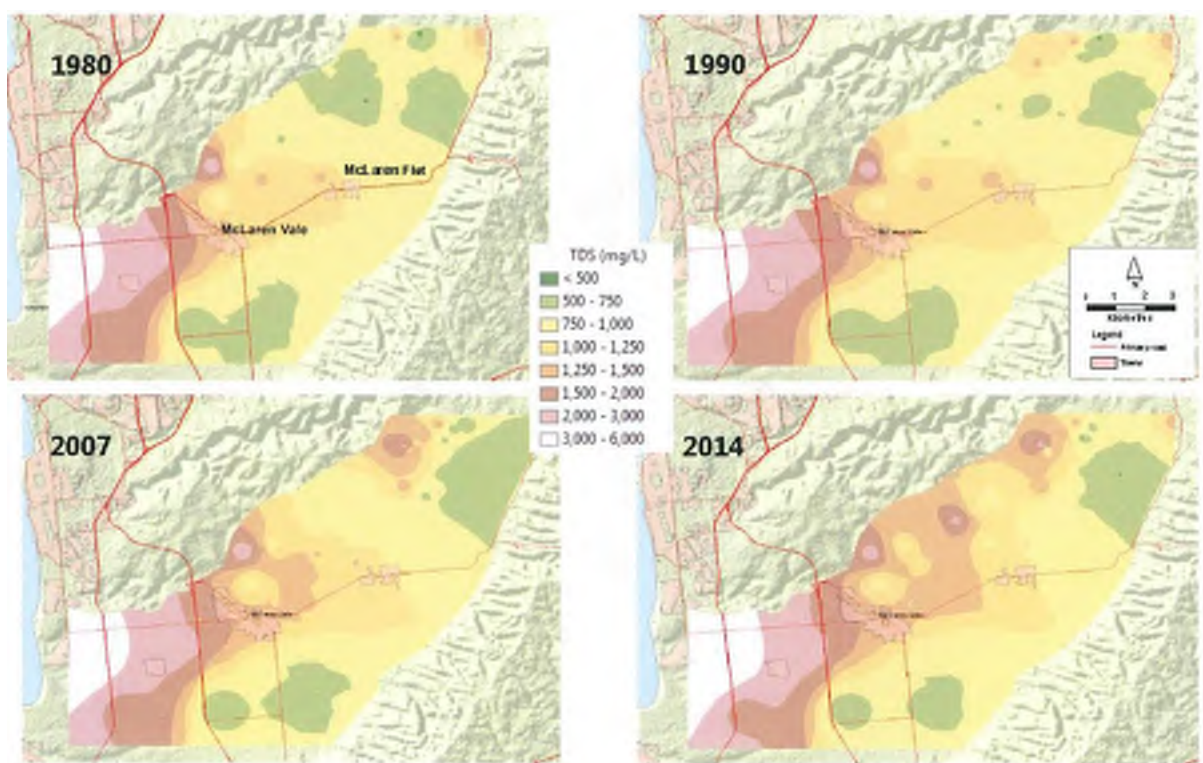
The McLaren Vale Prescribed Wells Area was proclaimed in 1999 and the water allocation plan has been in place since 2002. Despite actual yield averaging 4,400 ML, well below the 6,600 ML maximum allocation yield under the McLaren Vale PWA Water Allocation Plan, the basin is still under stress in some areas and is not suitable for additional large-scale extraction.

Recent investigations from the Department of Environment and Water (DEW) have identified a progressive increase in the salinity of the groundwater in the Pirramimma and Masin Sands aquifers which are located in the northern part of the McLaren Vale region. Salinity trends from 1990 to 2014 are shown below indicating significant parts of these aquifers are yielding groundwater with a salinity in excess of 1,500mg/L. These salinities are marginal for grape production and prohibitive for premium grape production.

In particular, the Piramimma Sands aquifer which extends into the Blewitt Springs region has seen considerable degradation since 2007. This is consistent with the increased demand for treated water from WBWC from irrigators in this region. The treated water provided by WBWC has a salinity level in the range of 650 – 850mg/L which is ideally suited to premium wine production. The treated water storage facility will act as a catalyst for WBWC expanding its pipe network into the Blewitt Springs region which will give these irrigators access to a sustainable, good quality, alternate water source.

Figure 6.1 Time series map of groundwater salinity in the Maslin Sands aquifer

(Source: Department of Environment and Water, 2018)



7. Development Plan Assessment

The subject site is located within both the **Primary Production Zone** and the **Deferred Urban Zone** of the City of Onkaparinga, as referenced within the Onkaparinga Development Plan (Consolidated 20 December 2018).

The primary production Zone generally seeks the long-term continuation of primary production whilst the Deferred Urban Zone generally accommodates a restricted range of rural uses that are not prejudicial to development of the land for future urban purposes.

The subject site is also located within the **Character Preservation District Overlay** of the Onkaparinga Development Plan. This is a district where:

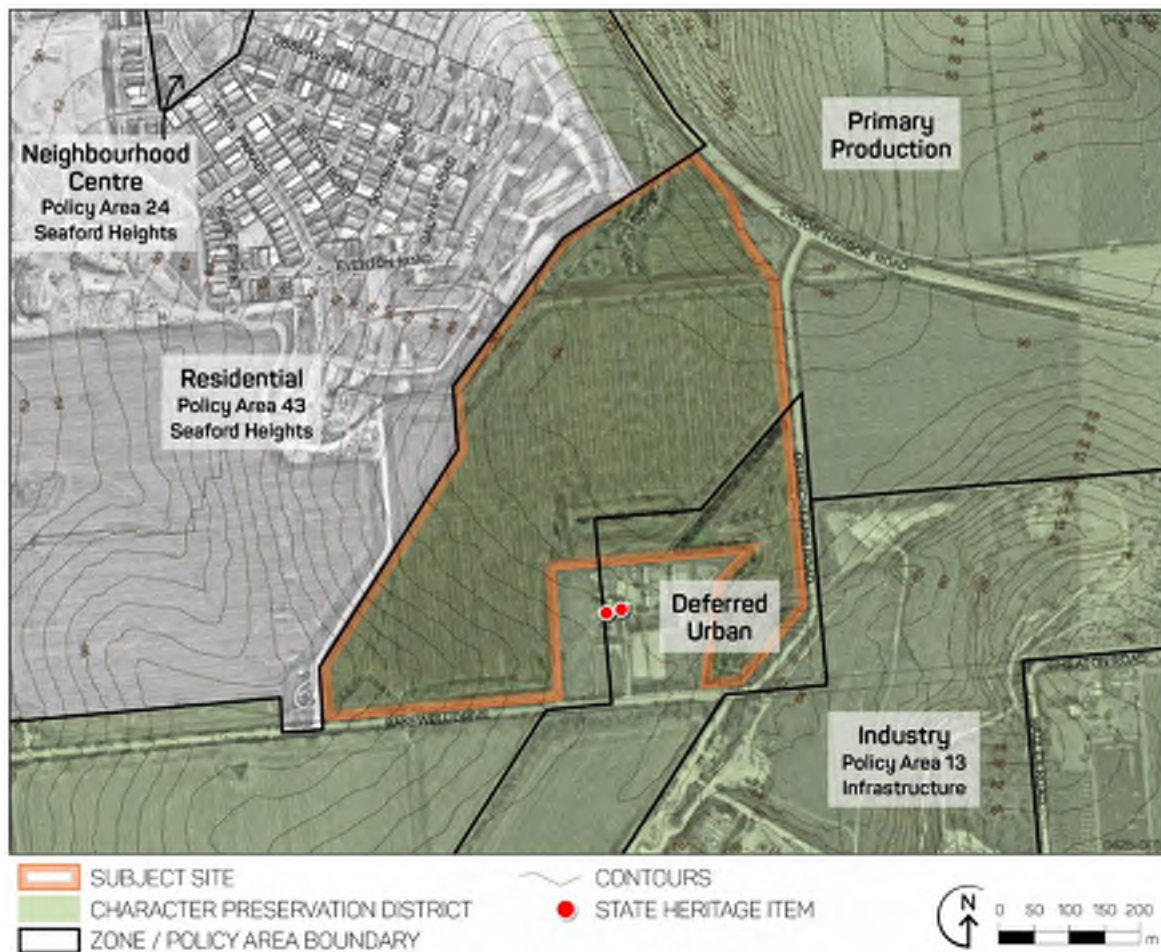
- scenic and rural landscapes are highly valued, retained and protected;
- development near entrances to towns and settlements does not diminish the rural setting, character and heritage values associated with those towns and settlements;
- the long term use of land for primary production and associated value adding enterprises is assured and promoted;
- activities positively contribute to tourism;
- the heritage attributes of the district are preserved; and
- buildings and structures complement the landscape.

The site is also subject to the *Character Preservation (McLaren Vale) Act, 2012* which provides measures to protect and enhance the special character of the McLaren Vale region while providing for the economic, physical and social wellbeing of the communities within the district. The Onkaparinga Development Plan was amended in 24 February 2013 to include the 'Heritage and Character Preservation District Overlay' which largely reflects the identified character values of the *Character Preservation (McLaren Vale) Act, 2012*

To the immediate west of the site is the 'Seaford Heights Policy Area 43' of the 'Residential Zone'.

The site location in the context of the zone and policy framework is provided in **Figure 7.1** over page.

Figure 7.1 Zoning and Policy Area of Subject Site



In addition, the subject site is also located within the:

- The McLaren Vale Prescribed Wells Area; and
- The Western Mount Lofty Ranges Prescribed Water Resource Area.

Development within the McLaren Vale Prescribed Wells Area and the Western Mount Lofty Ranges Prescribed Water Resource Area should not adversely affect the quality or quantity of water resources within these areas.

The McLaren Vale Prescribed Wells Area and the Western Mount Lofty Ranges Prescribed Water Resource Area are demonstrated spatially within *Figure 7.2* and *Figure 7.3* respectively.

Figure 7.2 McLaren Vale Prescribed Wells Area

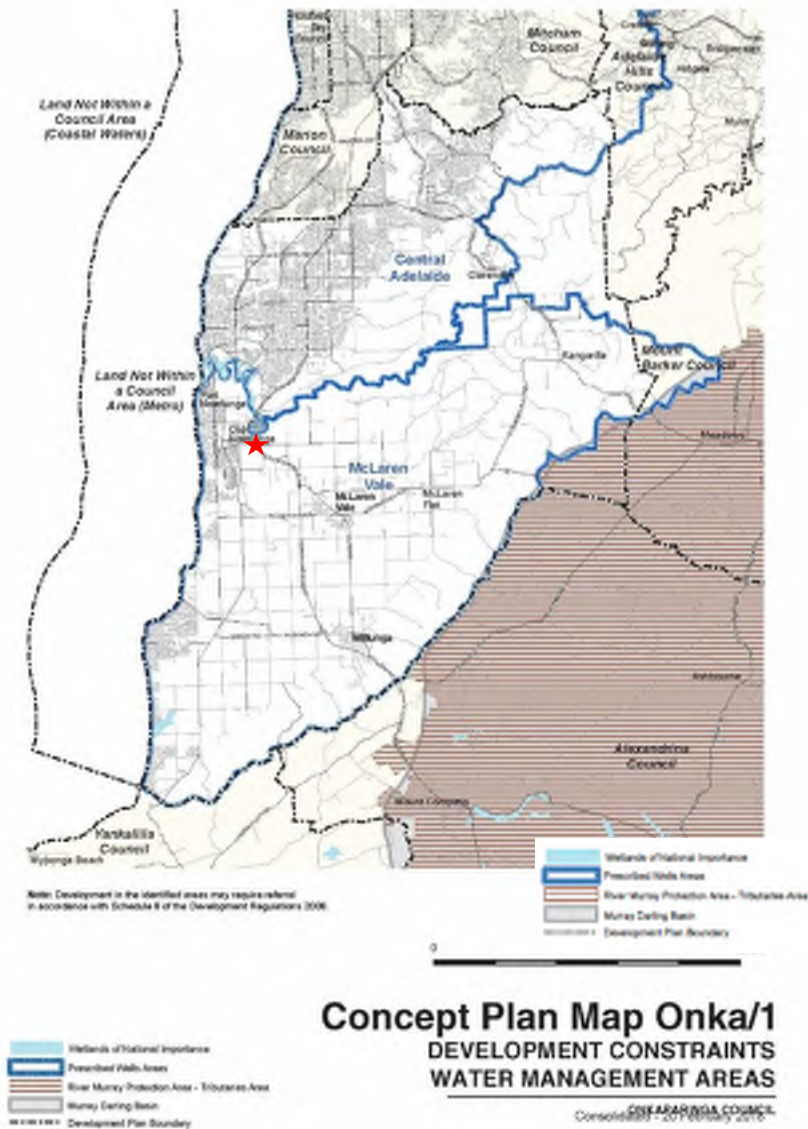
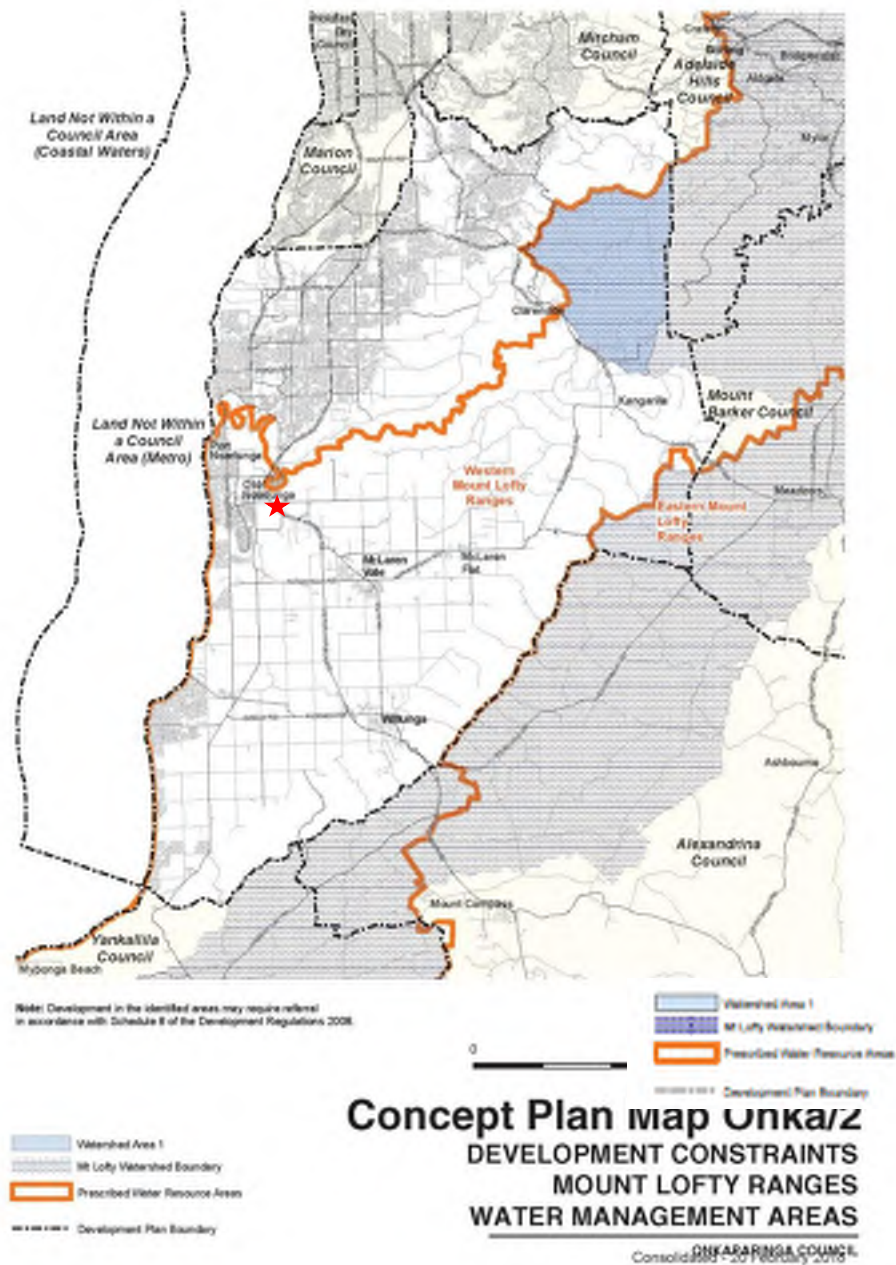


Figure 7.3 *Western Mount Lofty Ranges Prescribed Water Resource Area.*



An assessment of the relevant Development Plan provision is outlined below.

7.2 Land Use

The proposed water storage dam is a form of public infrastructure involving the storage and supply of water.

The suitability of the proposed use of the land for a water storage dam within both the Primary Production Zone and Deferred Urban Zone is discussed below.

7.2.1 Primary Production Zone

Some of the key provisions of the Primary Production Zone directly relating to the use of land within the Primary Production Zone are reproduced below:

- OBJ 1 The long term continuation of primary production where natural resources are not jeopardised.*
- OBJ 2 Economically productive, efficient and environmentally sustainable primary production.*
- OBJ 4 Protection of primary production from encroachment by incompatible land uses and protection of scenic qualities of rural landscapes.*
- OBJ 5 The extension of the economic base of the region in an environmentally sensitive and sustainable manner.*
- OBJ 8 Encouragement of the establishment of appropriately scaled 'value added' commercial activities to utilise local rural production, including the establishment of niche market products, within suitable areas and resulting in minimal landscape intrusion and environmental impact.*
- OBJ 9 The maintenance and enhancement of the natural resources of the zone.*

Desired Character Statement

Much of the area is suitable for a range of agricultural production, notably vines, grazing, cropping, almonds, strawberries and other similar foods including niche market products. Accommodation of associated 'value added' industries in appropriate locations is envisaged, along with appropriately scaled tourism infrastructure.

- PDC 4 Development within the zone should be compatible with its use as a water catchment and storage area, and with its values as an area of agricultural production and scenic quality.*
- PDC 5 Development should ensure that genuine agricultural activities are not prejudiced.*
- PDC 6 Development which would remove productive land from agriculture or diminish its overall productivity for primary production should not be undertaken unless the land is required for essential public purposes.*

PDC 7 Primary production should be carried out having regard to water conservation, the preservation of bushland remnants and landscape beauty.

Water storage dams are common place in Primary Production Zones however a water storage dam of this size and capacity is not specifically contemplated or nominated as an envisaged land use within the Primary Production Zone.

Whilst the proposed water storage dam will result in the removal of some land utilised for primary production cropping, it will provide an additional source of irrigation water to support the growing demand for water from the region's expanding viticulture and horticultural industries within the Primary Production Zone.

The proposed treated water storage dam will enable an additional 600ML of treated water to be distributed by WBWC in summer. Further, the completion of the treated water storage will provide additional treated water to WBWC to expand its pipeline into Blewitt Springs thereby providing an alternate water source to irrigators in this region who are suffering from deteriorating groundwater salinity.

The proposed development therefore directly satisfies Objective 1 and 2 of the Zone by contributing to the long term continuation of primary production within the region without jeopardising natural resources and promoting economically productive, efficient and environmentally sustainable primary production.

In accordance with Objective 5 of the Primary Production Zone the proposed water storage dam will also allow for the sustainable expansion of existing viticulture and horticulture in the region in an environmentally sensitive and sustainable manner. The proposed development will directly extend and expand the economic base of the region with direct regional benefits from the proposed 600ML water storage dam including:

- The preservation/creation of 48 full time on farm jobs and 120 winery jobs;
- The preservation/creation of 3,750 tonnes of premium grape production worth \$5.5M in farm gate revenue annually (average price of \$1,500/tonne); and
- The preservation /creation of 2.25M bottles of premium wine production annually, worth \$33.75M annually in bottled wine sales (average price of \$15/bottle)

In accordance with Principle of Development Control 5 of the Primary Production Zone the proposed development will support and not prejudice agricultural activities within the Zone. Further, in accordance with Principle of Development Control 7 of the Primary Production Zone the proposed storage and ultimate distribution of treated water will assist to conserve water and reduce stress on existing aquifers used for agricultural irrigation whilst providing irrigators with access to a sustainable, good quality, alternate water source.

The proposed development is also compatible with Principle of Development Control 4 of the Primary Production Zone which acknowledges that the Zone is used as a water catchment and storage area and does not prejudice the values of the area in regard to agricultural production and scenic quality (to be discussed in Section 7.3 below).

Whilst the proposed development will remove an existing small portion of land currently used for agriculture, the land will be utilised for a water storage dam which is a form of public infrastructure (for the supply and distribution of water) which is directly aligned with Principle of Development Control 6 of the Primary Production Zone.

Accordingly, the proposed development is highly aligned with the Primary Production Zone and whilst the proposed development will result in a very small loss of land utilised for primary production cropping it will provide water storage that will support and intensify higher value agricultural use of surrounding primary production land.

7.2.2 Deferred Urban Zone

The Deferred Urban Zone represents a narrow strip of land (approximately 200 metres in width) at the north-west interface with the Southern Regional Waste Resource Authority (SRWRA) which is one of the State's major landfill operations currently receiving over 100,000 tonnes of waste annually. As stated in the Seaford Heights Development Plan Amendment by the Minister dated 26 May 2011, the Deferred Urban Zone provides a buffer to landfill operations on the SRWRA site. Following closure, remediation and management of the SRWRA site (including requirements to suitably manage possible land fill gas migration), the Deferred Urban Zone could arguably be rezoned to accommodate future urban expansion when it is no longer required as a buffer.

Notwithstanding, it is noted that the entirety of the Deferred Urban Zone (in this location) and the surrounding Primary Production Zone is located within the *Heritage and Character Preservation District Overlay* and is subject to the *Character Preservation (McLaren Vale) Act, 2012*. This Act provides measures to protect and enhance the special character of the McLaren Vale region and restricts the creation of additional residential development in the rural areas of the districts to halt urban sprawl to the south of Adelaide's built-up area.

Given the Deferred Urban Zone is now located within the Character Preservation District Overlay and is separated from the Seaford Heights Residential Zone by the Primary Production Zone, it may arguably never be rezoned for urban purpose.

The proposed Water Storage Dam therefore represents an appropriate and economic use of the land within the Deferred Urban Zone which acts as an effective 'buffer' between residential Development within the 'Vista' estate and the ongoing land fill operations on the adjacent SRWRA site.

The more relevant provisions of the Deferred Urban Zone that directly relate to the use of land for public infrastructure in the form of a Water Storage Dam are reproduced below:

- OBJ 1** *A zone accommodating a restricted range of rural uses that are not prejudicial to development of the land for urban purposes and maintain the rural appearance of the zone.*
- OBJ 2** *A zone comprising land to be used primarily for broad-acre cropping and grazing purposes until required for future urban expansion.*

OBJ 3 *Prevention of development likely to be incompatible with long-term urban development, or likely to be detrimental to the orderly and efficient servicing and conversion of the land for urban use.*

Desired Character

The zone primarily comprises land for future urban expansion. While the zoning is to be regarded as a holding measure with its ultimate use not yet determined, development within the zone will generally comprise low-scale agricultural uses that do not prejudice the orderly conversion of the land for residential purposes.

It is envisaged that development will only occur following the rezoning of the land and the completion of detailed structure planning to ensure an orderly extension of existing urban areas and to prevent the creation of isolated communities that are remote from infrastructure and services.

PDC 1 *The following forms of development are envisaged in the zone:*

- *broad-acre cropping*
- *grazing.*

PDC 2 *Development listed as non-complying is generally inappropriate.*

PDC 3 *Development should not be undertaken if it will be prejudicial to the orderly and economic development of future urban land uses within the zone.*

The proposed water storage dam is a form of public infrastructure which will provide an appropriate and economic use of land in the Deferred Urban Zone that forms an effective 'buffer' between the adjoining Seaford 'Vista' estate and the SRWRA land fill facility.

Given the location of the site within the Character Preservation District Overlay and the ongoing statutory framework provided by the recent introduction of the *Character Preservation (McLaren Vale) Act, 2012*, it is unlikely that the Deferred Urban Zone will now be rezoned for future urban purposes. Accordingly, the proposed development is unlikely to prejudice the orderly and economic development of future urban land uses within the Zone.

Further, in the unlikely event that the land within the Deferred Urban Zone is rezoned for urban purposes, the proposed water storage dam would not result in outward impacts (i.e. noise, odour, air quality etc) that would restrict or prevent the balance of land within this Zone being used for future urban purposes.

7.3 Character Preservation District Overlay

As discussed, the subject site is located within the Character Preservation District Overlay of the Onkaparinga Development Plan.

The following relevant Objective and Principle of Development Control of the Character Preservation District Overlay is relevant to the use of land for public infrastructure in the form of a Water Storage Dam.

OBJ 1 *A district where:*

- (a) scenic and rural landscapes are highly valued, retained and protected*
- (b) development near entrances to towns and settlements does not diminish the rural setting, character and heritage values associated with those towns and settlements*
- (c) the long term use of land for primary production and associated value adding enterprises is assured and promoted*
- (d) activities positively contribute to tourism*
- (e) the heritage attributes of the district are preserved*
- (f) buildings and structures complement the landscape.*

PDC 1 *Development in the district should:*

- (a) when located near townships, contribute towards and maintain the identity of those townships*
- (b) retain the predominant rural landscape character and function*
- (c) foster primary production and associated value adding enterprises and tourism activities.*

The proposed water storage dam has been carefully designed with landscape mounds which will be constructed adjacent the dam embankment and will disrupt views of the embankment. The mounds are proposed to be planted with native vegetation and will increase the amenity of the proposed development from viewpoints on Victor Harbor Road and Bakewell Drive. These features will replace the existing arable cropping land with trees and shrubs, complementing existing pockets of remnant vegetation east of Victor Harbor Road. The proposed development will therefore ‘*retain the predominant rural landscape character*’ as outlined in Principle of Development Control 1.

The proposed water storage dam will also assure and promote the long-term use of land for primary production within the Character Preservation District by providing an additional source of irrigation water to support the growing demand for water from the region’s expanding viticulture and horticultural industries. The storage and

supply of additional water for the purposes of primary production in the district will also foster further primary production and associated value adding enterprises as envisaged by Objective 1 and PDC 1.

7.4 Built Form, Landscape & Visual Impact

The visual impact of the proposed development is closely related to the proposed built form composition of the dam and associated landscape treatments that have been proposed to screen the development and preserve the visual character of the locality.

The following provisions of the Development Plan are most relevant to the built form and landscape composition of the development and its resultant visual impact on the locality.

Primary Production Zone

OBJ 4 *Protection of primary production from encroachment by incompatible land uses and protection of scenic qualities of rural landscapes*

PDC 16 *The excavation and/or filling of land should:*

(a) be kept to a minimum and be limited to no greater than 1.5 metres so as to preserve the natural form of the land and the native vegetation

(b) only be undertaken in order to reduce the visual impact of buildings, including structures, or in order to construct water storage facilities for use on the allotment

(c) only be undertaken if the resultant slope can be stabilised to prevent erosion

(d) result in stable scree slopes which are covered with top soil and landscaped so as to preserve and enhance the natural character or assist in the re-establishment of the natural character of the region.

PDC 17 *Driveways and access tracks should follow the contours of the land so as to reduce their visual impact and erosion from water run-off and be surfaced with dark materials.*

PDC 19 *Buildings, including structures, should be located in unobtrusive locations and, in particular, should be located:*

(a) on an excavated rather than a filled site in order to reduce the vertical profile of the building

(b) in such a way as to maximise the retention of existing native vegetation and the protection and retention of watercourses.

PDC 20 *Buildings, including structures, should be designed in such a way and be of such a scale as to be unobtrusive and not detract from the desired rural character of the zone:*

(a) the mass of buildings should be minimised by variations in wall and roof lines and by floor plans which complement the contours of the land

(b) large eaves, verandas and pergolas should be incorporated into designs so as to create shadowed areas which reduce the bulky appearance of buildings

(c) the mass of buildings should be minimised by having separate vehicle storage areas.

PDC 31 Development should be undertaken with the minimum effect on natural features, land adjoining water, scenic routes or scientifically attractive areas.

PDC 38 Visually prominent structures associated with agricultural activities and intensive animal keeping should not be developed on exposed land and on scenic routes.

PDC 40 Excavation and earthworks should take place in a manner that is not extensively visible from surrounding localities.

PDC 41 The appearance of land, buildings and objects should not impair the amenity of the locality in which they are situated.

PDC 42 The rural character, comprising natural features and man-made activities, should be preserved by careful siting, design and landscaping of new building development and/or intensive land uses.

PDC 43 Buildings or structures should be sited unobtrusively and be of a character and design which will harmonise with the landscape.

PDC 61 Landscaped buffers located adjacent a residential or urban zone should be designed taking into account the nature, source and frequency of potential adverse impacts; prevailing winds in the locality; topography of the area; existing vegetation and the presence of potentially sensitive adjacent uses

Council Wide

Design and Appearance

OBJ 1 Development of a high design standard and appearance that responds to and reinforces positive aspects of the local environment and built form

Infrastructure

OBJ 2 The visual impact of infrastructure facilities managed.

Landscaping, Fences and Walls

OBJ 1 *The amenity of land and development enhanced with appropriate planting and other landscaping works, using locally indigenous plant species where possible.*

OBJ 2 *Functional fences and walls that enhance the attractiveness of development*

PDC 7 *Landscaping for non-residential development should be undertaken in accordance with Table Onka/6 - Landscaping Guidelines for Non-Residential Development.*

Screening and buffers	<ol style="list-style-type: none"> 1 Screen plantings and materials should be provided for visual separation between service areas or a common boundary between residential and commercial activities. 2 A densely vegetated landscaped buffer should be provided between development which is industrial or commercial in nature and any adjacent residential land.
Site character	<ol style="list-style-type: none"> 1 The function of landscaping usually extends beyond utilitarian purposes to establish an image or sense of place described herein as 'site character'. 2 Good visual balance and welcoming, pleasant surroundings are key elements to a positive outcome; blending natural and man-made forms to relate more closely to the 'human' scale. 3 Landscaping should be the deliberate outcome of a defined desired character, rather than an experiment of random elements.
Establishment and maintenance	<ol style="list-style-type: none"> 1 Plantings within bays should allow room for growth and movement. 2 Landscaped areas should be fully irrigated until the plants are established or self sufficient. 3 Mulching should be provided to improve site presentation, moderate soil conditions and act as a weed suppressant.

Siting and Visibility

PDC 1 *Development should be sited and designed to minimise its visual impact on:*

(a) the natural, rural or heritage character of the area

(b)...

PDC 4 *Buildings and structures should be designed to minimise their visual impact in the landscape, in particular:*

(a) the profile of buildings should be low and the roof lines should complement the natural form of the land

(b) the mass of buildings should be minimised by variations in wall and roof lines and by floor plans which complement the contours of the land

(c) large eaves, verandas and pergolas should be incorporated into designs so as to create shadowed areas that reduce the bulky appearance of buildings.

PDC 9 *Development should be screened through the establishment of landscaping using locally indigenous plant species:*

(a) around buildings and earthworks to provide a visual screen as well as shade in summer, and protection from prevailing winds

(b) along allotment boundaries to provide permanent screening of buildings and structures when viewed from adjoining properties and public roads

(c) along the verges of new roads and access tracks to provide screening and minimise erosion

Sloping Land

OBJ 1 *Development on sloping land designed to manage visual impacts, minimise impacts on the natural environment and protect soil stability and water quality.*

PDC 7 *The cutting and/or filling of land outside townships and urban areas should:*

(a) be kept to a minimum and be limited to a maximum depth or height no greater than 1.5 metres so as to preserve the natural form of the land and the native vegetation

(b) only be undertaken in order to reduce the visual impact of buildings, including structures, or in order to construct water storage facilities for use on the allotment

(c) only be undertaken if the resultant slope can be stabilised to prevent erosion

(d) result in stable scree slopes which are covered with top soil and landscaped so as to preserve and enhance the natural character or assist in the re-establishment of the natural character of the area.

The proposed dam will be compatible with the use of the area for water catchment and storage, whilst maintaining scenic quality within the locality

As described in Section 5 above, the dam will be constructed as a 'turkey's nest' with the top of the dam embankment elevated above the natural ground level of the subject land. The dam will sit approximately 5 metres higher than the existing ground level. As a result of the sloping site, the dam embankments vary in height above ground level, varying between 4.6m to 7.7m.

The dam will be constructed with a 1 in 3 internal batter which will be plastic lined. There will be an external 1 in 3 slope surrounding the dam which will be constructed with compacted earth. Engineering requirements state that these embankments must be free of vegetation. At the base of this dam embankment will be an access road, security fencing and a swale to collect stormwater runoff.

Adjacent the dam embankment and access road will be a series of constructed earth mounds of varying heights (depending on existing ground level) between 1.5m – 7.8m at a slope of 1 in 4. These will be constructed using the excess fill excavated for the dam and will be vegetated with plants and trees in order to minimise visual impacts of the dam embankment.

The mounds are proposed to be vegetated with site appropriate plant species (refer to Section 5.7.2 above) which are currently present within the existing 'Buffer Zone Landscaping Area' on site.

The visual effect of the proposed development is therefore mitigated through the addition of a series of vegetated landscape mounds in front of the dam embankments. The mounds have been designed in positions which screen views of the dam embankment from viewpoints along Victor Harbor Road and Bakewell Drive as well as the 'Vista' residential housing estate. The mounds will respond to the local topography and landscape character by presenting as a series of low hills with vegetation.

The introduction of the new landscape into the locality will be appreciated within the context of the wider landscape character. Existing ridgelines and hills to the north and east are covered with belts of vegetation and trees that contribute to the local landscape character. The proposed mounds and vegetated treatments aim to replicate these existing landscape features, providing areas of vegetation over elevated landforms.

The proposed development has been designed to create an extension of the existing 'Buffer Zone Landscaping Area' and vegetated horizon line when viewed from Main South Road and the Vista residential housing estate.

The development of the site offers the opportunity to increase the vegetation character and screening associated with the land management agreement buffer planting area. The use of native species together with complementary tree and shrub species, will significantly increase the landscape amenity, removing the monoculture of the existing arable cropping and replacing it with a diverse native vegetation character that will increase the visual amenity as well as provide increased habitat biodiversity.

As the dam will be elevated above the surrounding locality, the water within the dam will not be visible from any external points and in combination with the proposed landscape mounds, there will not be any indication that the subject land contains a water storage dam.

A 'Visual Impact Assessment' of the development has been prepared by WAX Design and considers the visibility of the proposed development and the contribution to the amenity of the locality that the proposed development will make.

The Visual Impact Assessment is attached in **Appendix 13** and confirms that the proposed series of vegetated landscape mounds to the north, west and south as well as the retention of the existing tree line to the east will adequately screen the proposed development from views on Victor Harbor Road, Bakewell Drive and from the adjacent Vista residential housing estate. WAX Design conclude that the subject land will be viewed as a series of landscape mounds with vegetated ridges above the existing arable land which is reminiscent of the surrounding locality which contains many vegetated ridges, hills, vineyards and cropping land.

In accordance with Council Wide 'Siting and Visibility' PDC 9, the proposed development will therefore be effectively screened through the establishment of native vegetation on landscaped mounds that will provide permanent visual screening of the structure from adjoining properties and roads.

The Visual Impact Assessment also includes a series of photomontages providing an indication of the visual effects of the development at the following three (3) external viewpoints:

1. Victor Harbor Road;
2. Bakewell Drive; and
3. The Vista Residential Housing development (Corner of Edison & Cotterell Road).

WAX Design confirm that the photomontages only provide an indication of the visual effects of the development and should be taken into consideration alongside the visual assessment discussion and analysis within the broader Visual Impact Assessment.

Figure 7.4 Visual Impact Assessment – Viewpoint locations



Figure 7.5 Viewpoint 1 – Victor Harbor Road



Figure 7.6 Viewpoint 2 – Bakewell Road



Figure 7.7 Viewpoint 3 – Vista Estate (Corner of Edison & Cotterell Road)



It is acknowledged that Primary Production Zone PDC 16(a) and Council Wide 'Sloping Land' PDC 7 identify that the excavation and/or filling of land should be kept to a minimum and be limited to no greater than 1.5 metres so as to preserve the natural form of the land and the native vegetation. Whilst the proposed development includes mounds that are larger than anticipated in the zone (up to 7.8 metres in height), they are being constructed in response to the underlying topography of the land and will be used to introduce significant areas of native vegetation. The construction of the dam will result in large amounts of excess fill which will be used to form the mounds, reducing the visual impact of the dam embankment and protecting the character of the locality. Consistent with Primary Production Zone PDC 16(b) and Council Wide 'Sloping Land' PDC 7 the proposed retention of fill on site has been undertaken in order to reduce the visual impact of the structure and to construct water storage facilities on the site.

7.5 Interface with Sensitive Development

The following provisions of the Onkaparinga Development Plan are considered most relevant to the assessment of the interface of the proposed development with adjoining sensitive land uses.

Primary Production Zone

PDC 61 *Landscaped buffers located adjacent a residential or urban zone should be designed taking into account the nature, source and frequency of potential adverse impacts; prevailing winds in the locality; topography of the area; existing vegetation and the presence of potentially sensitive adjacent uses.*

Council Wide

Interface Between Land Uses

OBJ 1 Development located and designed to minimise adverse impact and conflict between land uses.

OBJ 2 Protect community health and amenity from adverse impacts of development.

OBJ 3 Protect desired land uses from the encroachment of incompatible development.

PDC 1 Development should not detrimentally affect the amenity of the locality or cause unreasonable interference through any of the following:

(a) the emission of effluent, odour, smoke, fumes, dust or other airborne pollutants

(b) noise

(c) vibration

(d) electrical interference

(e) light spill

(f) glare

(g) hours of operation

(h) traffic impacts.

PDC 11 Development with the potential to emit harmful or nuisance-generating air pollution should incorporate air pollution control measures to prevent harm to human health or unreasonable interference with the amenity of sensitive uses within the locality

The potential impacts associated with the development of a water storage dam are generally limited to possible noise, air quality (odour), traffic (during site construction and operation) and vibration (during dam construction). Each matter is addressed respectively below.

7.5.1 Air Quality (Odour)

An 'Odour Assessment' of the water storage dam has been undertaken by ERM (refer to **Appendix 9** and Section 5.5.1 above) and was based on field odour observations at current treated water storage facilities in the area of the proposed dam location. ERM have concluded that any odour associated with the proposed dam would be very low level (low odour concentration and intermittent) and not of an offensive nature.

In addition, ERM observed that the proposed water storage dam is proposed on a hill top providing good exposure and good dispersion conditions. Further, it is noted that the proposed Water Storage Dam

incorporates a series of vegetation landscape mounds which will separate and provided a 'buffer' between the proposed dam and the closest adjoining sensitive residential development to the west and south in accordance with Primary Production Zone PDC 61.

7.5.2 Noise

As previously discussed in Section 5.5.2 above, the proposed dam will be filled and emptied using the existing pumping infrastructure at the existing WBWC site at Quarry Road. The new dam will therefore not require new pumping infrastructure to transfer water to and from the existing Quarry Road dam. Accordingly, no noise will be generated on site during the ongoing operation of the dam.

7.5.3 Traffic Impacts

Existing traffic volumes on both Bakewell Drive and Ostrich Farm Road are relatively low (approximately 100 vehicles per day). During general operations, it is anticipated that a single utility vehicle would access the site of the proposed water storage dam a few times per week for general site security and maintenance. The traffic volume generated by the proposed development would therefore be relatively insignificant, even considering the relatively low existing traffic volumes on the adjoining road network. On this basis, the traffic volume generated by the proposed development is not likely to impact the current operation of the adjoining road network or its intersections.

During construction, earthmoving equipment and other construction and delivery vehicles will access the site. Given the earth excavated to create the dam will be used in the dam wall batters and on-site landscaping (i.e. a neutral balance of cut and fill) it is not anticipated that material will be removed from the site. On this basis, it is anticipated that there will be a relatively low traffic generation associated with the construction of the facility. Once a contractor is engaged for the construction activity, as part of a Site Management Plan the contractor will be required to prepare a Traffic Management Plan which outlines how vehicles are to access the site. Where required, this plan could consider the need to install work zone traffic management along Bakewell Drive to manage the interface between construction traffic and through traffic.

7.5.4 Vibration

A 'Geotechnical Investigation Report' and 'Construction Report' has been prepared by SMEC and is attached at **Appendix 7 and Appendix 8 respectively.**

The geotechnical investigations have revealed that the natural clay soils on site are expected to be generally excavatable using conventional machinery such as excavators and dozers. Slower production rates would be expected in the residual soils and the very low strength weathered rocks. Should medium strength siltstone be encountered the use of specialist rock breaking equipment may be required. However, SMEC note the need for the use of drill and blast techniques for excavation is not considered likely.

On this basis, it is not anticipated that vibration during construction of the proposed dam will detrimentally affect the amenity of the locality nor result in vibration damage to adjoining residential buildings or outbuildings during construction.

7.6 Infrastructure

The following provisions of the Onkaparinga Development Plan are considered most relevant to the development of infrastructure assessment of the interface of the proposed development with adjoining sensitive land uses.

Council Wide

Infrastructure

PDC 11 Utility buildings and structures should be grouped with non-residential development, where possible

Orderly and Sustainable Development

PDC 6 Development should be located and staged to achieve the economical provision of public services and infrastructure, and to maximise the use of existing services and infrastructure.

In accordance with Council Wide 'Infrastructure' PDC 11 and 'Orderly and Sustainable Development' PDC 6 the proposed dam is located adjacent and in close proximity to WBWC's Quarry Road dam and pump station (opposite the site over Victor Harbor Road) to maximise the efficiency of the existing recycled water storage network and infrastructure.

The proximity of the proposed dam to the existing Quarry Road dam and pump station and its connectivity to the existing recycled water network is a key factor in the selection and suitability of the subject site for the proposed water storage dam.

Recycled water received at Quarry Road is proposed to be pumped to the new dam for storage, and gravity fed back to the Quarry Road site when it is needed for sale to customers. WBWC have an existing pipe that crosses Victor Harbour Road in the road reserve adjacent to the proposed dam site which enables the treated water to be transferred into the proposed dam via a minor pipe extension. A separate gravity transfer pipe will be installed to transfer the water back to the existing Quarry Road dam for pumping by the existing Quarry Road Pump Station. This avoids the need for pumping of water from the proposed dam site.

7.7 Transportation and Access

The following provisions of the Onkaparinga Development Plan are considered most relevant to the traffic and transport assessment of the proposed development.

Primary Production Zone

PDC 17 Driveways and access tracks should follow the contours of the land so as to reduce their visual impact and erosion from water run-off and be surfaced with dark materials.

Sloping Land

PDC 1 Development and associated driveways and access tracks should be sited and designed to integrate with the natural topography of the land and minimise the need for earthworks.

PDC 2 Development and associated driveways and access tracks, including related earthworks, should be sited, designed and undertaken in a manner that:

(a) minimises their visual impact

(b) reduces the bulk of the buildings and structures

(c) minimises the extent of cut and/or fill

(d) minimises the need for, and the height of, retaining walls

(e) does not cause or contribute to instability of any embankment or cutting

(f) avoids the silting of watercourses

(g) protects development and its surrounds from erosion caused by water runoff

PDC 3 Driveways and access tracks across sloping land should be accessible and have a safe, all-weather trafficable surface.

Siting and Visibility

PDC 8 Driveways and access tracks should be designed and surfaced to blend sympathetically with the landscape and to minimise interference with natural vegetation and landforms.

PDC 9 Development should be screened through the establishment of landscaping using locally indigenous plant species:

(c) along the verges of new roads and access tracks to provide screening and minimise erosion.

Transportation and Access

OBJ 2 Development that:

(a) provides safe and efficient movement for all transport modes

(b) ensures access for vehicles including emergency services, public infrastructure maintenance and commercial vehicles

(c)...

PDC 22 *Development should have direct access from an all-weather public road.*

PDC 23 *Development should be provided with safe and convenient access which:*

(a) avoids unreasonable interference with the flow of traffic on adjoining roads

(b) provides appropriate separation distances from existing roads or level crossings

(c) accommodates the type and volume of traffic likely to be generated by the development or land use and minimises induced traffic through over-provision

(d) is sited and designed to minimise any adverse impacts on the occupants of and visitors to neighbouring properties.

PDC 29 *Driveways, access tracks and parking areas should be designed and constructed to:*

(a) follow the natural contours of the land

(b) minimise excavation and/or fill

(c) minimise the potential for erosion from surface runoff

(d) avoid the removal of existing vegetation

(e) be consistent with Australian Standard AS: 2890 - Parking facilities.

During general operations, it is anticipated that a single utility vehicle would access the site of the proposed water storage dam a few times per week for general site security and maintenance. Given there is no public access to the site and only a single utility vehicle would visit the site at any one time, it is not proposed to provide any car parking on site.

The existing traffic volumes on both Bakewell Drive and Ostrich Farm Road are low and are likely to be in the order of 100 vehicles per day. Given the very low traffic generated by the development (one utility vehicle several times a week) and the relatively low existing traffic volumes on the adjoining road network, the traffic volume generated by the proposed development is not likely to impact the current operation of the adjoining road network or its intersections.

During construction, earthmoving equipment and other construction and delivery vehicles will access the site. Given the earth excavated to create the dam will be used to form the dam wall batters and on-site landscaping (i.e. a neutral balance of cut and fill) it is not anticipated that material will be removed from the site. On this

basis, it is anticipated that there will be a relatively low traffic generation associated with the construction of the facility. Once a contractor is engaged for the construction activity, as part of a Site Management Plan the contractor will be required to prepare a Traffic Management Plan which outlines how vehicles are to access the site. Where required, this plan could consider the need to install work zone traffic management along Bakewell Drive to manage the interface between construction traffic and through traffic.

Proposed vehicle access to the site is via a single crossover to Bakewell Drive which will be designed to ensure adequate clearance and sight lines for vehicles entering and exiting the site. The proposed access will cater for vehicle movements in all directions and has been designed to accommodate access and egress for a standard utility vehicle.

Given the very limit number of traffic movements generated by the development the proposed 3.0m wide vehicle access driveway into the site and around the upper circumference of the dam wall is proposed to be constructed with compacted rubble. In accordance with Council Wide 'Traffic and Access' PDC 23(d) and 'Sloping Land' PDC 1 and 2 the proposed access track around the upper circumference of the dam wall and around the base of the dam embankment will be effectively screened from the adjoining 'Vista' residential estate, Victor Harbor Road and Bakewell Drive by proposed landscape treatments including a series of mounds which will be constructed adjacent the dam embankment. The existing belt of established trees along Ostrich Farm Road to the east will also effectively limit the views of the dam and access road from this direction.

In accordance with Council Wide 'Traffic and Access' PDC 23, the proposed development therefore provides safe and convenient vehicle access which will not impact on the current operation of the adjoining road network or its intersections and has been designed to accommodate the volume and nature of traffic likely to be generated by the development.

7.8 Stormwater

The following provisions of the Onkaparinga Development Plan are considered most relevant to the assessment of stormwater.

Hazards - Flooding

PDC 6 *Development should not be undertaken in areas liable to inundation by tidal, drainage or flood waters unless the development can achieve all of the following:*

(a) it is developed with a public stormwater system capable of catering for a 1-in-100 year average return interval flood event

(b) buildings are designed and constructed to prevent the entry of floodwaters in a 1-in-100 year average return interval flood event.

PDC 7 *Development, including earthworks associated with development, should not do any of the following:*

- (a) impede the flow of floodwaters through the land or other surrounding land*
- (b) increase the potential hazard risk to public safety of persons during a flood event*
- (c) aggravate the potential for erosion or siltation or lead to the destruction of vegetation during a flood*
- (d) cause any adverse effect on the floodway function*
- (e) increase the risk of flooding of other land*
- (f) obstruct a watercourse.*

Natural Resources - Water Sensitive Design

PDC 5 Development should be designed to maximise conservation, minimise consumption and encourage re-use of water resources.

PDC 7 Development should be sited and designed to:

- (a) capture and re-use stormwater, where practical*
- (b) minimise surface water runoff*
- (c) prevent soil erosion and water pollution*
- (d) protect and enhance natural water flows*
- (e) protect water quality by providing adequate separation distances from watercourses and other water bodies*
- (f) not contribute to an increase in salinity levels*
- (g) avoid the water logging of soil or the release of toxic elements*
- (h) maintain natural hydrological systems and not adversely affect:*
 - (i) the quantity and quality of groundwater*
 - (ii) the depth and directional flow of groundwater*
 - (iii) the quality and function of natural springs.*

PDC 8 Water discharged from a development site should:

- (a) be of a physical, chemical and biological condition equivalent to or better than its pre-developed state*

(b) not exceed the rate of discharge from the site as it existed in pre-development conditions.

PDC 9 Development should include stormwater management systems to protect it from damage during a minimum of a 1-in-100 year average return interval flood.

PDC 10 Development should have adequate provision to control any stormwater over-flow runoff from the site and should be sited and designed to improve the quality of stormwater and minimise pollutant transfer to receiving waters.

PDC 11 Development should include stormwater management systems to mitigate peak flows and manage the rate and duration of stormwater discharges from the site to ensure the carrying capacities of downstream systems are not overloaded.

PDC 12 Development should include stormwater management systems to minimise the discharge of sediment, suspended solids, organic matter, nutrients, bacteria, litter and other contaminants to the stormwater system.

PDC 13 Stormwater management systems should preserve natural drainage systems, including the associated environmental flows.

PDC 14 Stormwater management systems should:

(a) maximise the potential for stormwater harvesting and re-use, either on-site or as close as practicable to the source

Natural Resources - Water Catchment Areas

PDC 17 Development located within any of the following areas should not adversely affect the quality or quantity of water resources:

(a) 'River Murray Protection Area - Tributaries Area' designated on Concept Plan Map Onka/1 - Development Constraints - Water Management Areas

(b) 'Prescribed Wells Areas' designated on Concept Plan Map Onka/1 - Development Constraints - Water Management Areas

(c) 'Mount Lofty Watershed 1' designated on Concept Plan Map Onka/2 - Development Constraints Mount Lofty Ranges Water Management Areas

(d) 'Prescribed Water Resource Areas' designated on Concept Plan Map Onka/2 - Development Constraints Mount Lofty Ranges Water Management Areas.

PDC 24 The location and construction of dams, water tanks and diversion drains should:

(a) occur off watercourse

(b) not take place in ecologically sensitive areas or on erosion prone sites

(c) provide for low flow by-pass mechanisms to allow for migration of aquatic biota

(d) not negatively affect downstream users

(e) minimise in-stream or riparian vegetation loss

(f) incorporate features to improve water quality (eg wetlands and floodplain ecological communities)

(g) protect ecosystems dependent on water resources.

Natural Resources - Soil Conservation

PDC 38 *Development should be designed and sited to prevent erosion.*

PDC 40 *Development should minimise the loss of soil from a site through soil erosion or siltation during the construction phase of any development and following the commencement of an activity*

A Stormwater Management Plan has been prepared by Tonkin Consulting and is attached at **Appendix 14**.

The proposed Stormwater Management Plan has been prepared taking into consideration the requirements of the City of Onkaparinga (Council) as well as other relevant authorities. The proposed stormwater management system has been designed to mitigate peak flows and manage the rate and duration of stormwater discharges from the site to ensure the carrying capacities of downstream systems are not overloaded.

In accordance with Natural Resources, Water Sensitive Design, PDC 8 the proposed stormwater management system has been designed so that water discharged from the development site will:

- not exceed the rate of discharge from the site as it existed in pre-development conditions; and
- be of a physical, chemical and biological condition equivalent to or better than its pre-development state.

Tonkin consulting have undertaken MUSIC modelling which has concluded that the development will not negatively impact the water quality of downstream receiving waters and therefore in accordance with water Catchment Areas PDC 17 the proposed development will not adversely affect the quality of water resources in the McLaren Vale 'Prescribed Wells Area' or the Western Mount Loft Ranges 'Prescribed Water Resource Area'.

8. Conclusion

WBWC operates a large reclaimed water scheme in South Australia servicing the McLaren Vale, Willunga and Sellicks regions. WBWC is licensed to take treated water from SA Water's Christies Beach Wastewater Treatment Plant and pumps it via a network of more than 120 kilometres of pipelines to more than 220 irrigators in the McLaren Vale region. The treated water is principally used for drip irrigation of vines, fruit trees, nut crops and flowers (primary production) within the McLaren Vale region.

The capacity of WBWC to supply additional customers is currently limited by the availability of water to meet the peak summer demands. Accordingly, WBWC seeks Development Plan Consent for a new 600 ML Water Storage Dam on land located at Lot 108 in Deposited Plan 80592 and Lot 102 in Deposited Plan 46795 (Bakewell Drive, Seaford Heights). The purpose of the dam is to take and store recycled water purchased from SA Water at the Christies Beach WWTP at times when there is low demand for irrigation water (winter), and then distribute that recycled water to customers in times of high demand (summer).

The completion of the treated water storage will provide additional treated water to WBWC to expand its pipeline into Blewitt Springs thereby providing an alternate water source to irrigators in this region who are suffering from deteriorating groundwater salinity. The proposed development will also ensure a more efficient use of a limited resource and delivers strong environmental and community value by reducing the discharge of treated effluent to the Gulf St Vincent and by replacing water that would otherwise be taken from a stressed groundwater resources and the River Murray.

The proposed 600ML water storage dam will also result in significant regional economic and employment benefits including:

- Preservation /creation of 48 full time on farm jobs and 120 winery jobs;
- Preservation /creation of 3,750 tonnes of premium grape production worth \$5.5M in farm gate revenue annually (average price of \$1,500/tonne), and
- Preservation /creation of 2.25M bottles of premium wine production annually, worth \$33.75M annually in bottled wine sales (average price of \$15/bottle).

This excludes the benefits to the tourism sector from the sustainable management of the regions water resources.

Following an inspection of the subject site and locality, a review of the proposed plans and associated documentation accompanying the application and a detailed assessment of the proposed development against the relevant provisions of the Onkaparinga Council Development Plan, we have formed the opinion that the proposed development represents appropriate and orderly development that deserves favourable consideration for approval.

In particular, we note that:

- The proposed water storage dam is aligned with the **Primary Production Zone** given it will:
 - » support and not prejudice agricultural activities within the Zone and will allow for the sustainable expansion of existing viticulture and horticulture in the region in an environmentally sensitive and sustainable manner.
 - » store and facilitate the distribution of treated water which will assist to conserve water and reduce stress on existing aquifers used for agricultural irrigation whilst providing irrigators with access to a sustainable, good quality, alternate water source;
 - » not prejudice the values of the area with respect to agricultural production and scenic quality;
 - » result in a very small loss of land utilised for primary production cropping but will provide public infrastructure for the supply and distribution of water that will support and intensify higher value agricultural use of surrounding primary production land.
- The proposed water storage dam is an appropriate land use in the **Deferred Urban Zone** given the context of the subject site and surrounds and given:
 - » it represents an appropriate and economic use of the land in a Zone that acts as an effective 'buffer' between residential Development within the 'Vista' estate and the ongoing land fill operations on the adjacent SRWRA site;
 - » the location of the site within the Character Preservation District Overlay and the ongoing statutory framework provided by the recent introduction of the *Character Preservation (McLaren Vale) Act, 2012*, suggests that it is unlikely that the Deferred Urban Zone will now be rezoned for future urban purposes and therefore the proposed development is unlikely to prejudice the orderly and economic development of future urban land uses within the Zone;
 - » irrespective, if the land within the Deferred Urban Zone is ultimately rezoned for urban purposes, the proposed water storage dam would not result in outward impacts (i.e. noise, odour, air quality etc) that would restrict or prevent the balance of land within this Zone being used for future urban purposes.
- In accordance with the **Character Preservation District Overlay** the proposed water storage dam:
 - » has been carefully designed with landscape mounds which will be constructed adjacent the dam embankment and will disrupt views of the embankment and '*retain the predominant rural landscape character*'.
 - » will assure and promote the long-term use of land for primary production within the Character Preservation District by providing an additional source of irrigation water to:
 - support the growing demand for water from the region's expanding viticulture and horticultural industries; and
 - foster further primary production and associated value adding enterprises;

- The proposed development will not breach nor contravene an existing '**Development Deed**' applicable to the site (dated 7 November 2017) which requires that the land owner '*SRWRA must not cause, suffer or permit the receipt, handling, storage or disposal of waste on the Land.*
- The proposed development will not impact, damage or remove any landscaping in the 'Buffer Zone Landscaping Area' nor will it result in the change of the use of the 'Buffer Land' as defined within the **Land Management Agreement (LMA)** between the Minister for Planning and the land Owner (SRWRA) which applies to the land.
- The design of the proposed dam will follow appropriate elements of the **ANCOLD (Australian National Commission on Large Dams)** Guidelines on Consequence Categories for Dams (2012).
- The proposed water storage dam does not require an EPA license, however the facility has been designed in accordance with the '**EPA Guideline EPA509/14 – Wastewater Lagoon Construction**' and a '**Geotechnical Inspection and Testing Authority**' (GITA) will provide Level 1 supervision on-site during construction in accordance with AS3798:2007 to provide appropriate CQA (Construction Quality Assurance).
- **Geotechnical investigations** have revealed that the proposed dam is likely to be excavatable using conventional machinery such as excavators and dozers with some specialist rock breaking equipment and that the need for the use of drill and blast techniques for excavation is considered unlikely.
- A **Construction Environmental Management Plan (CEMP)** will be prepared following receipt of Development Approval and will describe how activities undertaken during the construction phase of development will be managed to avoid or mitigate negative environmental impacts on the site and how those environmental management requirements will be implemented.
- A **Traffic Management Plan** will be prepared as part of an overall 'Construction Environmental Management Plan' (CEMP) and will outline how vehicles are to access the site during construction.
- The **operation of the dam** will be undertaken by WBWC who:
 - » has experience in the operations of similar dams including three (3) treated water storage dams adjacent to the Willunga Community Wastewater Management Scheme on Little Road, Willunga;
 - » holds an approval from SA Health for the use of recycled water through the Willunga Basin Pipeline network pursuant to the *South Australian Public Health (Wastewater) Regulations, 2013*;
 - » maintains an Irrigation Risk Management Plan (IRMP) in accordance with the '*Australian Guidelines for Water Recycling*' and EPA's Recycled Water Guidelines which provides for reporting of water use and operations to relevant regulatory authorities;
 - » will constantly monitor water consumption using data loggers on each customer meter, as well as 24x7 monitoring of water flows in the network via their '*Supervisory, Control and Data Acquisition*' (SCADA) system;
 - » will maintain a network of shallow observation wells for monitoring leakage or runoff from the storage dam; and

- » will maintain an 'Operations Management Plan' that will address standard operations, water quality monitoring to ensure water quality standards, mitigation measures for improvements to water quality if required and incident response procedures to ensure performance.
- Based on field odour observations and assessment undertaken by ERM it cannot be concluded that there will be no **odour** at the nearest sensitive receptor locations at the Seaford Heights residential development as a result of the construction of the treated water storage dam however ERM have concluded that the assessment shows that any odour would be very low level (low odour concentration and intermittent) and not of an offensive nature.
- No **noise** will be generated on site during the ongoing operation of the dam (with only minor stormwater pumps required to occasionally pump stormwater from on-site detention basins back into the water storage dam during and immediately following rain and storm events).
- The proposed dam design will be consistent with SA Health's requirements for minimising impacts associated with nuisance **vectors** such as mosquitos.
- The **traffic volume** generated by the proposed development are relatively insignificant and will not impact the current operation of the adjoining road network or its intersections.
- Relatively **low traffic generation is anticipated during construction** as earth excavated to create the dam will be used to form the dam wall batters and on-site landscaping (i.e. a neutral balance of cut and fill) and therefore it is not anticipated that material will be removed from the site.
- With the exception of a proposed stormwater swale and a buried inlet-outlet pipe to the quarry road pump station, the proposed development is setback further than 35 metres from Victor Harbor Road reserve and is therefore **unlikely to impact on potential future road widening** of this road.
- Arborman have confirmed that no approval is required for the removal of any **existing vegetation** on site to accommodate the proposed new dam given:
 - » there are no Regulated or Significant Trees on site;
 - » the trees planted in a wind break adjacent the southern boundary of the site are juvenile planted specimens and their clearance is not controlled under the *Native Vegetation Act, 1991*.
- A '**Visual Impact Assessment**' of the development has been prepared by WAX Design and confirms that:
 - » the proposed series of vegetated landscape mounds to the north, west and south of the proposed dam as well as the retention of the existing tree line to the east will adequately screen the proposed development from views on Victor Harbor Road, Bakewell Drive and from the adjacent Vista residential housing estate;
 - » following development of the dam and the establishment of proposed landscape treatments the subject land will be viewed as a series of landscape mounds with vegetated ridges above the existing arable land which is reminiscent of the surrounding locality which contains many vegetated ridges, hills, vineyards and cropping land;

- » the proposed development has been designed to create an extension of the existing 'Buffer Zone Landscaping Area' and vegetated horizon line when viewed from Main South Road and the Vista residential housing estate; and
- » there will not be any indication that the subject land contains a water storage dam as the dam will be elevated above the surrounding locality and suitably screened with proposed landscape mounds,
- Tonkin Consulting have confirmed that the proposed **stormwater management system** has been designed so that water discharged from the development site will:
 - » not exceed the rate of discharge from the site as it existed in pre-development conditions; and
 - » be of a physical, chemical and biological condition equivalent to or better than its pre-development state.

The proposed development is therefore adequately aligned with the most relevant provisions of the Onkaparinga Development Plan and warrants Development Approval, subject to reasonable and relevant conditions.

Appendix 1. Certificates of Title

REAL PROPERTY ACT, 1866



The Registrar-General certifies that this Title Register Search displays the records maintained in the Register Book and other notations at the time of searching.



Certificate of Title - Volume 6034 Folio 589

Parent Title(s) CT 5403/182

Creating Dealing(s) RTU 11136862

Title Issued 01/05/2009

Edition 3

Edition Issued

05/12/2017

Estate Type

FEE SIMPLE

Registered Proprietor

SOUTHERN REGION WASTE RESOURCE AUTHORITY
OF PO BOX 2414 MCLAREN VALE SA 5171

Description of Land

ALLOTMENT 108 DEPOSITED PLAN 80592
IN THE AREA NAMED SEAFORD HEIGHTS
HUNDRED OF WILLUNGA

Easements

NIL

Schedule of Dealings

Dealing Number	Description
12835643	AGREEMENT UNDER DEVELOPMENT ACT, 1993 PURSUANT TO SECTION 57(1)

Notations

Dealings Affecting Title NIL

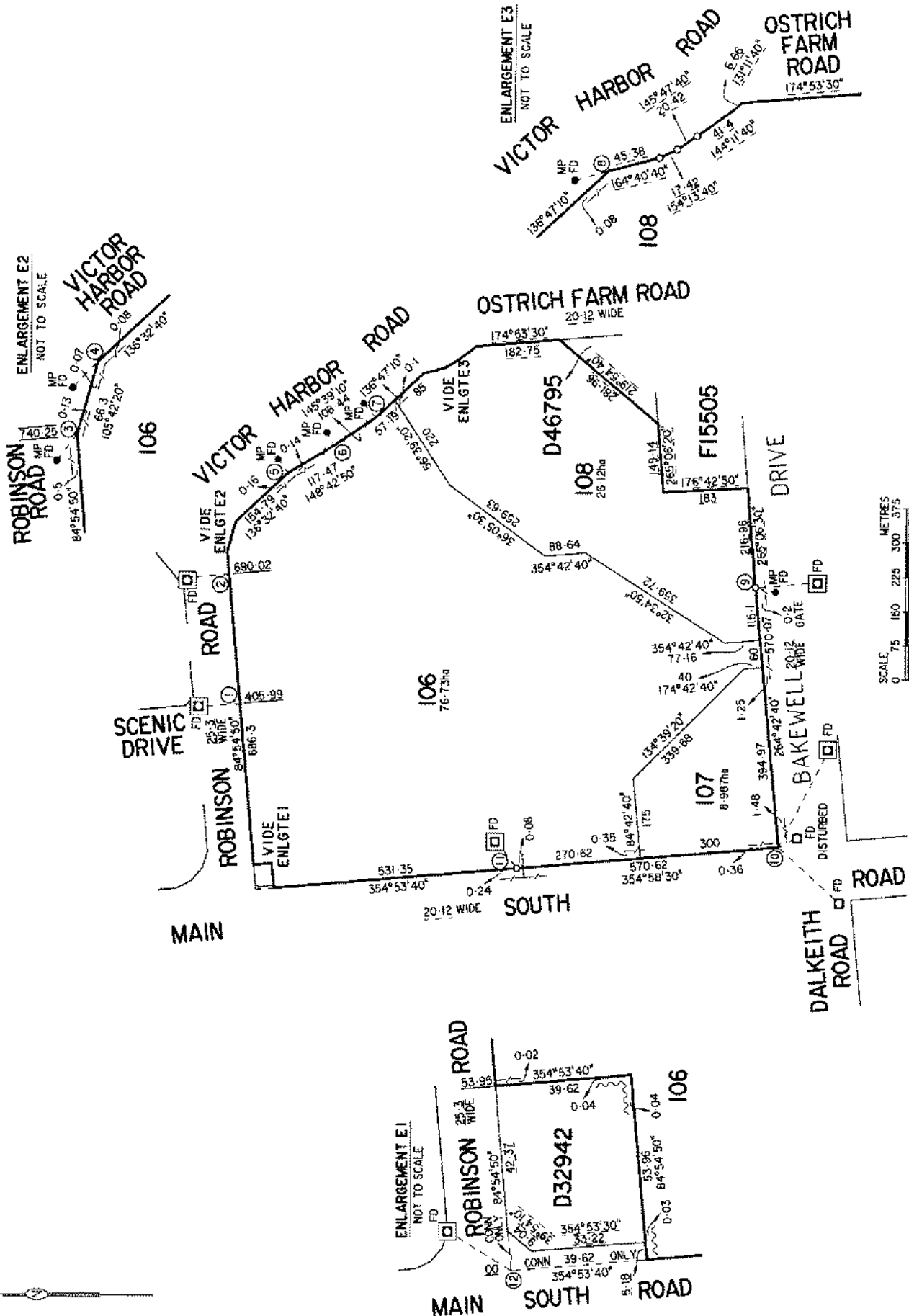
Priority Notices NIL

Notations on Plan NIL

Registrar-General's Notes

CONTROLLED ACCESS ROAD VIDE PLAN 10
APPROVED G21/2011
AMENDMENT TO DIAGRAM VIDE 47/2010

Administrative Interests NIL



SURVEY INFORMATION IS DERIVED FROM DEPOSITED PLAN 80592

REAL PROPERTY ACT, 1866



The Registrar-General certifies that this Title Register Search displays the records maintained in the Register Book and other notations at the time of searching.



Certificate of Title - Volume 5829 Folio 936

Parent Title(s) CT 5403/179

Creating Dealing(s) SC 8974989

Title Issued 14/12/2000 Edition 4 Edition Issued 24/07/2009

Estate Type

FEE SIMPLE

Registered Proprietor

SOUTHERN REGION WASTE RESOURCE AUTHORITY
OF PO BOX 2414 MCLAREN VALE SA 5171

Description of Land

ALLOTMENT 102 DEPOSITED PLAN 46795
IN THE AREA NAMED SEAFORD HEIGHTS
HUNDRED OF WILLUNGA

Easements

NIL

Schedule of Dealings

Dealing Number	Description
12966519	LEASE TO TELSTRA CORPORATION LTD. (ACN: 051 775 556) COMMENCING ON 01/06/2018 AND EXPIRING ON 31/05/2028 OF PORTION (AREA A IN F 253623)

Notations

Dealings Affecting Title NIL

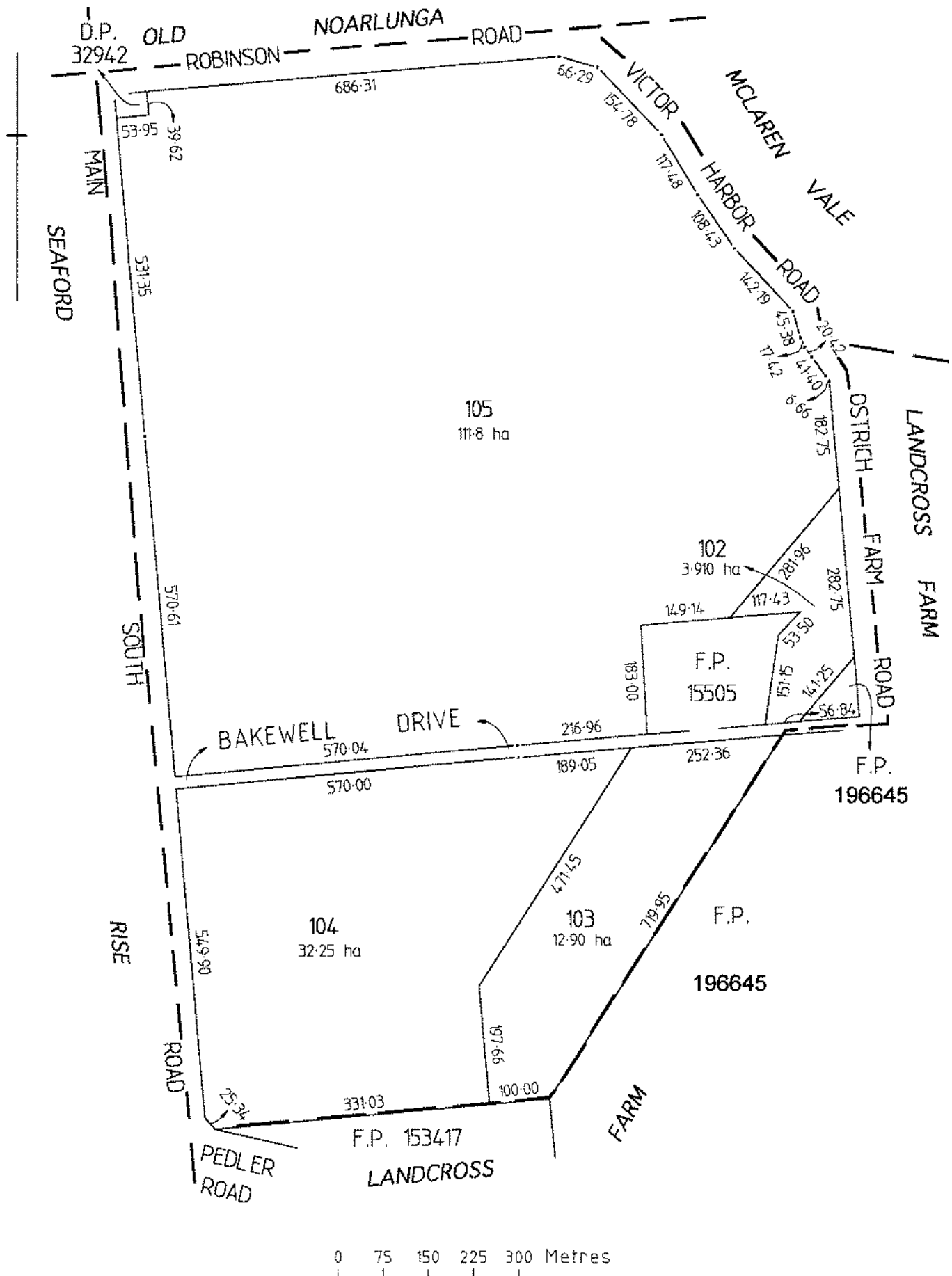
Priority Notices NIL

Notations on Plan NIL

Registrar-General's Notes

AMENDMENT TO DIAGRAM VIDE 47/2010
APPROVED FILED PLAN FOR LEASE PURPOSES FX253623

Administrative Interests NIL



Appendix 2. DPTI Sponsorship of Application as Public Infrastructure

COPY

#13088653



Government
of South Australia

The Hon Stephan Knoll MP
Member for Schubert

Mr Richard Dwyer
Managing Director
ekistics
Level 1/16 Vardon Avenue
ADELAIDE SA 5000

Dear Mr Dwyer

Thank you for your letter and supplementary information regarding the 600ML treated water dam at Seaford Heights and associated infrastructure proposed by your client Willunga Basin Water Company Pty Ltd (WBWC).

Given that the proposed works meet the definition of "public infrastructure" as outlined in Section 49(1)(a) of *Development Act 1993*, I am pleased to confirm support and specific endorsement pursuant to Section 49 (2)(c) of the *Development Act 1993* for the 600ML treated water dam including the 500mm inlet/outlet pipe and associated vegetation - as detailed in the attached Hydroplan concept plans dated 29/3/2018 drawings 14689 SK015 and SK013.

It is WBWC's responsibility to obtain all other statutory approvals, licences and permits from relevant authorities and to fund the project. The State of South Australia makes no commitment to provide any funding for the project or to purchase any product or service related to the project.

All costs of the development application, lodgement with the State Commission Assessment Panel (SCAP) and any subsequent action are the responsibility of WBWC. No representations or warranties are given in relation to the outcome of the development application or time that it takes to secure a planning outcome.

A development application must be lodged with SCAP on or prior to 30 September 2019. If this is not achieved by that time, my support under Section 49(2)(c) of the *Development Act 1993* will lapse. It is also a requirement that you contact Mr Brett Fundak, Senior Infrastructure Coordinator, prior to lodgement of the development application. Furthermore, if you have any queries in regard to this letter, please contact Mr Fundak on 8402 1845 or via e-mail at brett.fundak@sa.gov.au.

Yours sincerely


HON STEPHAN KNOLL MP
MINISTER FOR TRANSPORT, INFRASTRUCTURE AND LOCAL GOVERNMENT
MINISTER FOR PLANNING

17 January 2019

Attachments: Hydroplan concept plans – dated 29/3/2018 drawings 14689 SK015 and SK013.
Minister for Transport, Infrastructure and Local Government
Minister for Planning

Roma Mitchell House Adelaide SA 5000 | GPO Box 1533 Adelaide SA 5001 DX 171
Tel 08 7109 8430 | Email ministerknoll@sa.gov.au



Appendix 3. Development Deed

Development Deed

South Australian Housing Trust

and

Urban Renewal Authority

and

Southern Region Waste Resource Authority

Table of Contents

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5.	Waiver	3
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10.	Miscellaneous	5

Date

7 November 2017

Parties

1. **South Australian Housing Trust** (ABN 17 545 435 789) a body corporate pursuant to the South Australian Housing Trust Act 1994 of Level 5 Riverside Centre, North Terrace, Adelaide SA 5000 (**SAHT**)
2. **Urban Renewal Authority** (ABN 86 832 349 553) of Level 9 (West) Riverside Centre, North Terrace, Adelaide SA 5000 (**URA**)
3. **Southern Region Waste Resource Authority** of 112 Bakewell Drive, Seaford Heights SA 5169 (**SRWRA**)

Recitals

- A SAHT and URA are the registered proprietors of the whole of the land which is comprised and described in Certificate of Title Volume 6175 Folio 501, Certificate of Title Volume 6034 Folio 589 and Certificate of Title Volume 5403 Folio 181 (**Land**).
- B SRWRA proposes to purchase the Land from SAHT and URA.
- C The Land is in proximity to land that is used for residential purposes and land that is proposed to be developed for residential purposes (**Residential Land**).
- D The Parties have agreed to enter into this Deed for the purposes of limiting the impact of the development of the Land on the amenity of the Residential Land.

It is agreed as follows.

1. Recitals

The Parties agree that the Recitals are true and correct and form part of this Deed.

2. Definitions and Interpretation

In the interpretation of this Deed, unless the contrary intention appears or the context otherwise requires:

- (a) **Business Day** means any day other than a Saturday, Sunday or public holiday;
- (b) **Government Agency** means any government department or any statutory, public, municipal, local or other authority charged with the responsibility for administering any relevant legislation, regulations, ordinances or by laws;

- (c) **Land** means the whole of the land which is comprised and described in Certificate of Title Volume 6175 Folio 501, Certificate of Title Volume 6034 Folio 589 and Certificate of Title Volume 5403 Folio 181;
- (d) **waste** means any discarded, rejected, abandoned, unwanted or surplus matter,
 - (i) whether or not intended for sale or for recycling, reprocessing, recovery or purification by a separate operation from that which produced the matter; and
 - (ii) whether of value or not,
 but for the avoidance of doubt does not include landscaping materials derived from green waste;
- (e) singular includes plural and vice versa and any gender includes every gender;
- (f) references to a person include a corporation, association, partnership, Government Agency or other legal entity;
- (g) references to statutes include statutes amending, consolidating or replacing the statutes referred to and all regulations, orders-in-council, rules, by laws and ordinances made under those statutes;
- (h) references to sections of statutes or terms defined in statutes refer to corresponding sections or defined terms in amended, consolidated or replacement statutes;
- (i) headings and the table of contents are used for convenience only and are to be disregarded;
- (j) where any word or phrase is given a defined meaning, any other grammatical form of that word or phrase has a corresponding meaning;
- (k) a reference to two (2) or more persons means those persons jointly and severally;
- (l) a reference to a Party includes:
 - (i) the successors and permitted assigns of that Party;
 - (ii) that Party acting in a trustee or other representative capacity;
- (m) a reference to including is not and must not be treated as a word of limitation;
- (n) a provision of this Deed must not be construed to the disadvantage of a Party because that Party (or its advisers) was responsible for the preparation of the Deed (or a portion of the Deed);
- (o) if any term of this Deed is legally unenforceable or made inapplicable, it will be severed or read down, but so as to maintain (as far as possible) all other terms of this Deed (unless to do so would change the underlying principal commercial purposes of this Deed).

3. Development of Land

SRWRA must not cause, suffer or permit the receipt, handling, storage or disposal of waste on the Land.

4. Default

- (a) If either party (**Defaulting Party**), is in Default the other party (**Non-Defaulting Party**) may give the Defaulting Party a written notice (**Default Notice**) specifying:
 - (i) the nature and extent of the Default that has occurred; and
 - (ii) the act, matter or thing that the Defaulting Party must do or refrain from doing in order to rectify the Default.
- (b) Upon receipt of a Default Notice, the Defaulting Party has such reasonable time as may be specified in the Notice in which to rectify the Default in the manner specified in the Default notice.
- (c) The period specified in a Default Notice for the rectification of a Default must not be less than 10 Business Days, unless the Defaulting Party can comply with the Default Notice by refraining from engaging in a specified act or activity.
- (d) The Defaulting Party must diligently pursue the rectification of a Default during the period specified in a Default Notice given to the Defaulting Party under this clause in respect of the Default. If the Defaulting Party does not diligently pursue the rectification of the Default at any time during that period, the Non-Defaulting Party may forthwith exercise its rights under clause (e).
- (e) If the Defaulting Party does not rectify the Default in the manner specified in the Default notice within the period specified in the Default Notice, the Non-Defaulting Party may undertake or cause to be undertaken such actions as are reasonably required to rectify the Default and recover the costs of doing so as a debt from the Defaulting Party.
- (f) The rights of the Non-Defaulting Party to take other action (including instituting legal proceedings) to restrain the Default or to require the Defaulting Party to specifically perform the Defaulting Party's obligations under this Deed are not affected by reason that the Non-Defaulting Party has given the Defaulting Party a Default notice in relation to the Default.
- (g) This clause does not affect any right either party may have to terminate this Deed.
- (h) The Non-Defaulting Party may, without prejudice to any of its other rights under this clause, if the Defaulting Party does not comply with a Default notice, commence legal proceedings for damages against the Defaulting Party and the Defaulting Party must indemnify the party not in default in respect of any costs incurred by the Council arising from the commencement of those proceedings.

5. Waiver

The failure of a Party at any time to insist on performance of any obligation under this Deed of another Party is not a waiver of its right:

- (a) to insist on performance of, or claim damages for breach of, that obligation unless that Party acknowledges in writing that the failure is a waiver; and

- (b) at any other time to insist on performance of that or any other obligation of that other Party under this Deed.

6. Termination

- (a) The parties may terminate this Deed at any time by mutual agreement entered into in writing.
- (b) Subject to clause (c) below and any other provisions of this Deed which are expressed to survive termination, this Deed continues until terminated in accordance with this Deed.
- (c) If this Deed is taken to be terminated each of the parties is discharged from any obligation or liability under this Deed other than any liability for a breach of or failure to comply with any obligation under this Deed by the party before its termination.

7. Notice

- (a) Each Party notifying or giving notice under this Deed must do so:
 - (i) in writing;
 - (ii) addressed to the address of the recipient as specified in this Deed, as altered from time to time by notice given in accordance with this clause:
and
 - (iii) hand delivered or sent by prepaid post to that address or sent by facsimile transmission.
- (b) A notice given in accordance with clause (a) is received:
 - (i) if hand delivered, on the date of delivery;
 - (ii) if sent by prepaid post, five (5) days after the date of posting; and
 - (iii) if sent by facsimile transmission, on the day the transmission is sent (but only if the sender has a confirmation report specifying a facsimile number of the recipient, the number of pages sent and the date of transmission).

8. Transfer

SRWRA must not transfer the Land to any person (**Transferee**) unless the Transferee enters into a deed with SAHT and URA under which the Transferee covenants to be bound by the terms of this Deed and SRWRA will remain liable for any obligation it has under this Deed until the Transferee covenants to be bound by this Deed.

9. Amendment

All additions, amendments or modifications to this Deed (including any Appendix of this Deed) may be made in writing and signed by a duly authorised

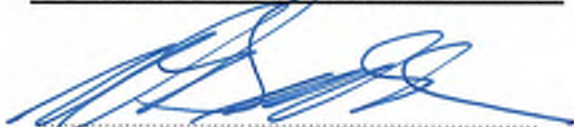
representative of the Parties. All such additions, amendments or modifications must be dated, numbered, and attached to or appended to this Deed.

10. Miscellaneous

- (a) This Deed is governed by the law applicable in South Australia.
- (b) This Deed (including all its Appendices) constitutes the entire agreement between the Parties as to its subject matter and supersedes all prior representations and agreements in connection with that subject matter.
- (c) Each Party must:
 - (i) do or cause to be done all things necessary or desirable to give effect to the performance of this Deed (including signing all such documents as may be required by this Deed); and
 - (ii) refrain from doing anything that could hinder performance of this Deed.

Executed as a Deed

Sealed under the authority of
SOUTH AUSTRALIAN HOUSING TRUST



Authorised Signatory

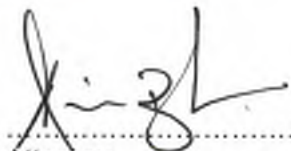
NORM SWANSSON - Manager Conveyancing
Print Name:



Authorised Signatory

Julie Waters - Manager
Sales & Acquisitions
Print Name:

2/2015
SIGNED for and on behalf of the
**URBAN RENEWAL AUTHORITY trading
as Renewal SA** by its duly constituted
Attorney pursuant to Power of Attorney
[INSERT], who has not received a notice of
the revocation of that Power of Attorney in
the presence of:



7 November
2017

Attorney

Michael Buchan

Full Name of Attorney

Address:

C/- Urban Renewal Authority
Level 9 Riverside Centre
North Terrace Adelaide SA 5000
Tel.8207 1300



Witness

Courtney Amelia Tyler

Full Name of Witness

Address:

C/- Urban Renewal Authority
Level 9 Riverside Centre
North Terrace Adelaide SA 5000
Tel.8207 1300

EXECUTED BY THE PURCHASER on

15TH

day of ~~September~~ 2017

THE COMMON SEAL of
**SOUTHERN REGION WASTE
RESOURCE AUTHORITY**
was affixed in the presence of:

.....
Chairperson

.....
Board Member



Appendix 4. Legal Opinion – Stuart Henry SC

July 5, 2018

CARRINGTON CHAMBERS

BARRISTERS

48 Carrington Street
Adelaide SA 5000

(T) 08 8212 4511
(F) 08 8231 6080

O'Loughlins
Lawyers
Level 2, 99 Frome Street
Adelaide SA 5000

Attention: James Frearson-Lea

Dear James

Willunga Basin Water Co Pty Ltd

You have asked for my opinion on certain issues arising from a proposal by your client Willunga Basin Water Co. Pty Ltd (**WBW**) to construct and use a dam on land at Seaford Heights for the storage of recycled water.

Current operations

WBW is in the business of distributing recycled water principally to customers engaged in primary production within the Willunga Basin.

WBW presently sources its recycled water from the Christies Beach Wastewater Treatment Plant (**Christies Beach WWTP**) operated by SA Water.

SA Water receives sewage at the Christies Beach WWTP, and then subjects that sewage to sequential treatment including primary sedimentation/settling; activated sludge secondary treatment; secondary sedimentation/settling and chlorination.

Following treatment by SA Water, the treated water is either discharged to the sea at Christies Beach, or it is diverted by pipe to a storage dam on adjacent land operated by WBW.

WBW pays a commercial rate to SA Water for the purchase of the recycled water which is diverted to its Christies Beach dam.

The recycled water purchased from SA Water is pumped several kilometres from WBW's Christies Beach dam to WBW's site at Quarry Road Seaford Heights via a trunk main. The Quarry Road site includes a 13ML storage dam and a pump station. From the Quarry Road site, WBW distributes the recycled water to customers in the Willunga Basin via an existing network of pipes. The customers generally use the recycled water for the irrigation of crops.

SA Health has granted to SA Water a licence under the *Public and Environmental Health (Waste Control) Regulations* for the supply of recycled water from the Christies Beach WWTP, subject to conditions directed to achieving water quality requirements.

Proposal for additional storage dam

WBW proposes to construct a 700ML dam at Lot 108 in Deposited Plan 80592 at Seaford Heights (**Lot 108**). Lot 108 is conveniently located near the Quarry Road dam and pump station. Recycled water received at Quarry Road will be pumped to the proposed dam at Lot 108 for storage, and pumped back to the Quarry Road site when it is needed for sale to customers.

Lot 108 is presently owned by Southern Region Waste Resources Authority (SRWRA). WBW and SRWRA propose to enter into a lease whereby WBW will take possession of Lot 108, construct the dam and use the dam for the purposes of its recycled water distribution business.

The purpose of the dam on Lot 108 will be to take and store recycled water purchased from SA Water at the Christies Beach WWTP at times when there is low demand for irrigation water from WBW's customers, and then distribute that recycled water to customers in times of high demand. It is expected that the dam would be filled over the winter months when demand for irrigation water is low, and will progressively be emptied over the summer months when demand for irrigation water is high.

The dam on Lot 108 will be filled and emptied using the existing pumping infrastructure at the existing WBW site at Quarry Road.

In terms of composition and quality, there will be no difference between the water held in the dam on Lot 108 and the water currently being distributed by WBW using its existing infrastructure and systems. The purpose of the dam is simply to provide additional storage capacity within the distribution system to augment WBW's ability to provide irrigation water in summer.

The legal issue

SRWRA bought Lot 108 from the South Australian Housing Trust and the Urban Renewal Authority in about 2017. At about the time of the sale, the vendors and SRWRA executed a 'Development Deed' dated 7 November 2017. The Deed recites that its purpose is to limit the impact of the development of the land to which it relates on the amenity of nearby land that is used for residential purposes or that is proposed to be developed for residential purposes.

From my reading of the Development Deed clause 3 is its only operative clause. Clause 3 reads as follows:

3 *SRWRA must not cause, suffer or permit the receipt, handling, storage or disposal of waste on the Land.*

In the Development Deed, 'Land' is defined to include Lot 108.

Further the Deed contains the following definition of 'waste':

waste means any discarded, rejected, abandoned, unwanted, or surplus matter,

- (i) whether or not intended for sale or for recycling, reprocessing, recovery or purification by a separate operation from that which produced the matter; and
- (ii) whether of value or not,

but for the avoidance of doubt does not include landscaping materials derived from green waste.

A question has arisen whether the storage of recycled water sourced from the Christies Beach WWTP in a dam to be constructed on Lot 108 would be contrary to clause 3 of the Development Deed. This issue comes down to whether or not the recycled water is 'waste' as defined in the Development Deed.

Discussion

Clause 3 of the Development Deed would only be contravened if the recycled water held in the dam proposed on Lot 108 met the definition of 'waste' set out in the Development Deed.

That definition is in all material respects the same as the definition of 'waste' as it was found in section 3(1) of the *Environment Protection Act 1993* (SA) (the **EP Act**) at the time the Development Deed was executed and before an amendment to the definition in the EP Act in November 2017.¹

The definition of waste in the EP Act was the subject of an appeal heard by the Full Court of the Supreme Court of South Australia in the matter of *Wood v Adelaide Resource Recovery Pty Ltd* in 2017.² That appeal was concerned with a licenced waste depot at which construction and demolition waste was 'processed' into a form of alternative fuel suitable for use in some

¹The definition in the EP Act allowed for the definition to be enlarged by the inclusion of additional forms of waste by way of regulation or environment protection policy. This aspect of the EP Act definition is absent from the definition in the Development Deed. The EP Act definition also makes no reference to landscaping materials derived from green waste. Neither of these aspects of the definition are relevant for present purposes.

²[2017] SASFC 13. This decision was published on 20 February 2017.

industrial activities. The question was whether the construction and demolition waste had ceased to be waste for the purposes of the definition on account of it having been 'processed' into a product.

The Court ultimately held that on the facts of the case there had not been sufficient processing of the waste to convert it into a product. However, as the nature of the materials bore no resemblance to the irrigation water with which we are concerned here, the importance of the Full Court case lies in the principles discussed by the Court in determining whether materials are waste for the purposes of the definition, or alternatively whether they are a product.

The Court said:

[44] *In ordinary parlance, waste is a purposive concept. It is a relative and not absolute concept. It is not an inherent characteristic of material that it comprises waste: it must be assessed from the perspective of a person whose purpose is to be considered at the relevant time. Waste is the antithesis of a product in ordinary parlance.*

[45] *This dichotomy between waste and a product is reflected in the first limb of the definition of "waste" in the Act. If material that was waste has been used to make or has otherwise become a product, by a combination of what it says and does not say the definition treats the material as no longer being waste. Thus, the definition explicitly provides that the mere fact that the material is intended for sale, recycling, reprocessing, recovery or purification does not prevent it being waste if it falls within the first part of the limb. Conversely, the definition implicitly provides that if the material has actually been sold, recycled, reprocessed, recovered or purified such that it is now a product, it is no longer waste.*

[46] *The conversion of unwanted waste into a product of value may be a complex process over an extended time period. In many cases, it will be a question of fact and degree to determine the point at which waste has changed its character and become a product. However, the mere fact that there may be questions of judgment involved in determining the precise point at which this occurs does not detract from the dichotomy evident in the definition between waste and a product. The definition makes plain that mere intention to convert waste into a product will not suffice: the enquiry is into objective fact.*

Because the definition of waste in the Development Deed is relevantly in the same terms as the definition of waste in the EP Act, in my view the Full Court's statements of principle in paragraphs [44] - [46] quoted above have application to the definition in the Development Deed, and are therefore likely to be decisive in determining the question whether the recycled water in the proposed dam will be 'waste'.

Paragraph [44] of the Full Court's decision requires the identification of the person whose purpose will determine the status of the material. In this case, in my view, that person will be WBW as the occupier of Lot 108 and the operator of the dam to be built there. It will not be

SRWRA, who will merely hold ownership of the land and will not be involved in any handling of the water. It will plainly not be SA Water, whose involvement with the water ceases when it is sold to WBW and piped from the Christies Beach WWTP into WBW's holding dam at Christies Beach.

Further, in the hands of WBW at Lot 108, the recycled water is neither discarded, rejected, abandoned, unwanted nor surplus. On the contrary, the water is a valuable resource for which WBW has paid a commercial rate to acquire title, and for the purpose of re-selling at a profit. Clearly, in the hands of WBW the recycled water is not waste within the definition.

Paragraph [45] recognises that material that was formally waste may be turned into a product, and once this occurs it is no longer waste. In the circumstances of this case, the sewage received by SA Water at Christies Beach is undoubtedly waste. However that sewage is processed by SA Water at the Christies Beach WWTP, and reusable water emerges from those processes. The principles discussed by the Full Court in paragraph [45] suggest that in the hands of SA Water the recycled water may still be waste, despite the fact that it is intended to be sold to WBW, because mere intention to sell is not sufficient to convert something from waste into a non-waste. However the last sentence of paragraph [45] makes it clear that upon actual sale of the processed material to a customer, then that material ‘...is now a product, it is no longer waste.’

Thus it is clear that upon delivery from SA Water to WBW, the recycled water becomes a product, and is no longer waste.

It can further be seen that in accordance with the principles identified by the Full Court, the mere transportation of the recycled water from WBW's Christies Beach storage to the proposed dam at Lot 108 will not change the status of the water, and will certainly not convert the water into waste.

Paragraph [46] refers to the possibility of conversion of waste into a product over time and by a complex process. In my view, the relevant time frame and processes occur at SA Water's Christies Beach WWTP, and the point at which the water changes its character from waste to product occurs when the recycled water is diverted into WBW's storage dam at Christies Beach. At that point there is something more than mere intention on the part of SA Water. The water is sold for value, and a change in ownership takes place.

Summary

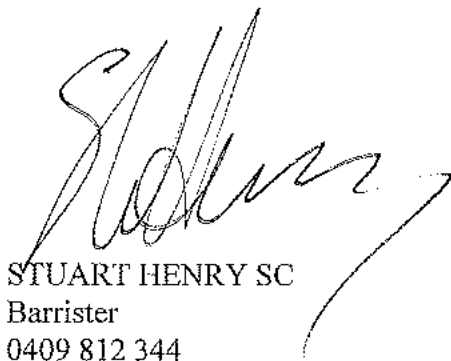
The definition of ‘waste’ in the Development Deed is framed in terms relevantly identical to the old definition of ‘waste’ in the EP Act. As such, the Full Court's decision in *Woods v Adelaide Resource Recovery* sets out the relevant principles for determining whether the recycled water to be held in the proposed dam on Lot 108 will be ‘waste’ for the purposes of the Deed.

It is plain from the Full Court's decision that material may be transformed from waste into a product through the application of industrial processes, and that if such a product is sold to a customer who wishes to put the product to some use, then the product is not waste.

In my view, this is exactly the situation involving WBW and the proposed dam at Lot 108. WBW buys the recycled water from SA Water. WBW values the recycled water because WBW is able to sell the recycled water to its customer at a profit.

The recycled water is not, in my view, a form of 'waste' for the purposes of the Development Deed.

Yours sincerely

A handwritten signature in black ink, appearing to read 'Stuart Henry', with a long, sweeping horizontal stroke extending to the right.

STUART HENRY SC

Barrister

0409 812 344

s.henry@carringtonchambers.com.au

Appendix 5. Land Management Agreement (LMA)

DATED

23rd

DAY OF

OCTOBER

2017

LAND MANAGEMENT AGREEMENT

BETWEEN

MINISTER FOR PLANNING ("MINISTER")

-AND-

SOUTHERN REGION WASTE RESOURCE AUTHORITY (ABN 37 443 976 085)
("OWNER")



Government
of South Australia

CROWN SOLICITOR
Level 9, 45, Pirie Street, Adelaide SA 5000

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LAND MANAGEMENT AGREEMENT dated ~~day of~~ *23rd October*

2017

PARTIES:

MINISTER FOR PLANNING of a body corporate pursuant to the *Administrative Arrangements Act 1994 (SA)* of 9th Floor Terrace Towers, 176 North Terrace, Adelaide 5000 in the State of South Australia ("**MINISTER**")

AND

SOUTHERN REGION WASTE RESOURCE AUTHORITY of PO Box 2414 McLaren Vale SA 5171 ("**OWNER**")

RECITALS:

- A. The Owner is the registered proprietor of the whole of the land which is comprised and described in Certificate of Title Volume 6034 Folio 589 ("**Land**").
- B. The Minister for Planning and the Owner have agreed to enter into this Agreement pursuant to section 57(1) of the *Development Act 1993 (SA)* ("**the Act**") in relation to the development, management, preservation and conservation of the Land subject to the terms and conditions as expressed in this agreement.
- C. This Land Management Agreement is executed as a Deed and applies to the whole of the Land.

IT IS AGREED:

1. RECITALS

That the matters recited above are true and accurate and shall form part of this agreement.

2. DEFINITIONS

In this agreement, unless otherwise provided:

- 2.1 "Act" has the meaning given in Recitals paragraph B above;
- 2.2 "Buffer Land" means the area delineated as A on the plan attached to this agreement as Annexure C
- 2.3 "Buffer Zone Landscaping" means the landscaping and vegetation that has been established on the Buffer Zone Landscaping Area in accordance with the attached landscape drawings which form Annexure A to screen urban development and to interrupt sight lines from Victor Harbor Road and reference to Buffer Zone Landscaping includes reference to any portion of it;
- 2.4 "Buffer Zone Landscaping Area" means the landscaped and vegetated area where the Buffer Zone Landscaping exists and which is bounded in blue on the plan attached to this agreement as Annexure B
- 2.5 "Land" has the meaning given in Recitals paragraph A above;
- 2.6 "Laws" shall mean and include all present and future legislation (both State and Federal) and all amendments to them and re-enactments of them and all regulations, by-laws and orders made pursuant to them;
- 2.7 "LTO" means the Land Titles Office of South Australia;
- 2.8 "Minister" means the Minister to whom the Act is committed from time to time and includes his or her authorised agents or delegates;
- 2.9 "Owner" means the person and/or company registered or entitled to be registered as the proprietor of an estate in fee simple to the Land or to each and every one of all separate allotments into which the Land may be divided after the date of this Agreement (subject however to such encumbrances, liens and interests as are registered and notified by memoranda endorsed on the Certificate of Title thereof) and where the Owner consists of more than one person means each and every one or more of such persons jointly and each of them severally;

3. INTERPRETATION

3.1 In this agreement, unless a contrary intention is evident:

- 3.1.1 a reference to any legislation or to any provision of any legislation includes:
 - (a) all legislation, regulations, proclamations, ordinances, by-laws and instruments issued under that legislation or provision; and
 - (b) any modification, consolidation, amendment, re-enactment or substitution of that legislation or provision;

-
- 3.2 a reference to a party includes that party's administrators, successors, heirs and permitted assigns;
 - 3.3 a reference to two or more persons is a reference to those persons jointly and severally;
 - 3.4 a reference to a clause or schedule is a reference to a clause of, or a schedule to, this agreement;
 - 3.5 a reference to a clause number is a reference to all of its sub-clauses; and
 - 3.6 the clause headings are for convenient reference only and they do not form part of this agreement.

4. TERM

This agreement commences from the moment it is duly registered at the LTO pursuant to Section 57(5) of the Act and continues until terminated in accordance with this agreement.

5. MANAGEMENT OF LAND

- 5.1 The Owner must:
 - 5.1.1 not cause, suffer or permit interference with, damage to or removal or destruction of the Buffer Zone Landscaping;
 - 5.1.2 re-plant, re-establish or re-construct any part of the Buffer Zone Landscaping in the event that there is any damage to, or destruction of the Buffer Zone Landscaping on the Buffer Zone Landscaping Area or the removal of any vegetation or soil from the Buffer Zone Landscaping Area; and
 - 5.1.3 not permit the doing or omission of any act, matter or thing on the Buffer Zone Landscaping Area which has the potential to cause such act, matter or thing in 5.1.1 or 5.1.2;as it relates to the Land and without the prior written approval of the Minister.
- 5.2 The Owner must:
 - 5.2.1 ensure that the Buffer Land is maintained as primarily a passive vegetated area to screen development and interrupt site lines from Victor Harbor Road; and
 - 5.2.2 obtain the consent of the Developer for any change in the use of the Buffer Land as described in 5.2.1.
- 5.3 In this clause 5, "Developer" means Fairmont Land Holdings Pty Ltd (ACN 098 486 429), LandSA Pty Ltd (ABN 47 079 317 623) and MSP Property Holdings Pty Ltd (ACN 110 753 707) and each of their successors and permitted assigns in respect of the deed entitled Development Deed – Seaford Heights 2008 dated 29 May 2009 and as subsequently varied.

6. RESTRICTIONS ON LEASING AND OTHER DEALINGS

The Owner must not grant, or agree to grant, any lease, licence, easement (including a right of way) or other right of any nature whatsoever which may give any person the right to possession or control of or entry on to the Land which right would enable such person to breach any of the obligations imposed on the Owner by this agreement unless such grant:

- 6.1 is in writing; and
- 6.2 contains as an essential term a covenant by the grantee not to do, or omit to do (or suffer or permit any other person to do or omit to do) any act, matter or thing which would constitute a breach by the Owner of the Owner's obligations under this agreement if the Owner itself performed (or omitted to perform) the act.

7. SEVERANCE

- 7.1 Each word, phrase, sentence, paragraph and clause of this agreement is severable.
- 7.2 If a court determines that a part of this agreement is unenforceable, invalid, illegal or void that court may sever that part.
- 7.3 Severance of a part of this agreement will not affect any other part of this agreement.

8. ENTIRE AGREEMENT

- 8.1 This agreement contains the entire agreement between the parties with respect to its subject matter.
- 8.2 This agreement supersedes any prior agreement, understanding or representation of the parties on the subject matter.

9. MODIFICATION

- 9.1 Any modification of this agreement must be in writing and signed by each party.
- 9.2 Modifications must be enacted in accordance with the provisions of the Act which apply to changes or alterations of Land Management Agreements.

10. WAIVER

- 10.1 A waiver of any provision of this Agreement must both be in writing and be signed by the parties or by a person duly authorised to sign such a document on a party's behalf.
- 10.2 No waiver by a party of a breach of a term or condition contained in this agreement shall operate as a waiver of any breach of the same or any other term or condition contained in this agreement.
- 10.3 No forbearance, delay or indulgence by any party in enforcing the provisions of this agreement shall prejudice or restrict the rights of that party.

EXECUTED AS A DEED BY

THE COMMON SEAL of
SOUTHERN REGION WASTE
RESOURCE AUTHORITY
was affixed in the presence of:



.....
Chairperson

.....
Board Member

THE COMMON SEAL of MINISTER
FOR PLANNING
was hereto affixed in the presence of:

.....
Witness

[Print Name: CHELSEA KATE LUCAS]



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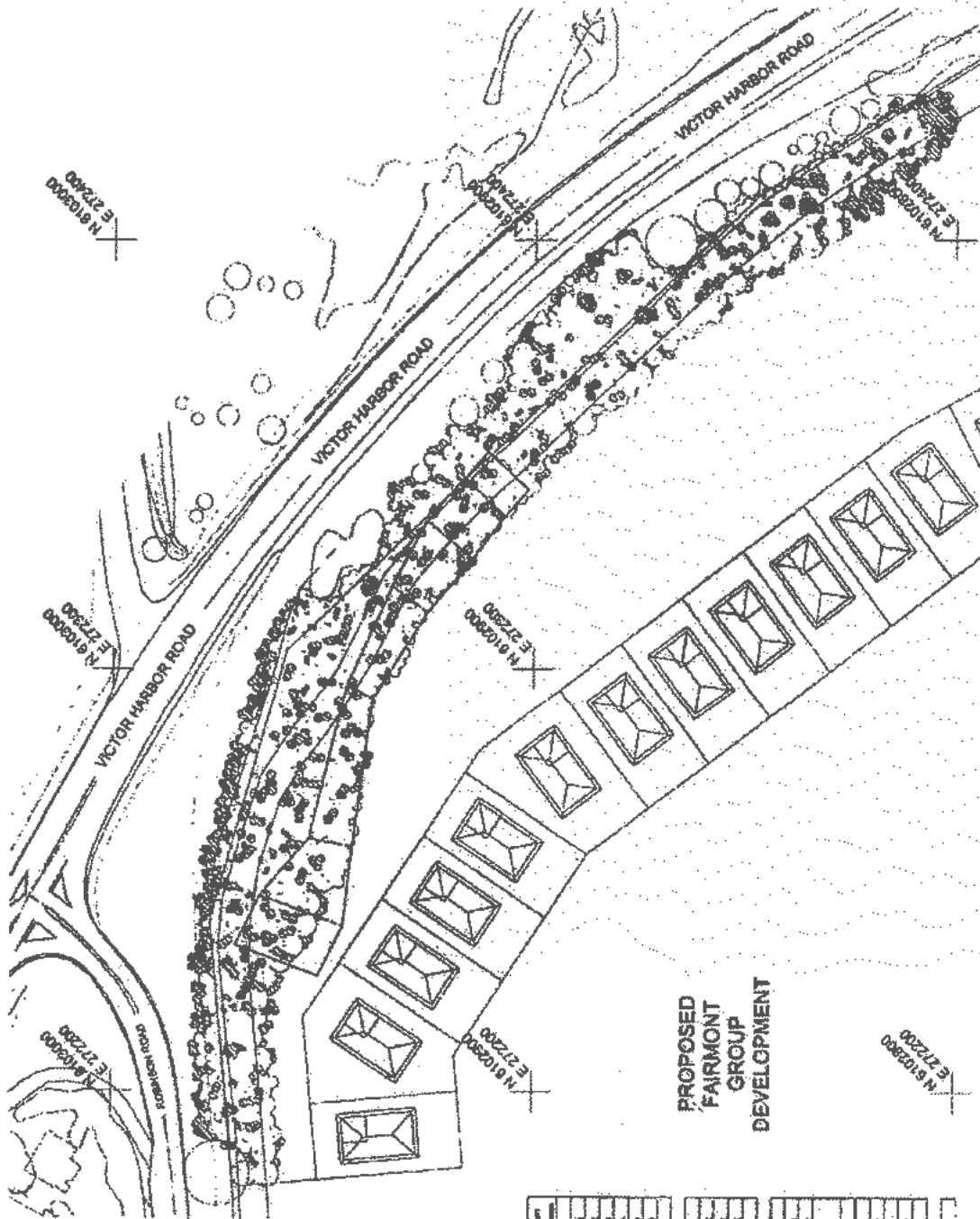
ANNEXURE A
Buffer Zone Landscaping

DRAWING	LOCATION MAP
SHEET 500	PLANT LAYOUT 1
SHEET 501	PLANT LAYOUT 2
SHEET 502	PLANT LAYOUT 3
SHEET 503	MOUND LAYOUT 1
SHEET 504	MOUND LAYOUT 2
SHEET 505	

[illegible]

LEGEND

- TREE SPECIES MIX 1
- TREE SPECIES MIX 2
- UNIDENTIFIED
- EXISTING VEGETATION
- MOULD FOOTPRINT



PROPOSED FAIRMONT GROUP DEVELOPMENT

PLANT SPECIES	Quantity	Volume	Weight	Value	Notes
TREE SPECIES MIX 1					
Acacia saligna	1.5	200	20	20	
Callitris glauca	1.5	200	20	20	
Conocarpus strictus	1.5	200	20	20	
Leptospermum laevis	1.5	200	20	20	
Phoradendron vitaceum	1.5	200	20	20	
TREE SPECIES MIX 2					
Callitris glauca	1.5	200	20	20	
Conocarpus strictus	1.5	200	20	20	
Leptospermum laevis	1.5	200	20	20	
Phoradendron vitaceum	1.5	200	20	20	
SHrub SPECIES					
Callitris glauca	1.5	200	20	20	
Conocarpus strictus	1.5	200	20	20	
Leptospermum laevis	1.5	200	20	20	
Phoradendron vitaceum	1.5	200	20	20	
SHrub SPECIES					
Callitris glauca	1.5	200	20	20	
Conocarpus strictus	1.5	200	20	20	
Leptospermum laevis	1.5	200	20	20	
Phoradendron vitaceum	1.5	200	20	20	

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SPECIFIED

Department of Planning, Transport and Infrastructure

Project No: 2012/00000000

Project Name: VICTOR HARBOR ROAD LANDSCAPE CONSTRUCTION

Scale: 1:500

Author: [Name]

Project No: 2012/00000000

Project Name: VICTOR HARBOR ROAD LANDSCAPE CONSTRUCTION

Scale: 1:500

Author: [Name]

Project No: 2012/00000000






Project Name: VICTOR HARBOR ROAD LANDSCAPE CONSTRUCTION

Scale: 1:500

Author: [Name]



LEGEND

	TREE SPECIES MIX 1
	TREE SPECIES MIX 2
	UNDERSTORY
	ROOSTING VEGETATION
	MOUND HOUSING

[illegible][illegible]

00726

[illegible]

TYPE OF DOCUMENT

APPLICATION TO NOTE LAND MANAGEMENT AGREEMENT

PRIVACY COLLECTION STATEMENT: The information in this form is collected under statutory authority and is used for maintaining publicly searchable registers and indexes. It may also be used for authorised purposes in accordance with Government legislation and policy requirements.

(Pursuant to s 57(5) of the Development Act 1993)

To the Registrar-General:

1. The MINISTER FOR PLANNING a body corporate constituted by a proclamation made pursuant to s 7(1) of the *Administrative Arrangements Act 1994* ("the Minister") of 11th Floor 45 Pirie Street Adelaide South Australia 5000 has entered into the attached Land Management Agreement dated the 23rd day of October 2017 ("the Agreement") with SOUTHERN WASTE RESOURCE AUTHORITY (ABN 37 443 975 085) of Post Office Box 2414 McLaren Vale 5171 pursuant to Section 57(1) of the *Development Act 1993* ("the Act").
2. The Agreement relates to the whole of the land comprised in Certificate of Title Volume 6034 Folio 589 ("the Land").

NOW THEREFORE the Minister applies pursuant to s 57(5) of the Act to note the Agreement against the Land.

Dated 21st day of November 2017

THE COMMON SEAL of MINISTER
FOR PLANNING was hereto affixed
in the presence of:

Signature of Witness

CHELSEA KATE LULAS
Full Name of Witness

45 PIRIE STREET
ADELAIDE SA 5000
8204 1495



FORM 100 (1/1/17)
 AG 12835643

 11:39 28-Nov-2017
 4 of 4

LANDS TITLES REGISTRATION OFFICE
 SOUTH AUSTRALIA

FORM APPROVED BY THE REGISTRAR-GENERAL

PRIORITY NOTICE ID	
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BELOW THIS LINE FOR OFFICE &
 STAMP DUTY PURPOSES ONLY

SERIES NO	PREFX
4	AG

AGENT CODE

LODGED BY:



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CORRECTION TO:

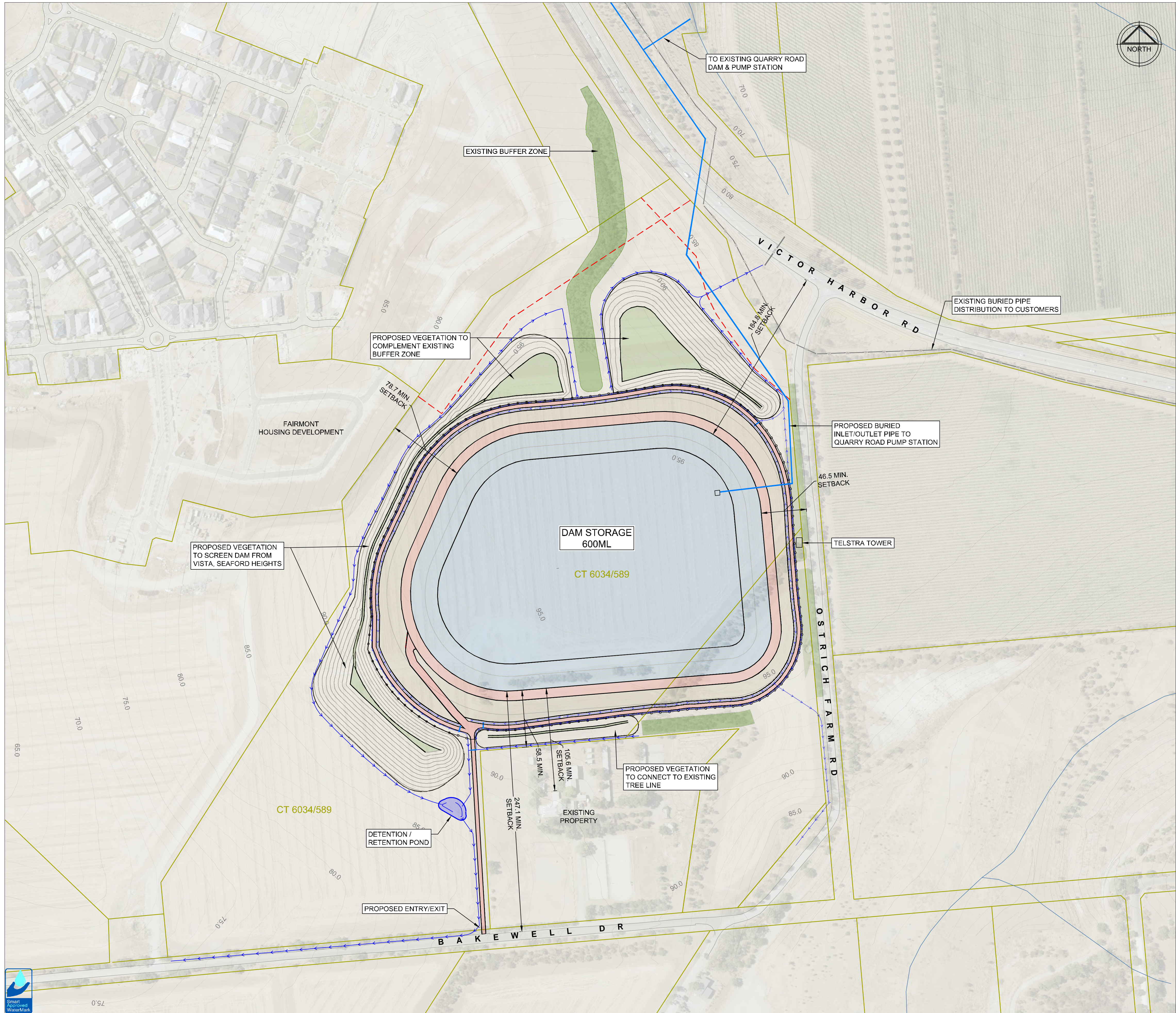
SOUTH AUSTRALIAN HOUSING TRUST SAHT

SUPPORTING DOCUMENTATION LODGED WITH INSTRUMENT
(COPIES ONLY)

- 1
- 2
- 3
- 4
- 5

CORRECTION	PASSED
REGISTERED	 
5 - DEC 2017	

Appendix 6. Concept Plans for Development (Hydroplan)



SITeworks LEGEND

- PROPERTY LINE
- PROPOSED PIPELINE
- PROPOSED SWALE
- EXISTING PIPELINE
- BUFFER LAND BOUNDARY LINE

FINISHED SURFACE LEGEND

- RUBBLE AREA
- STORAGE AREA (PLASTIC LINED)
- OUTSIDE BATTER AREA

VEGETATION LEGEND

EXTENDED VEGETATION AREA:
(FOR SCREENING - INDICATIVE ONLY)

EXAMPLE:



NOTE: VEGETATION PLAN TO BE AGREED WITH BIODIVERSITY McLaren VALE AND DEW. VEGETATION TO SCREEN A 1.8m HIGH SECURITY FENCE ON THE INTERNAL SIDE OF EXTENDED VEGETATION ALIGNMENT.

EXISTING VEGETATION AREA:

EXAMPLES:



SCALE 1:2000 ORIGINAL SIZE A1

Drawing file: Z:\WBW\14689 SRWA Dam Drawings\SK017-d7 (57MM x Mounds) dwg - 19/12/2018 5:14 PM Original Size: ISO Full Bleed A1 (841.00 X 594.00 MM)

4	19/12/2018	JT	BH	FOR DISCUSSION					
3	16/11/2018	JT	JG/BH	FOR DISCUSSION					
2	22/10/2018	JT	JG/BH	FOR DISCUSSION					
1	03/10/2018	JT	JG/BH	FOR DISCUSSION					
0	20/09/2018	JT	JG/BH	FOR DISCUSSION					
REV	ISSUED	D.DWN	APRVD	REVISION DESCRIPTION	REV	ISSUED	D.DWN	APRVD	REVISION DESCRIPTION



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PERTH ADELAIDE SYDNEY BRISBANE BEIJING

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be used for the purpose for which it was
commissioned and in accordance with the terms of
engagement for the commission.

The arrangement and general details as shown on
this drawing are essentially diagrammatic and must
be applied to the circumstances as found on site.

DES/DRAWN:	JT	CLIENT: WILLUNGA BASIN WATER							
CHECKED:	BH								
APPROVED:	JG	PROJECT: SRWRA STORAGE CONCEPT DESIGN PLAN WITH MOUNDS							
DATE:	29/03/2018								
DRAFT REF:	2-WBW-d7	DRAWING No.	14689-SK017	SHEET	1	OF	1	REVISION	4

Appendix 7. Geotechnical Investigation Report (SMEC)



DRAFT GEOTECHNICAL INVESTIGATION REPORT

SRWRA Storage Seaford

Reference No. 3005628
Prepared for Hydroplan
18 June 2018

Document Control

Document:	DRAFT GEOTECHNICAL INVESTIGATION REPORT
File Location:	SA Project Drive
Project Name:	SRWRA Storage Seaford
Project Number:	3005628
Revision Number:	Rev A Draft for Client Review

Revision History

REVISION NO.	DATE	PREPARED BY	REVIEWED BY	APPROVED FOR ISSUE BY
Rev A	14 June 2018	Simon Pointon	Mark Drechsler	Mark Drechsler

Issue Register

DISTRIBUTION LIST	DATE ISSUED	NUMBER OF COPIES
Hydroplan	18 June 2018	1

SMEC Company Details

Approved by:	Mark Drechsler		
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Email:	< Mark.Drechsler@smec.com >	Website:	www.smec.com

The information within this document is and shall remain the property of Hydroplan.

Important Notice

This report is confidential and is provided solely for the purposes of assessing the ground conditions at the SRWRA Storage Seaford. This report is provided pursuant to a Consultancy Agreement between SMEC Australia Pty Limited ("SMEC") and Hydroplan, under which SMEC undertook to perform a specific and limited task for Hydroplan. This report is strictly limited to the matters stated in it and subject to the various assumptions, qualifications and limitations in it and does not apply by implication to other matters. SMEC makes no representation that the scope, assumptions, qualifications and exclusions set out in this report will be suitable or sufficient for other purposes nor that the content of the report covers all matters which you may regard as material for your purposes.

This report must be read as a whole. The executive summary is not a substitute for this. Any subsequent report must be read in conjunction with this report.

The report supersedes all previous draft or interim reports, whether written or presented orally, before the date of this report. This report has not and will not be updated for events or transactions occurring after the date of the report or any other matters which might have a material effect on its contents or which come to light after the date of the report. SMEC is not obliged to inform you of any such event, transaction or matter nor to update the report for anything that occurs, or of which SMEC becomes aware, after the date of this report.

Unless expressly agreed otherwise in writing, SMEC does not accept a duty of care or any other legal responsibility whatsoever in relation to this report, or any related enquiries, advice or other work, nor does SMEC make any representation in connection with this report, to any person other than Hydroplan. Any other person who receives a draft or a copy of this report (or any part of it) or discusses it (or any part of it) or any related matter with SMEC, does so on the basis that he or she acknowledges and accepts that he or she may not rely on this report nor on any related information or advice given by SMEC for any purpose whatsoever.

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1 Introduction

A geotechnical investigation has been undertaken by SMEC Australia at the location of the proposed Willunga Basin Water storage project at Seaford Heights, South Australia. The project locality is shown on Figure 1.

The objective of the investigation was to provide Hydroplan with a broad understanding of the foundation, excavation and earthworks conditions for a proposed 700 ML water storage to be located on Ostrich Farm Road.

SMEC understands that Hydroplan is looking for a site for a Willunga Basin Water storage for the Southern Region Waste Resource Authority (SRWRA) with the capacity of 700ML. The concept design is for a site at Seaford Heights on Ostrich Farm Road at the top of a hill, which is located above a new subdivision, the Victor Harbor Road and neighbouring properties. Excavations within the subdivision infer a weathered profile of siltstones and sandstone at depth, which are inferred to extend under the water storage facility.

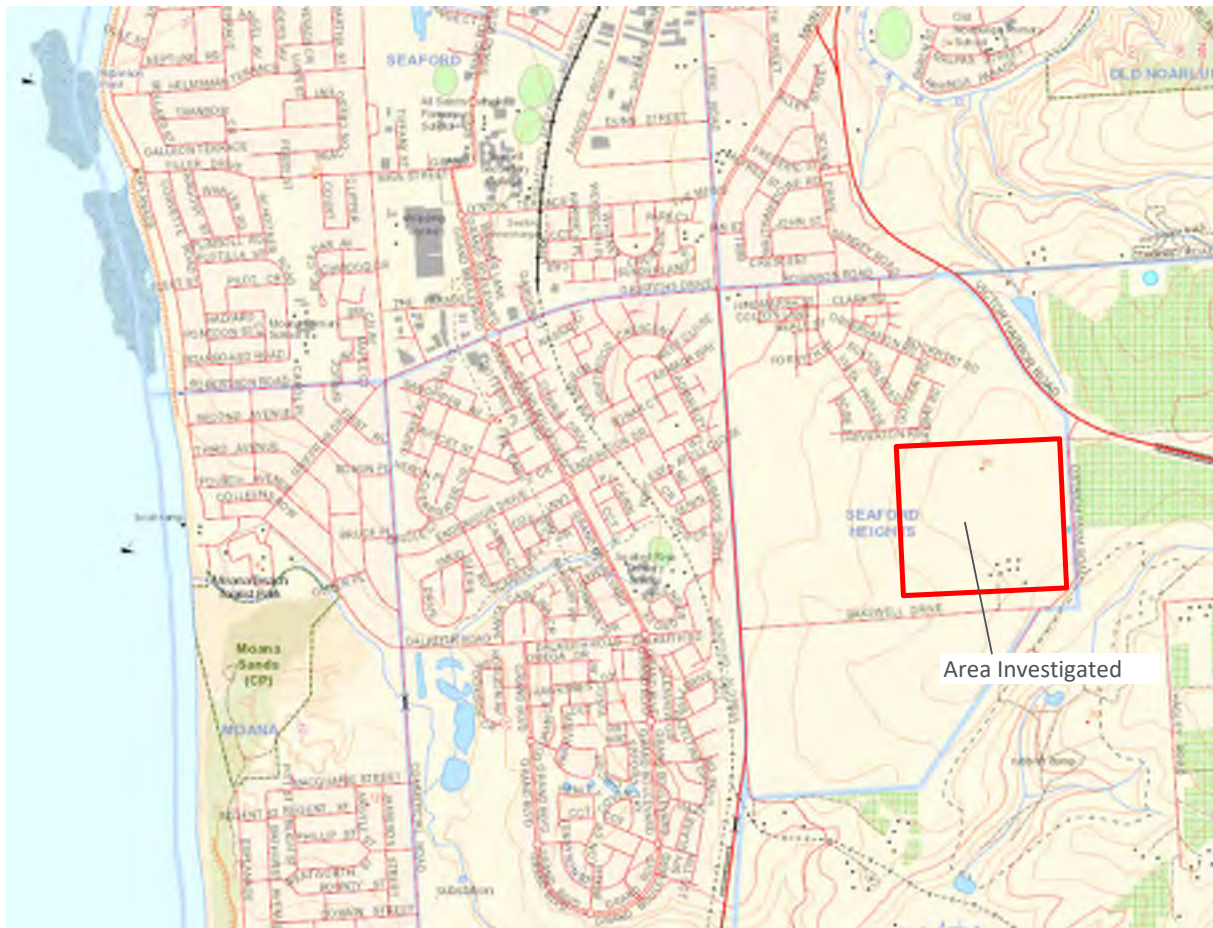


Figure 1: Project Location

[Image Source: Department of State Development, the Government of South Australia, SARIG (South Australian Resources Information Gateway) <https://map.sarig.sa.gov.au/> accessed May 2018]

2 OUTLINE OF THE SITE INVESTIGATION

2.1 Field Investigation

The field investigation was carried out on 21 May and 22 May 2018 and comprised drilling four boreholes (denoted BH1 to BH4) to a target depth of 8 m. The boreholes were drilled by subcontractor Drilling Solutions using a truck mounted drilling rig and the HQ diamond coring technique.

The boreholes were positioned to provide a broad coverage of the proposed storage area. The field investigation was completed in general accordance with AS1726:2017 Geotechnical Site Investigations, and was supervised by an experienced Geotechnical Engineer from SMEC. The boreholes were backfilled with spoil following completion of the site investigation.

A plan of the boreholes is included in Appendix A. Representative site photographs are presented in Appendix B. Engineering logs of the boreholes are contained in Appendix C. The position of the boreholes was recorded on site using a hand-held GPS unit and has been reported on the logs.

2.2 Laboratory Testing

Samples were collected for laboratory testing and were submitted for testing at the NATA registered Golder laboratory in Adelaide. The purpose of the testing was to assess the physical and dispersive properties of the soil.

The following scope of testing was completed:

- 3 x Particle Size Distribution
- 3 x Atterberg Limits
- 3 x Emerson Class

3 SITE CONDITIONS

3.1 Site Description

The project site is located at Seaford Heights, approximately 31 km south of the Adelaide CBD. The site is bound to the east by Ostrich Farm Road, to the south by Bakewell Road, to the west by undeveloped farmland and to the north-west by a residential sub-division.

The topography of the local area consists of a series of undulating hills. The proposed water storage basin is located at the top of a hill and the terrain gently slopes away from a high point at the centre of the site (near BH1). At the time of investigation, the land was being used for agricultural purposes and the surface vegetation consisted of a low stubble, with rows of trees surrounding the perimeter of the field. Photographs of the site are included in Appendix B.

3.2 Regional Geology

The regional geology map (1:50,000 Noarlunga Sheet) shows undifferentiated Quaternary deposits at the surface including Hindmarsh Clay, Ngalinga Clay and a lower sand unit equivalent to the Carisbrook Sand, Ochre Cove Formation and Seaford Formation. The Hindmarsh/Ngalinga Formations comprise brown, red and olive clays and sandy clays with sand and gravel lenses.

The geology map indicates the upper clay soils are underlain by Proterozoic bedrock including:

- SEACLIFF SANDSTONE: Pale grey and red sandstone, quartzite and red siltstone
- BRACHINA FORMATION: Red and green siltstone and fine-grained sandstone
- REYNELLA SILTSTONE MEMBER: Mostly massive siltstone with small rock fragments
- WILMINGTON FORMATION: Massive, green-grey, fine-grained sandstone

It is understood that bedrock consistent with the above units has been intercepted at shallow depth during construction of the subdivision.

3.3 Subsurface Conditions

The subsurface conditions encountered in the boreholes were broadly consistent with the expected regional geology. The sub-surface soils can be broadly categorized into the following units listed in Table 1. The depth of the various units is summarised in Table 2.

Table 1: Summary of Encountered Soil Units

UNIT	DESCRIPTION
Topsoil (A Horizon):	Silty CLAY, dark brown with roots and other organics, trace to some sand.
Upper Clays (B Horizon)	Silty and Sandy CLAY, medium plasticity, pale brown mottle, with some sand and gravel
Hindmarsh / Ngalinga Clays	CLAY, high plasticity, grey mottled orange-brown and red-brown
Residual Soils	CLAY and CLAYEY SAND and with extremely to highly weathered fragments of the parent rock
Siltstone	Siltstone, red brown, orange brown and pale grey, indistinct fabric. Highly weathered and low strength at the top of the stratum, becoming moderately to slightly weathered and medium strength with depth. Encountered BH2 only.
Sandstone	Sandstone, orange brown, very low strength, highly to extremely weathered. Encountered BH4 only.

Table 2: Summary of sub-surface lithology

UNIT	BH1	BH2	BH3	BH4
Top Soil	0.0 m to ≈0.2 m	0.0 m to ≈0.2 m	0.0 m to ≈0.2 m	0.0 m to ≈0.2 m
Upper Clay	≈0.2 m - ≈2.5 m	≈0.2 m - 1.3 m	≈0.2 m - ≈2.5 m	≈0.2 m - ≈3.6 m
Hindmarsh / Ngalinga Clay	≈2.5 m - 7.5 m	Not Encountered	≈2.5 m - 7.8 m	Not Encountered
Clayey Sand	7.5 m – 8.0 m (EOH)	Not Encountered	7.8 - 8.06 m (EOH)	Not Encountered
Residual Soil		1.3 m – 1.6 m		3.6 m - 4.9 m
Siltstone / Sandstone		1.6 m – 8.1 m (EOH)		4.9 m - 8.0 m (EOH)

No groundwater was encountered within the depth investigated.

3.4 Dispersion Testing

Emerson Class laboratory testing was completed on three samples of the clays soils. The Emerson test divides soils up into eight classes based on their coherence in water (dispersion and slaking) and the presence of carbonate or gypsum.

The results of the testing were as follows:

- BH01 - 1.7 m to 2.0 m – **CLASS 4**, The remoulded soil does not disperse in water. Calcium carbonate (calcite) is present.
- BH01 - 2.7 m to 3.0 m and BH01 - 4.7 m to 5.0 m – **CLASS 2**, Air-dried crumbs of soil show a moderate to slight reaction. A moderate reaction consists of an easily recognizable cloud of colloids in suspension, usually spreading in thin streaks on the bottom of the beaker. A slight reaction consists of the bare hint of cloud in water at the surface of the crumbs.

The testing indicates that the soils below 2 m depth may be dispersive.

3.5 Soil Classification Testing

The results of soil classification testing are summarized in Table 3. The testing indicates the following soil properties:

- Clay soils with fines content (clays and silts) greater than 76%;
- High to very high plasticity, increasing with depth;
- Soils are highly reactive with respect to change in moisture content (linear shrinkage > 15%)

Table 3 : Summary of laboratory testing

TEST INTERVAL	SOIL DESCRIPTION	MOISTURE CONTENT %	PARTICLE SIZE DISTRIBUTION			ATTERBERG LIMITS		
			% Gravel	% Sand	% Silt and Clay	Liquid Limit (%)	Plasticity Index (%)	Linear Shrinkage (%)
BH01 1.7 m to 2.0 m	Clay, CH	21.7	1	19	80	56	36	15
BH01 2.7 m to 3.0 m	Clay, CH	31.0	0	24	76	69	49	16
BH01 4.7 m to 5.0 m	Clay, CH	32.3	0	20	80	81	58	16

3.6 Infiltration Rate

One in-hole infiltration test was completed at a depth of 5.5 m in a separate hole drilled adjacent to BH1. To conduct the test a solid casing was placed flush with the base of the hole. The casing was slightly pushed into the clay so the water didn't leak out horizontally. The PVC casing was then filled with water to the top of the hole and the rate of infiltration was measured over a period of two hours.

For this test an infiltration rate of $2.2 \times 10^{-5} \text{ m/sec}$ was calculated.

The above value represents an upper bound of the likely in-situ permeability. The value is indicative only as it is unclear if the soils surrounding the test holes reached full saturation. The true saturated in-situ permeability may be several magnitudes of order lower. The typical range of permeability for relatively homogeneous clays below the zone of weathering / effects of vegetation is $1 \times 10^{-12} \text{ m/sec}$ to 10^{-8} m/sec (Carter and Bentley (1991)). Further testing is recommended.

It is noted that the bedrock encountered at BH2 includes numerous defects and seams spaced at 20 to 60 mm. As a result, the rock is likely to be relatively permeable.

3.7 Excavations and Earthworks

The natural clay soils encountered in the boreholes are expected to be generally excavatable using conventional machinery such as excavators and dozers. Slower production rates would be expected in the residual soils and the very low strength weathered rocks. Use of specialist rock breaking equipment will likely be required for excavation of the medium strength siltstone encountered in BH2 below 3 m depth.

Temporary batter slopes or benches in the clay soils shall be cut at no steeper than 1H to 1V. For permanent works a 3H to 1V batter is considered suitable, provided the clays are protected from erosion caused by concentrated flows.

The natural clay soils at this site have high plasticity, with plasticity increasing with depth. Such soils are reactive in response to seasonal moisture changes (high shrink-swell potential) which may cause large surface movements and development of shrinkage cracks following desiccation. Pipe connections and shallow foundations will need to be designed with appropriate articulation to allow for surface movements.

4 Statement of Limitations

4.1 Geotechnical Reports

The following notes have been provided to outline the methodology and limitations inherent in geotechnical reporting. The issues discussed are not relevant to all reports and further advice should be sought if there are any queries regarding any advice or report.

Geotechnical reports are prepared by qualified personnel on the information supplied or obtained and are based on current engineering standards of interpretation and analysis.

Information may be gained from limited subsurface testing, surface observations, previous work, and is supplemented by knowledge of the local geology and experience of the range of properties that may be exhibited by the materials present. For this reason geotechnical reports should be regarded as interpretative rather than factual documents, limited to some extent by the scope of information on which they rely.

Where the report has been prepared for a specific purpose (e.g. design of a three storey building), the information and interpretation may not be appropriate if the design is changed (e.g. a twenty-storey building). In such cases, the report and the sufficiency of the existing work should be reviewed by SMEC in the light of the new proposal.

Every care is taken with the report content, however, it is not always possible to anticipate or assume responsibility for the following conditions:

- Unexpected variations in ground conditions. The potential for this depends on the amount of investigative work undertaken.
- Changes in policy or interpretation by statutory authorities
- The actions of contractors responding to commercial pressures

If these occur, SMEC would be pleased to resolve the matter through further investigation, analysis or advice.

4.2 Unforeseen Conditions

Should conditions encountered on site differ markedly from those anticipated from the information contained in the report, SMEC should be notified immediately. Early identification of site anomalies generally results in any problems being more readily resolved and allows re-interpretation and assessment of the implications for future work.

4.3 Subsurface Information

Logs of a borehole, recovered core, test pit, excavated face, or cone penetration test are an engineering and/or geological interpretation of the subsurface conditions. The reliability of the logged information depends on the drilling/testing method, sampling/observation spacing's and the ground conditions. It is not always possible or economic to obtain continuous high-quality data. It should also be recognised that the volume of material observed or tested is only a fraction of the total subsurface profile.

Interpretation of subsurface information and application to design and construction must take into consideration the spacing of the test locations, the frequency of observations and testing, and the possibility that geological boundaries may vary between observation points.

Groundwater observations and measurements outside of specially designed and constructed piezometers should be treated with care for the following reasons:

- In low permeability soils groundwater may not seep into an excavation or bore in the short time it is left open.
- A localized perched water table may not represent the true water table.
- Groundwater levels vary according to rainfall events or season.
- Some drilling and testing procedures mask or prevent groundwater inflow.
- The installation of piezometers and long-term monitoring of groundwater levels may be required to adequately identify groundwater conditions.

Appendix A Site Plan

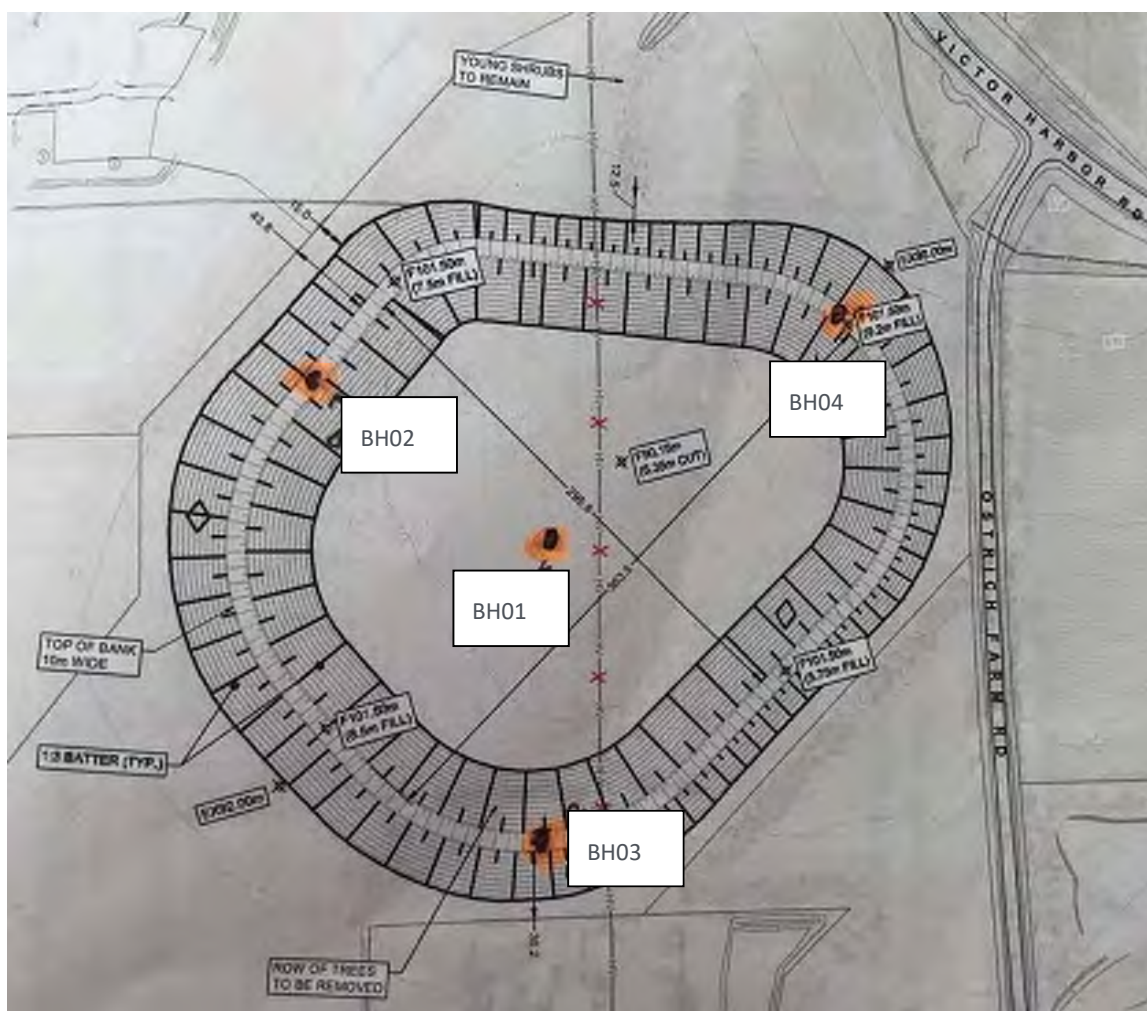


Figure 2: Borehole Location Plan

Appendix B Site Photographs



Photograph 1: Site looking downhill towards Victor Harbor Road



Photograph 2: Looking east towards Ostrich Farm Road



Photograph 3: Looking south towards BH 1 (location of truck in background)



Photograph 4: BH4 looking North



Photograph 5: BH4 looking North-East



Photograph 6: BH4 looking East



Photograph 7: BH4 looking South



Photograph 8: BH4 looking uphill towards BH1



Photograph 9: BH4 looking West



Photograph 10: BH3 looking North



Photograph 11: BH3 looking West



Photograph 12: BH3 looking South



Photograph 13: BH3 looking East



Photograph 14: South Western Corner of Site, Looking West



Photograph 15: South Western Corner of Site, Looking South



Photograph 16: South Western Corner of Site, Looking North



Photograph 17: BH2 Looking East



Photograph 18: BH2 Looking North



Photograph 19: BH2 Looking West



Photograph 20: BH2 Looking South

Date & Time: Tue May 22 16:39:47 ACST 2018
Position: 34 S 270220 3702222
Altitude: 50m
Battery: 70%
Azimuth Bearing: 65° NNE 000m/s (True)
Elevation Angle: -0.1°
Horizon Angle: -0.05°
Zoom: 1X
BH2 north adjacent subdivision



Photograph 21: BH2 Looking North Adjacent Subdivision.

Appendix C Borehole Logs

CORED DRILL HOLE - ENGINEERING LOG

HOLE NO : BH1
PROJECT NUMBER : 3005628
SHEET : 1 OF 2
FINAL DEPTH : 8 m

CLIENT : Hydroplan
LOCATION : Centre of site





















PROJECT : Willunga Basin SRWRA Storage

POSITION : E: 272459.0, N: 6102245.0 (MGA94 Zone 54) SURFACE ELEVATION : INCLINATION° / ORIENTATION° : 90° / N/A

RIG TYPE : MKV2 MOUNTING : Truck CONTRACTOR : Drilling Solutions HOLE DIA :

DATE STARTED : 22/05/2018 DATE COMPLETED : 22/05/2018 DATE LOGGED : 22/05/2018 LOGGED BY : SK CHECKED BY : SP

CASING DIAMETER : BARREL (Length) : BIT : BIT CONDITION :

DRILLING							MATERIAL							FRACTURES												
PROGRESS		TCR% DRILL DEPTH	ROD% DRILL DEPTH	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	ELEVATION	DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION ROCK NAME : grain size, colour, texture and fabric, features, inclusion and minor components	Weathering / Alteration	ESTIMATED STRENGTH 1st(50)										DEFECT SPACING (mm)				VISUAL	ADDITIONAL DATA (joints, partings, seams, zones, etc) Description, orientation, infilling or coating, shape, roughness, thickness, other
DRILLING & CASING	DRILLING FLUID										VL	L	M	H	VH	EH	20	60	200	600	2000					
HQ3							0.0		START CORING AT 0.00m		EL -0.03															
							0.10m		Silty CLAY (Cl): medium plasticity, dark brown, with fine to medium grained sand, (topsoil) CORE LOSS 1.50m (0.10-1.60)		L -0.1															
							0.5				M -0.3															
							1.0				H -1															
							1.5				VH -3															
							1.60m		Silty CLAY (CH): high plasticity, mottled pale brown and off-white, trace fine grained sand		EH -10															
							2.00m																			
							2.0		CORE LOSS 0.70m (2.00-2.70)																	
							2.5																			
							2.70m		Silty CLAY (CH): high plasticity, grey brown, trace fine grained sand																	
					3.00m																					
					3.0		CORE LOSS 0.40m (3.00-3.40)																			
					3.40m		Silty CLAY (CH): high plasticity, mottled grey brown and orange brown; moist greater than plastic limit, very stiff - hard																			
					4.0																					
					4.00m		CORE LOSS 0.20m (4.00-4.20)																			
					4.20m		Silty CLAY (CH): high plasticity, grey brown mottled orange brown and red brown; moist greater than plastic limit, very stiff to hard																			
					4.5																					
					4.70m																					
					5.00m																					
					5.0																					

DRILLING CC Concrete core WB Wash bore DB Wash bore with drag bit NQ Wireline core barrel 42mm NQ3 Wireline core barrel 45mm HQ Wireline core barrel 64mm HQ3 Wireline core barrel 62mm PQ Wireline core barrel 85mm NMLC Diamond core 52mm diameter HMLC Diamond core 62mm diameter VC Vibro-core drilling PT Continuous push tube	WATER dd/mm/yy Water Level on Date shown Drilling water level water inflow water outflow WEATHERING FR Fresh SW Slightly Weathered MW Moderately Weathered HW Highly Weathered DW Distinctly Weathered XW Extremely Weathered RS Residual Soil	STRENGTH EH Extremely High VH Very High H High M Medium L Low VL Very Low ROUGHNESS Po Polished SI Slickensided Sm Smooth Ro Rough VR Very Rough	DEFECT TYPE Bg Bedding C Cleavage Pt Parting CZ Crushed Zone SZ Shear Zone IS Infilled Seam Jt Joint Se Seam SS Shear Seam Ve Vein VO Void Cn Contact Bd Boundary DB Drilling Break HB Handling Break	COATING CN Clean CT Coating (>= 1.0mm) FLD Filled SN Stained VNR Veneer (< 1.0mm) PLANARITY Cu Curved DIS Discontinuous Ir Irregular Pl Planar St Stepped Un Undulose Vu Vuggy Wv Wavy	INFILL Ca Calcite Cl Clay Fe Iron Oxide Fe Cl Iron Oxide Clay Ch Chlorite Um Unidentified Mineral Qz Quartz X Carbonaceous Py Pyrite Mn Manganese Cr Crushed Rock Co Coal Gp Gypsum Fp Feldspar
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See Explanatory Notes for details of abbreviations & basis of descriptions.

SMEC AUSTRALIA



CORED DRILL HOLE - ENGINEERING LOG

HOLE NO : BH1
PROJECT NUMBER : 3005628
SHEET : 2 OF 2
FINAL DEPTH : 8 m

CLIENT : Hydroplan
LOCATION : Centre of site



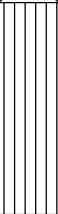


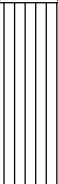



PROJECT : Willunga Basin SRWRA Storage

POSITION : E: 272459.0, N: 6102245.0 (MGA94 Zone 54) SURFACE ELEVATION : INCLINATION° / ORIENTATION° : 90° / N/A

RIG TYPE : MKV2 MOUNTING : Truck CONTRACTOR : Drilling Solutions HOLE DIA :

DATE STARTED : 22/05/2018 DATE COMPLETED : 22/05/2018 DATE LOGGED : 22/05/2018 LOGGED BY : SK CHECKED BY : SP

CASING DIAMETER : BARREL (Length) : BIT : BIT CONDITION :

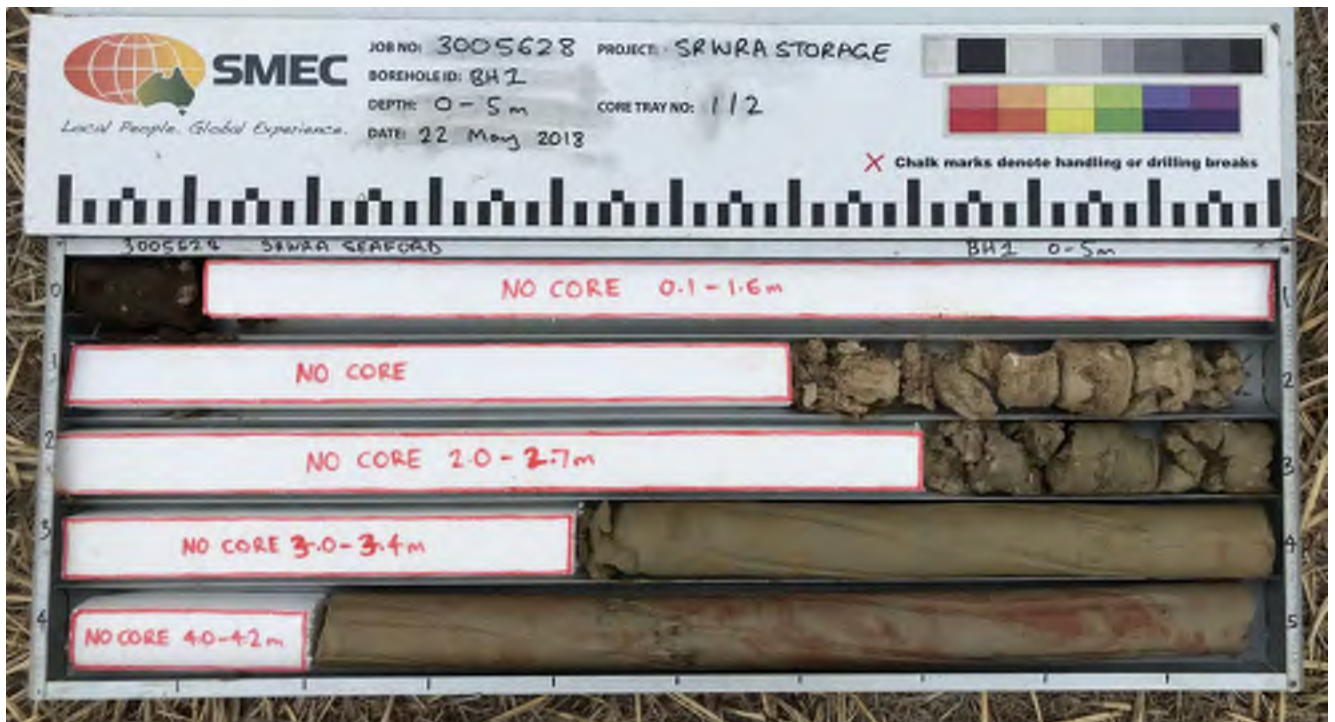
DRILLING						MATERIAL						FRACTURES										
PROGRESS		TCR% DRILL DEPTH	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	ELEVATION	DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION ROCK NAME : grain size, colour, texture and fabric, features, inclusion and minor components	Weathering / Alteration	ESTIMATED STRENGTH Is(50)						DEFECT SPACING (mm)				VISUAL	ADDITIONAL DATA (joints, partings, seams, zones, etc) Description, orientation, infilling or coating, shape, roughness, thickness, other	
DRILLING & CASING	DRILLING FLUID									EL	VL	L	M	H	VH	EH	20	60	200			600
H03 ↓						5.0		CORE LOSS 0.20m (5.00-5.20)		EL -0.03	VL -0.1	L -0.3	M -1	H -3	VH -10	EH						
						5.20m		Silty CLAY (CH): high plasticity, grey brown mottled red brown; moist greater than plastic limit, very stiff to hard														— 5.50: PP In-situ =370 - 420 kPa
						6.00m		CORE LOSS 0.50m (6.00-6.50)														
						6.50m		Silty CLAY (CH): high plasticity, grey brown mottled red brown; moist greater than plastic limit, very stiff to hard														
						7.20m		Sandy CLAY (CI-CH): medium to high plasticity, red brown and grey brown, fine to coarse grained sand; moist greater than plastic limit, very stiff to hard														
						7.50m		Clayey SAND (SC): fine to medium grained, red brown and grey brown; moist														
			8.00			8.0		Hole Terminated at 8.00 m Target Depth														

DRILLING CC Concrete core WB Wash bore DB Wash bore with drag bit NQ Wireline core barrel 42mm NQ3 Wireline core barrel 45mm HQ Wireline core barrel 64mm HQ3 Wireline core barrel 62mm PQ Wireline core barrel 85mm NMLC Diamond core 52mm diameter HMLC Diamond core 62mm diameter VC Vibro-core drilling PT Continuous push tube	WATER dd/mm/yy Water Level on Date shown Drilling water level water inflow water outflow WEATHERING FR Fresh SW Slightly Weathered MW Moderately Weathered HW Highly Weathered DW Distinctly Weathered XW Extremely Weathered RS Residual Soil	STRENGTH EH Extremely High VH Very High H High M Medium L Low VL Very Low ROUGHNESS Po Polished SI Slickensided Sm Smooth Ro Rough VR Very Rough	DEFECT TYPE Bg Bedding C Cleavage Pt Parting CZ Crushed Zone SZ Shear Zone IS Infilled Seam Jt Joint Se Seam SS Shear Seam Ve Vein VO Void Cn Contact Bd Boundary DB Drilling Break HB Handling Break	COATING CN Clean CT Coating (>= 1.0mm) FLD Filled SN Stained VNR Veneer (< 1.0mm) PLANARITY Cu Curved DIS Discontinuous Ir Irregular PI Planar St Stepped Un Undulose Vu Vuggy Wv Wavy	INFILL Ca Calcite Cl Clay Fe Iron Oxide Fe Cl Iron Oxide Clay Ch Chlorite Um Unidentified Mineral Qz Quartz X Carbonaceous Py Pyrite Mn Manganese Cr Crushed Rock Co Coal Gp Gypsum Fp Feldspar
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See Explanatory Notes for details of abbreviations & basis of descriptions.

SMEC AUSTRALIA





PointID : BH1 Depth Range: 0.00 - 5.00 m



PointID : BH1 Depth Range: 5.00 - 8.00 m



TITLE

Hydroplan
SMEC
Ostrich Farm Rd Seaford
Willunga Basin SRWRA Storage
Core Photo - BH1

DRAWN

DATE

27/05/2018

CHECKED

DATE

27/05/2018

SCALE

Not To Scale

A4

PROJECT No

3005628

FIGURE No

1/1

CORED DRILL HOLE - ENGINEERING LOG

HOLE NO : BH2
PROJECT NUMBER : 3005628
SHEET : 1 OF 2
FINAL DEPTH : 8.1 m

CLIENT : Hydroplan
LOCATION : Adjacent Sub-division

PROJECT : Willunga Basin SRWRA Storage

POSITION : E: 272312.0, N: 6102316.0 (MGA94 Zone 54) SURFACE ELEVATION : INCLINATION° / ORIENTATION° : 90° / N/A

RIG TYPE : MKV2 MOUNTING : Truck CONTRACTOR : Drilling Solutions HOLE DIA :

DATE STARTED : 22/05/2018 DATE COMPLETED : 22/05/2018 DATE LOGGED : 22/05/2018 LOGGED BY : SK CHECKED BY : SP

CASING DIAMETER : BARREL (Length) : BIT : BIT CONDITION :

DRILLING						MATERIAL						FRACTURES											
PROGRESS		TCR% DRILL DEPTH	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	ELEVATION	DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION ROCK NAME : grain size, colour, texture and fabric, features, inclusion and minor components START CORING AT 0.00m	Weathering / Alteration	ESTIMATED STRENGTH Is(50)								DEFECT SPACING (mm)				VISUAL	ADDITIONAL DATA (joints, partings, seams, zones, etc) Description, orientation, infilling or coating, shape, roughness, thickness, other
DRILLING & CASING	DRILLING FLUID									VI	LI	MI	HI	VH	EH	20	60	200	600	2000			
						0.0		0.10m Silty CLAY (CL): low plasticity, dark brown, with fine to medium grained sand, with roots CORE LOSS 0.90m (0.10-1.00)		EL -0.03 L -0.1 M -1 H -3 VH 10 EH													
						0.5																	
						1.0		1.00m Silty CLAY (CL): low plasticity, pale orange brown, brown and pale brown, trace roots															
						1.30m		CLAY (CL-CI): low to medium plasticity, pale brown and white, (EW SILTSTONE)															
						1.5		1.60m SILTSTONE: fine grained, pale brown with orange brown and brown staining From 1.8 m: pale grey with orange brown staining	HW										1.65: Note coring commenced from surface, start of rock core section of borehole log				
						2.0		2.00m CORE LOSS 0.05m (2.00-2.05) SILTSTONE: fine grained, indistinct fabric, red brown, orange brown and pale grey	HW										1.60 Fractured Zone, 150 mm 1.80 Jt, 70 - 90°, CI VNR, Ir				
						2.5													2.20 Fractured Zone, 35 mm 2.26 CS, clayey gravel, 50 mm 2.33 Fractured Zone, 130 mm				
						2.80m													2.51 CS, clayey gravel, 30 mm 2.63 Fractured Zone, 70 mm				
						3.0		CORE LOSS 0.20m (2.80-3.00)															
						3.00m		SILTSTONE: fine grained, indistinct fabric, red brown, orange brown and pale grey	HW										3.09 Jt, 50°, Fe SN, PI, Ro 3.16 CS, 10°, gravelly clay, 20 mm 3.22 Jt, 60°, Fe SN, PI, Ro 3.28 Jt, 40°, Fe SN, PI, Ro, x2				
						3.5			HW - MW										3.46 Jt, 50°, Fe SN, Un, Ro 3.50 CS, 20°, 10 mm 3.54 Jt, 40 - 70°, Fe SN, Un, Ro 3.64 CS, 30°, 40 mm 3.68 Fractured Zone, 80 mm				
						4.0		From 4.0 m: orange brown and pale grey											3.80 Jt, 70 - 90°, CI FLD, Ir, 5 mm thick 4.03 CS, 40°, gravelly clay, 60 mm 4.05 Jt, 50°, CI FLD, PI, 5-10 mm thick 4.16 Jt, 60°, CI FLD, PI, 2 mm thick, x2 at 10 mm spacing 4.40 Jt, 20°, CI FLD, PI, 5 mm thick 4.52 Jt, 20°, CI FLD, PI, 5 mm thick 4.63 Jt, 60°, Fe SN, PI, CI CT, x2 cross-jointed 4.70 CS, 40°, gravelly clay, 50 mm 4.80 Jt, 20°, Fe SN, PI				
						4.5																	
						5.0																	

DRILLING		WATER		STRENGTH		DEFECT TYPE		COATING		INFILL	
CC	Concrete core	dd/mm/yy Water		EH	Extremely High	Bg	Bedding	CN	Clean	Ca	Calcite
WB	Wash bore	Level on Date shown		VH	Very High	C	Cleavage	CT	Coating (>= 1.0mm)	Cl	Clay
DB	Wash bore with drag bit	Drilling water level		H	High	Pt	Parting	FLD	Filled	Fe	Iron Oxide
NQ	Wireline core barrel 42mm	water inflow		M	Medium	CZ	Crushed Zone	SN	Stained	Fe Cl	Iron Oxide Clay
NQ3	Wireline core barrel 45mm	water outflow		L	Low	SZ	Shear Zone	VNR	Veneer (< 1.0mm)	Ch	Chlorite
HQ	Wireline core barrel 64mm			VL	Very Low	IS	Infilled Seam			Un	Unidentified Mineral
HQ3	Wireline core barrel 62mm					Jt	Joint			Qz	Quartz
PQ	Wireline core barrel 85mm					Se	Seam			X	Carbonaceous
NMLC	Diamond core 52mm diameter					SS	Shear Seam			Py	Pyrite
HMLC	Diamond core 62mm diameter					Ve	Vein			Mn	Manganese
VC	Vibro-core drilling					VO	Void			Cr	Crushed Rock
PT	Continuous push tube					Cn	Contact			Co	Coal
						Bd	Boundary			Gp	Gypsum
						DB	Drilling Break			Fp	Feldspar
						HB	Handling Break				

See Explanatory Notes for details of abbreviations & basis of descriptions.

SMEC AUSTRALIA



CORED DRILL HOLE - ENGINEERING LOG

HOLE NO : BH2
PROJECT NUMBER : 3005628
SHEET : 2 OF 2
FINAL DEPTH : 8.1 m

CLIENT : Hydroplan
LOCATION : Adjacent Sub-division

PROJECT : Willunga Basin SRWRA Storage

POSITION : E: 272312.0, N: 6102316.0 (MGA94 Zone 54) SURFACE ELEVATION : INCLINATION° / ORIENTATION° : 90° / N/A

RIG TYPE : MKV2 MOUNTING : Truck CONTRACTOR : Drilling Solutions HOLE DIA :

DATE STARTED : 22/05/2018 DATE COMPLETED : 22/05/2018 DATE LOGGED : 22/05/2018 LOGGED BY : SK CHECKED BY : SP

CASING DIAMETER : BARREL (Length) : BIT : BIT CONDITION :

DRILLING					MATERIAL					FRACTURES				
PROGRESS	DRILLING & CASING	DRILLING FLUID	TCR% DRILL ROD% DRILL DEPTH	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	ELEVATION	DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION ROCK NAME : grain size, colour, texture and fabric, features, inclusion and minor components	Weathering / Alteration EL -0.03 VL -0.1 L -0.3 M -1 H -3 VH -10 EH	ESTIMATED STRENGTH Is(50) ● - Axial ○ - Diametral	DEFECT SPACING (mm)	VISUAL	ADDITIONAL DATA (joints, partings, seams, zones, etc) Description, orientation, infilling or coating, shape, roughness, thickness, other
	HQ3						5.0		SILTSTONE: fine grained, indistinct fabric, red brown, orange brown and pale grey (<i>continued</i>) From 5.25 m: red brown and orange brown	HW MW				4.92 Jt, 50°, CI FLD, PI, 6 mm thick 5.03 Jt, 70°, CI VNR, PI 5.10 Jt, 20°, CI VNR, PI 5.26 Jt, 70°, CI FLD, PI, 2-5 mm thick 5.64 Jt, 10°, Fe SN, PI 5.66 Jt, 10°, CI CT, PI 5.73 Jt, 40°, CI FLD, PI, 2 mm thick 5.85 Jt, 30°, Fe SN, PI 5.87 Jt, 60 - 80°, CI CT, Un, Um SN
							5.5							6.50 CS, 10°, gravelly clay, 20 mm 6.54 Jt, 30°, Um SN, PI 6.65 Jt, 70°, CI FLD, Un
							6.0		From 6.0 m: orange brown					6.92 Jt, 20°, Um SN, PI 7.00 Jt, 40°, CI FLD, PI 7.02 Jt, 70 - 80°, CI FLD 7.23 Jt, 40°, CI FLD, PI, x2 7.33 Jt, 50°, CI FLD, PI 7.35 Jt, 80 - 90°, Um SN, Un
							6.5			MW SW				7.61 Jt, 30°, CI VNR, PI 7.70 Jt, 40°, Um SN, St 7.79 Jt, 20°, CI VNR, PI
							7.0							7.95 Jt, 20°, Um SN, PI 7.97 Jt, 50°, CI FLD, PI, Um SN
							7.5							
							8.0		Hole Terminated at 8.10 m Target Depth					
							8.10							
							8.5							
							9.0							
							9.5							
							10.0							

DRILLING		WATER		STRENGTH		DEFECT TYPE		COATING		INFILL	
CC	Concrete core	dd/mm/yy	Water Level on Date shown	EH	Extremely High	Bg	Bedding	CN	Clean	Ca	Calcite
WB	Wash bore	≡	Drilling water level	VH	Very High	C	Cleavage	CT	Coating (>= 1.0mm)	Cl	Clay
DB	Wash bore with drag bit	≡	water inflow	H	High	Pt	Parting	FLD	Filled	Fe	Iron Oxide
NQ	Wireline core barrel 42mm	≡	water outflow	M	Medium	CZ	Crushed Zone	SN	Stained	Fe Cl	Iron Oxide Clay
NQ3	Wireline core barrel 45mm			L	Low	SZ	Shear Zone	VNR	Veneer (< 1.0mm)	Ch	Chlorite
HQ	Wireline core barrel 64mm			VL	Very Low	IS	Infilled Seam			Um	Unidentified Mineral
HQ3	Wireline core barrel 62mm					Jt	Joint			Qz	Quartz
PQ	Wireline core barrel 85mm					Se	Seam			X	Carbonaceous
NMLC	Diamond core 52mm diameter	FR	Fresh			SS	Shear Seam			Py	Pyrite
HMLC	Diamond core 62mm diameter	SW	Slightly Weathered			Ve	Vein			Mn	Manganese
VC	Vibro-core drilling	HW	Highly Weathered			VO	Void			Cr	Crushed Rock
PT	Continuous push tube	DW	Distinctly Weathered			Cn	Contact			Co	Coal
		XW	Extremely Weathered			Bd	Boundary			Gp	Gypsum
		RS	Residual Soil			DB	Drilling Break			Fp	Feldspar
						HB	Handling Break				

See Explanatory Notes for details of abbreviations & basis of descriptions.

SMEC AUSTRALIA





PointID : BH2 Depth Range: 0.00 - 5.00 m



PointID : BH2 Depth Range: 5.00 - 8.10 m



TITLE Hydroplan SMEC Ostrich Farm Rd Seaford Willunga Basin SRWRA Storage Core Photo - BH2	DRAWN	DATE 27/05/2018
	CHECKED	DATE 27/05/2018
	SCALE Not To Scale	A4
	PROJECT No 3005628	FIGURE No 1/1

CORED DRILL HOLE - ENGINEERING LOG

HOLE NO : BH3
PROJECT NUMBER : 3005628
SHEET : 1 OF 2
FINAL DEPTH : 8.06 m

CLIENT : Hydroplan
LOCATION : Southern Boundary Adjacent Farm House
PROJECT : Willunga Basin SRWRA Storage

POSITION : E: 272462.0, N: 6102076.0 (MGA94 Zone 54) SURFACE ELEVATION : INCLINATION° / ORIENTATION° : 90° / N/A
RIG TYPE : MKV2 MOUNTING : Truck CONTRACTOR : Drilling Solutions HOLE DIA :
DATE STARTED : 22/05/2018 DATE COMPLETED : 22/05/2018 DATE LOGGED : 22/05/2018 LOGGED BY : SK CHECKED BY : SP
CASING DIAMETER : BARREL (Length) : BIT : BIT CONDITION :

DRILLING							MATERIAL					FRACTURES			
PROGRESS		TCR% DRILL DEPTH	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	ELEVATION	DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION ROCK NAME : grain size, colour, texture and fabric, features, inclusion and minor components START CORING AT 0.00m CORE LOSS 1.20m (0.00-1.20)	Weathering / Alteration	ESTIMATED STRENGTH Is(50) ● Axial ○ Diametral VL -0.03 L -0.1 J -0.3 M -1 H -3 VH -60 EH	DEFECT SPACING (mm) 20 60 200 600 2000	VISUAL	ADDITIONAL DATA (joints, partings, seams, zones, etc) Description, orientation, infilling or coating, shape, roughness, thickness, other		
DRILLING & CASING FLUID	DRILLING FLUID														
<div><div>HQ3</div><div></div></div>															
							0.0						0.00: Topsoil: Silty CLAY: medium plasticity, dark brown, with fine to medium grained sand		
							0.5								
							1.0								
							1.20m								
							1.5	<div></div>	Sandy Silty CLAY (CI) : medium plasticity, pale grey brown, fine to coarse grained sand, trace fine to medium gravel gravel; moist greater than plastic limit						
							1.70m								
							2.0	<div></div>	Gravelly Sandy CLAY (CI) : medium plasticity, mottled pale brown and off-white, fine to coarse grained sand, fine to medium grained gravel; moist greater than plastic limit						
							2.00m								
							2.5		CORE LOSS 1.50m (2.00-3.50)						
							3.0								
							3.5								
							3.50m		Sandy CLAY (CH) : high plasticity, mottled red brown and pale grey, fine to medium grained sand; very stiff						
							4.0	<div></div>							
							4.5								
							5.0								
							5.00m								

DRILLING	WATER	STRENGTH	DEFECT TYPE	COATING	INFILL
CC Concrete core WB Wash bore DB Wash bore with drag bit NQ Wireline core barrel 42mm NQ3 Wireline core barrel 45mm HQ Wireline core barrel 64mm HQ3 Wireline core barrel 62mm PQ Wireline core barrel 85mm NMLC Diamond core 52mm diameter HMLC Diamond core 62mm diameter VC Vibro-core drilling PT Continuous push tube	dd/mm/yy Water Level on Date shown Drilling water level water inflow water outflow WEATHERING FR Fresh SW Slightly Weathered MW Moderately Weathered HW Highly Weathered DW Distinctly Weathered XW Extremely Weathered RS Residual Soil	EH Extremely High VH Very High H High M Medium L Low VL Very Low ROUGHNESS Po Polished SI Slickensided Sm Smooth Ro Rough VR Very Rough	Bg Bedding C Cleavage Pt Parting CZ Crushed Zone SZ Shear Zone IS Infilled Seam Jt Joint Se Seam SS Shear Seam Ve Vein VO Void Cn Contact Bd Boundary DB Drilling Break HB Handling Break	CN Clean CT Coating (>= 1.0mm) FLD Filled SN Stained VNR Veneer (< 1.0mm) PLANARITY Cu Curved DIS Discontinuous Ir Irregular PI Planar St Stepped Un Undulose Vu Vuggy Wv Wavy	Ca Calcite Cl Clay Fe Iron Oxide Fe Cl Iron Oxide Clay Ch Chlorite Um Unidentified Mineral Qz Quartz X Carbonaceous Py Pyrite Mn Manganese Cr Crushed Rock Co Coal Gp Gypsum Fp Feldspar

See Explanatory Notes for details of abbreviations & basis of descriptions.

SMEC AUSTRALIA



CORED DRILL HOLE - ENGINEERING LOG

HOLE NO : BH3
PROJECT NUMBER : 3005628
SHEET : 2 OF 2
FINAL DEPTH : 8.06 m

CLIENT : Hydroplan
PROJECT : Willunga Basin SRWRA Storage
LOCATION : Southern Boundary Adjacent Farm House

POSITION : E: 272462.0, N: 6102076.0 (MGA94 Zone 54) **SURFACE ELEVATION :** **INCLINATION° / ORIENTATION° :** 90° / N/A

RIG TYPE : MKV2 **MOUNTING :** Truck **CONTRACTOR :** Drilling Solutions **HOLE DIA :**

DATE STARTED : 22/05/2018 **DATE COMPLETED :** 22/05/2018 **DATE LOGGED :** 22/05/2018 **LOGGED BY :** SK **CHECKED BY :** SP

CASING DIAMETER : **BARREL (Length) :** **BIT :** **BIT CONDITION :**

DRILLING					MATERIAL					FRACTURES				
PROGRESS	DRILLING & CASING	DRILLING FLUID	TOR% DRILL DEPTH	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	ELEVATION	DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION ROCK NAME : grain size, colour, texture and fabric, features, inclusion and minor components	Weathering / Alteration	ESTIMATED STRENGTH Is(50)	DEFECT SPACING (mm)	VISUAL	ADDITIONAL DATA (joints, partings, seams, zones, etc) Description, orientation, infilling or coating, shape, roughness, thickness, other
							5.0		5.10m CORE LOSS 0.10m (5.00-5.10)					
							5.5		Sandy CLAY (CH): as above, increased sand content; very stiff					
							6.0		6.00m CORE LOSS 0.09m (6.00-6.09)					
							6.5		Sandy CLAY (CH): high plasticity, mottled orange brown, red brown and grey brown, fine to medium grained sand, trace fine grained gravel; hard					
							7.0							
							7.5							
							7.80m							
							8.0		Clayey SAND (SC): fine to coarse grained, pale brown and red brown, medium to high plasticity clay; moist, hard					
							8.06m		Hole Terminated at 8.06 m Target Depth					
							8.5							
							9.0							
							9.5							
							10.0							

DRILLING CC Concrete core WB Wash bore DB Wash bore with drag bit NQ Wireline core barrel 42mm NQ3 Wireline core barrel 45mm HQ Wireline core barrel 64mm HQ3 Wireline core barrel 62mm PQ Wireline core barrel 85mm NMLC Diamond core 52mm diameter HMLC Diamond core 62mm diameter VC Vibro-core drilling PT Continuous push tube	WATER dd/mm/yy Water Level on Date shown Drilling water level water inflow water outflow WEATHERING FR Fresh SW Slightly Weathered MW Moderately Weathered HW Highly Weathered DW Distinctly Weathered XW Extremely Weathered RS Residual Soil	STRENGTH EH Extremely High VH Very High H High M Medium L Low VL Very Low ROUGHNESS Po Polished SI Slickensided Sm Smooth Ro Rough VR Very Rough	DEFECT TYPE Bg Bedding C Cleavage Pt Parting CZ Crushed Zone SZ Shear Zone IS Infilled Seam Jt Joint Se Seam SS Shear Seam Ve Vein VO Void Cn Contact Bd Boundary DB Drilling Break HB Handling Break	COATING CN Clean CT Coating (>= 1.0mm) FLD Filled SN Stained VNR Veneer (< 1.0mm) PLANARITY Cu Curved DIS Discontinuous Ir Irregular Pl Planar St Stepped Un Undulose Vu Vuggy Wv Wavy	INFILL Ca Calcite Cl Clay Fe Iron Oxide Fe Cl Iron Oxide Clay Ch Chlorite Um Unidentified Mineral Qz Quartz X Carbonaceous Py Pyrite Mn Manganese Cr Crushed Rock Co Coal Gp Gypsum Fp Feldspar
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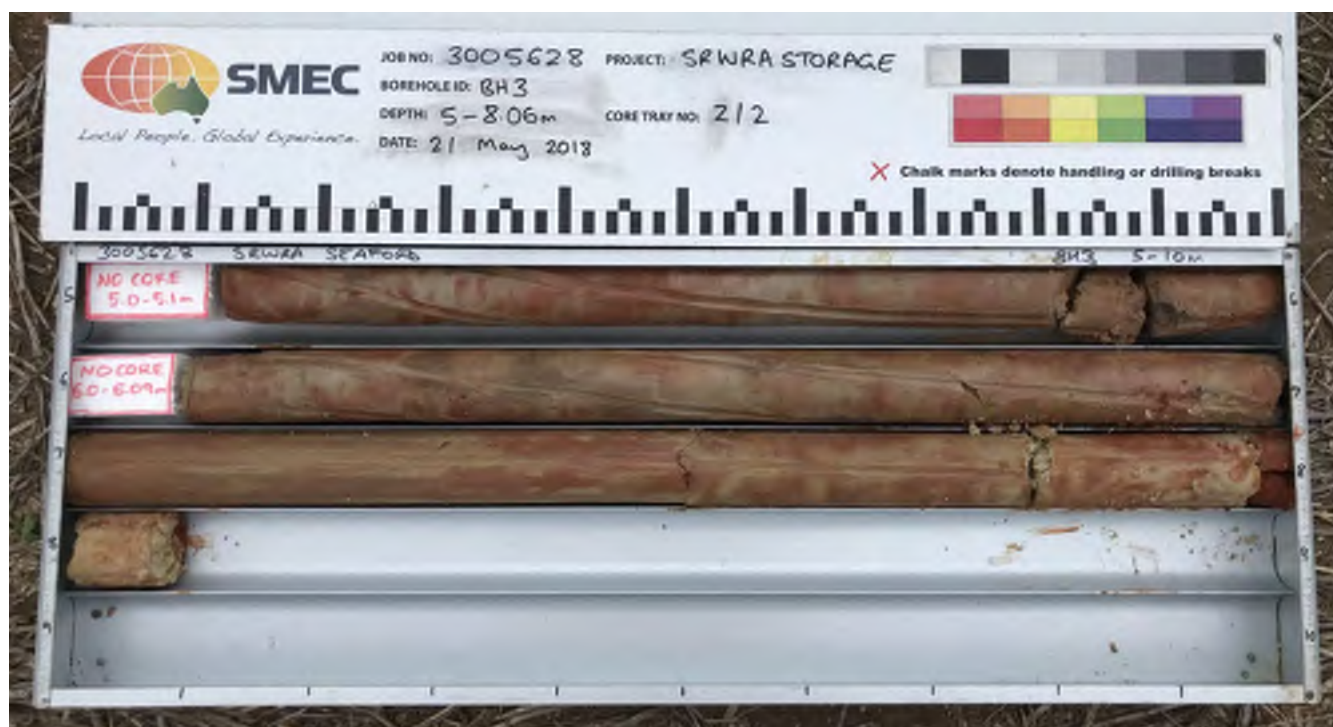
See Explanatory Notes for details of abbreviations & basis of descriptions.

SMEC AUSTRALIA





PointID : BH3 Depth Range: 0.00 - 5.00 m



PointID : BH3 Depth Range: 5.00 - 8.06 m



TITLE

Hydroplan
SMEC
Ostrich Farm Rd Seaford
Willunga Basin SRWRA Storage
Core Photo - BH3

DRAWN

DATE

27/05/2018

CHECKED

DATE

27/05/2018

SCALE

Not To Scale

A4

PROJECT No

3005628

FIGURE No

1/1

CORED DRILL HOLE - ENGINEERING LOG

HOLE NO : BH4
PROJECT NUMBER : 3005628
SHEET : 1 OF 2
FINAL DEPTH : 8 m

CLIENT : Hydroplan
PROJECT : Willunga Basin SRWRA Storage
LOCATION : Intersection Victor Harbour Rd/Ostrich Farm Rd

POSITION : E: 272634.0, N: 6102385.0 (MGA94 Zone 54) SURFACE ELEVATION : INCLINATION° / ORIENTATION° : 90° / N/A

RIG TYPE : MKV2 MOUNTING : Truck CONTRACTOR : Drilling Solutions HOLE DIA :

DATE STARTED : 22/05/2018 DATE COMPLETED : 22/05/2018 DATE LOGGED : 22/05/2018 LOGGED BY : SK CHECKED BY : SP

CASING DIAMETER : BARREL (Length) : BIT : BIT CONDITION :

DRILLING					MATERIAL					FRACTURES				
PROGRESS	DRILLING & CASING	DRILLING FLUID	TCR% DRILL DEPTH	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	ELEVATION	DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION ROCK NAME : grain size, colour, texture and fabric, features, inclusion and minor components START CORING AT 0.00m CORE LOSS 1.60m (0.00-1.60)	Weathering / Alteration	ESTIMATED STRENGTH Is(50)	DEFECT SPACING (mm)	VISUAL	ADDITIONAL DATA (joints, partings, seams, zones, etc) Description, orientation, infilling or coating, shape, roughness, thickness, other
							0.0							0.00: Topsoil: Silty CLAY; medium plasticity, dark brown, with fine to medium grained sand
							0.5							
							1.0							
							1.5							
							1.60m							
							1.85m		Silty CLAY (Cl): medium plasticity, pale brown with some brown mottled, with fine to medium grained sand, trace medium grained rounded gravel					
							2.00m		Sandy CLAY (Cl): medium plasticity, pale brown and brown, fine to coarse grained sand, trace fine to medium grained sub-rounded to rounded gravel					
							2.00m		CORE LOSS 1.10m (2.00-3.10)					
							2.5							
							3.0							
							3.10m							
							3.5		Sandy Gravelly CLAY (Cl): medium plasticity, grey brown and pale brown, medium grained sub-rounded to rounded gravel, fine to coarse grained sand					
							3.60m							
							4.0		CLAY (Cl): low plasticity, orange brown, red brown and yellow brown, with highly weathered sandstone fragments to 30 mm					
							4.90m		From 3.7 m: becoming orange brown and pale grey					
							5.0							

DRILLING CC Concrete core WB Wash bore DB Wash bore with drag bit NQ Wireline core barrel 42mm NQ3 Wireline core barrel 45mm HQ Wireline core barrel 64mm HQ3 Wireline core barrel 62mm FQ Wireline core barrel 85mm NMLC Diamond core 52mm diameter HMLC Diamond core 62mm diameter VC Vibro-core drilling PT Continuous push tube	WATER dd/mm/yy Water Level on Date shown Drilling water level water inflow water outflow WEATHERING FR Fresh SW Slightly Weathered MW Moderately Weathered HW Highly Weathered DW Distinctly Weathered XW Extremely Weathered RS Residual Soil	STRENGTH EH Extremely High VH Very High H High M Medium L Low VL Very Low ROUGHNESS Po Polished SI Slickensided Sm Smooth Ro Rough VR Very Rough	DEFECT TYPE Bg Bedding C Cleavage Pt Parting CZ Crushed Zone SZ Shear Zone IS Infilled Seam Jt Joint Se Seam SS Shear Seam Ve Vein VO Void Cn Contact Bd Boundary DB Drilling Break HB Handling Break	COATING CN Clean CT Coating (>= 1.0mm) FLD Filled SN Stained VNR Veneer (< 1.0mm) PLANARITY Cu Curved DIS Discontinuous Ir Irregular PI Planar St Stepped Un Undulose Vu Vuggy Wv Wavy	INFILL Ca Calcite Cl Clay Fe Iron Oxide Fe Cl Iron Oxide Clay Ch Chlorite Um Unidentified Mineral Qz Quartz X Carbonaceous Py Pyrite Mn Manganese Cr Crushed Rock Co Coal Gp Gypsum Fp Feldspar
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See Explanatory Notes for details of abbreviations & basis of descriptions.

SMEC AUSTRALIA



CORED DRILL HOLE - ENGINEERING LOG

HOLE NO : BH4
PROJECT NUMBER : 3005628
SHEET : 2 OF 2
FINAL DEPTH : 8 m

CLIENT : Hydroplan
PROJECT : Willunga Basin SRWRA Storage
LOCATION : Intersection Victor Harbour Rd/Ostrich Farm Rd

POSITION : E: 272634.0, N: 6102385.0 (MGA94 Zone 54) SURFACE ELEVATION : INCLINATION° / ORIENTATION° : 90° / N/A

RIG TYPE : MKV2 MOUNTING : Truck CONTRACTOR : Drilling Solutions HOLE DIA :

DATE STARTED : 22/05/2018 DATE COMPLETED : 22/05/2018 DATE LOGGED : 22/05/2018 LOGGED BY : SK CHECKED BY : SP

CASING DIAMETER : BARREL (Length) : BIT : BIT CONDITION :

DRILLING					MATERIAL					FRACTURES				
PROGRESS	DRILLING & CASING	DRILLING FLUID	TCR% DRILL ROD% DEPTH	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	ELEVATION	DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION ROCK NAME : grain size, colour, texture and fabric, features, inclusion and minor components	Weathering / Alteration	ESTIMATED STRENGTH Is(50)	DEFECT SPACING (mm)	VISUAL	ADDITIONAL DATA (joints, partings, seams, zones, etc) Description, orientation, infilling or coating, shape, roughness, thickness, other
							5.0		SANDSTONE: extremely to highly weathered, very low strength, fine grained, orange (<i>continued</i>)					
							5.5							
							6.0							
							6.5		From 6.2 m to 6.5 m: becoming orange and pale grey					
							6.50m		Sandy Silty CLAY: low plasticity, orange, fine grained sand, (extremely weathered SANDSTONE)					
							7.0							
							7.5							
							7.50m		CORE LOSS 0.50m (7.50-8.00)					
							8.0		Hole Terminated at 8.00 m Target Depth					
							8.00m							
							8.5							
							9.0							
							9.5							
							10.0							

DRILLING CC Concrete core WB Wash bore DB Wash bore with drag bit NQ Wireline core barrel 42mm NQ3 Wireline core barrel 45mm HQ Wireline core barrel 64mm HQ3 Wireline core barrel 62mm PQ Wireline core barrel 85mm NMLC Diamond core 52mm diameter HMLC Diamond core 62mm diameter VC Vibro-core drilling PT Continuous push tube	WATER dd/mm/yy Water Level on Date shown Drilling water level water inflow water outflow WEATHERING FR Fresh SW Slightly Weathered MW Moderately Weathered HW Highly Weathered DW Distinctly Weathered XW Extremely Weathered RS Residual Soil	STRENGTH EH Extremely High VH Very High H High M Medium L Low VL Very Low ROUGHNESS Po Polished SI Slickensided Sm Smooth Ro Rough VR Very Rough	DEFECT TYPE Bg Bedding C Cleavage Pt Parting CZ Crushed Zone SZ Shear Zone IS Infilled Seam Jt Joint Se Seam SS Shear Seam Ve Vein VO Void Cn Contact Bd Boundary DB Drilling Break HB Handling Break	COATING CN Clean CT Coating (>= 1.0mm) FLD Filled SN Stained VNR Veneer (< 1.0mm) PLANARITY Cu Curved DIS Discontinuous Ir Irregular Pl Planar St Stepped Un Undulose Vu Vuggy Wv Wavy	INFILL Ca Calcite Cl Clay Fe Iron Oxide Fe Cl Iron Oxide Clay Ch Chlorite Um Unidentified Mineral Qz Quartz X Carbonaceous Py Pyrite Mn Manganese Cr Crushed Rock Co Coal Gp Gypsum Fp Feldspar
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See Explanatory Notes for details of abbreviations & basis of descriptions.

SMEC AUSTRALIA





PointID : BH4 Depth Range: 0.00 - 5.00 m



PointID : BH4 Depth Range: 5.00 - 8.00 m



TITLE

Hydroplan
SMEC
Ostrich Farm Rd Seaford
Willunga Basin SRWRA Storage
Core Photo - BH4

DRAWN

DATE

27/05/2018

CHECKED

DATE

27/05/2018

SCALE

Not To Scale

A4

PROJECT No

3005628

FIGURE No

1/1

Appendix D Results of Laboratory Testing

Soils testing - Particle size distribution & consistency limits test report

Standard method (by sieving)

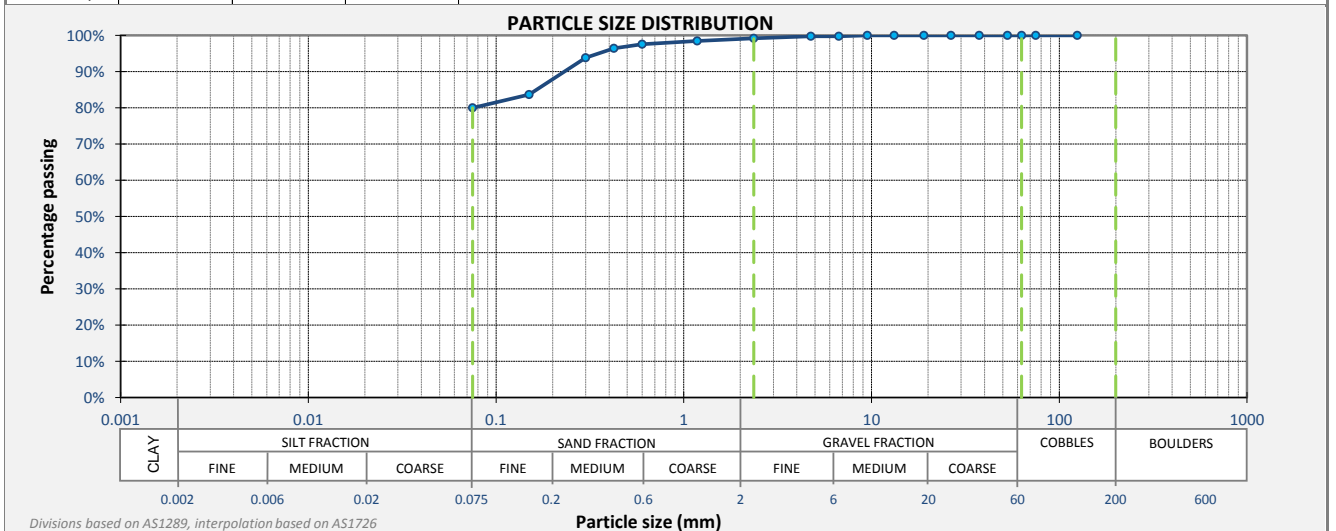
AS1289.3.6.1, 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1 & AS 1726:2017 Section 6.1



Test request #:	TRA18-0129	Lab sample ID:	LADL201805289	Golder Associates Pty Ltd ADELAIDE GEOTECHNICAL LABORATORY 118 Franklin Street, Adelaide, South Australia 5000
Client:	SMEC			
Client address:	Level 4, 19 Grenfell Street, Adelaide, SA, 5000			
Project ID:	1896865-002	Lab report ref.:	LADL_18016377	
Project name:	Storage Basin	Exploratory Hole	BH01 (22/5/18)	Sample depth (m): 1.70 - 2.00 Client sample ref:
Location:	Seaford	Project reference:	3005628	

Specimen description: (AS 1726:2017 Section 6.1)				(CH) CLAY, high plasticity, pale grey brown, with fine to coarse grained sand, trace fine gravel				Sampling co-ordinates		Reduced Level
								Easting (m)	Northing (m)	
PARTICLE SIZE DISTRIBUTION				AS 1289.3.6.1						
Sieve Size	Passing	LB S	UB S	Method:	AS 1289.2.1.1	AS 1289.3.1.2	AS 1289.3.2.1	AS 1289.3.3.1	AS 1289.3.4.1	
125 mm	100%				Moisture content	1 point Liquid limit	Plastic limit	Plasticity index	Linear shrinkage	Curling/ Crumbling/ Cracking
75 mm	100%			Result:	21.7% As Rcvd.	56%	20%	36%	15.0%	Cracking / Curling
63 mm	100%				LB S: UB S:					- -
53 mm	100%			Att. preparation method:		Dry sieved		LSM length (mm):		250
37.5 mm	100%			Specimen history/notes:	Preparation of specimen and testing performed on sample supplied to the laboratory					
26.5 mm	100%				Definitions:	LB S = Lower bound specification		N/A = Not applicable		
19 mm	100%					LSM = Linear shrinkage mould		ND = Not determined; SIB = Slip in bowl		
13.2 mm	100%				UB S = Upper bound specification		NO = Not obtainable; NP = Non plastic			
9.5 mm	100%			GRADING SUMMARY						
6.7 mm	100%			Fines	Sand*		Gravel*		Cobbles*	
4.75 mm	100%			(<75 µm)	(>75 µm - <2.36 mm)		(>2.36 mm - <63 mm)		(>63mm - <200 mm)	
2.36 mm	99%			80.0%	19.2%		0.8%		0.0%	
1.18 mm	98%			Proportions based on guidance in AS1726-2017 Section 6.1.4.2						
600 µm	98%									
425 µm	96%									
300 µm	94%									
150 µm	84%									
75 µm	80%									

Proportions based on guidance in AS1726-2017 Section 6.1.4.2



Testing performed by:		RD	Results reviewed by:		DBergen	Date reported:		8/06/2018
Cert. ref.:	1896865-002_BH01 (22-5-18)_TRA18-0129_PSD_1805289_Rep18016377					Approved signatory:		
	NATA accreditation number: 1961 - Site:1954 - Adelaide Accredited for compliance with ISO/IEC 17025 - Testing							
	THIS DOCUMENT SHALL ONLY BE REPRODUCED IN FULL							
Phone: +61 (08) 8213 2100		Fax: +61 (08) 8213 2101		E-mail: adlgeolab@golder.com.au		Web: www.golder.com.au		

These tests were carried out in accordance with the Australian standards identified in this certificate.

Rep AS1289.3.6.1 - RL32

Soils testing - Particle size distribution & consistency limits test report

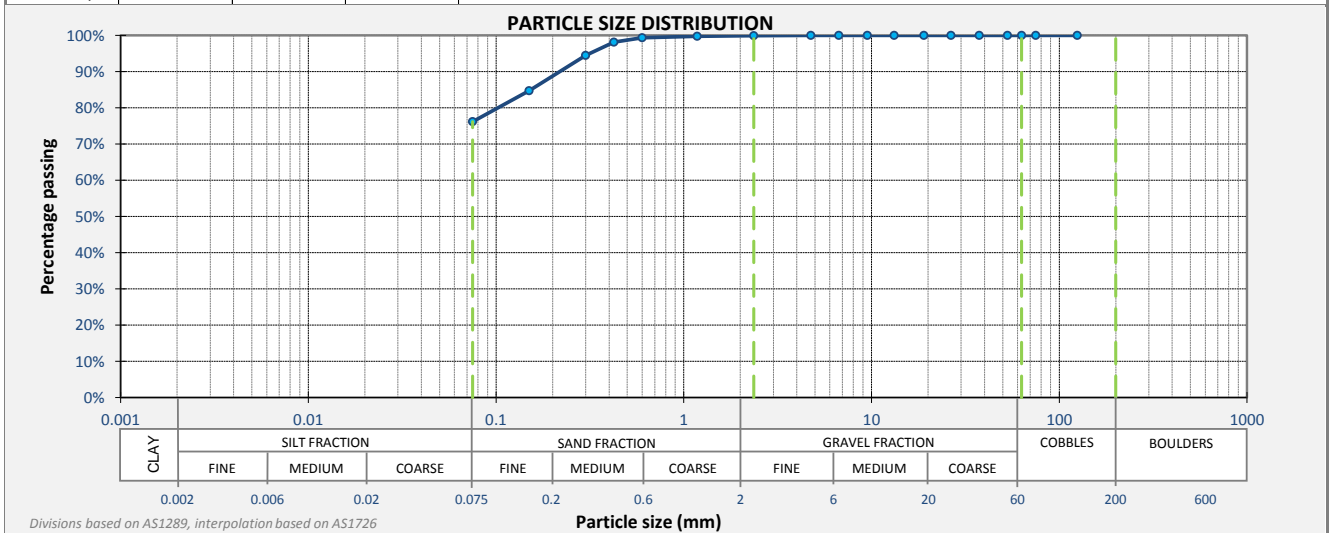
Standard method (by sieving)



AS1289.3.6.1, 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1 & AS 1726:2017 Section 6.1



Test request #:	TRA18-0129	Lab sample ID:	LADL2018052810	Golder Associates Pty Ltd ADELAIDE GEOTECHNICAL LABORATORY 118 Franklin Street, Adelaide, South Australia 5000
Client:	SMEC			
Client address:	Level 4, 19 Grenfell Street, Adelaide, SA, 5000			
Project ID:	1896865-002	Lab report ref.:	LADL_18016378	
Project name:	Storage Basin	Exploratory Hole	BH01 (22/5/18)	Sample depth (m): 2.70 - 3.00 Client sample ref: 3005628
Location:	Seaford	Project reference:	3005628	

Specimen description: (AS 1726:2017 Section 6.1)				(CH) CLAY, high plasticity, grey, with fine to coarse grained sand				Sampling co-ordinates		Reduced Level		
								Easting (m)	Northing (m)			
PARTICLE SIZE DISTRIBUTION AS 1289.3.6.1												
Sieve Size	Passing	LB S	UB S	Method:	AS 1289.2.1.1	AS 1289.3.1.2	AS 1289.3.2.1	AS 1289.3.3.1	AS 1289.3.4.1			
125 mm	100%				Moisture content	1 point Liquid limit	Plastic limit	Plasticity index	Linear shrinkage	Curling/ Crumbling/ Cracking		
75 mm	100%			Result:	31.0% As Rcvd.	69%	20%	49%	16.0%	Cracking / Curling		
63 mm	100%				LB S: UB S:						-	
53 mm	100%								-			
37.5 mm	100%			Att. preparation method:		Dry sieved		LSM length (mm):		250		
26.5 mm	100%			Specimen history/notes:	Preparation of specimen and testing performed on sample supplied to the laboratory							
19 mm	100%											
13.2 mm	100%			Definitions:	LB S = Lower bound specification				N/A = Not applicable			
9.5 mm	100%				LSM = Linear shrinkage mould				ND = Not determined; SIB = Slip in bowl			
6.7 mm	100%				UB S = Upper bound specification				NO = Not obtainable; NP = Non plastic			
4.75 mm	100%			GRADING SUMMARY								
2.36 mm	100%			Fines	Sand*	Gravel*		Cobbles*				
1.18 mm	100%			(<75 µm)	(>75 µm - <2.36 mm)	(>2.36 mm - <63 mm)		(>63mm - <200 mm)				
600 µm	99%			76.2%	23.7%	0.1%		0.0%				
425 µm	98%			Proportions based on guidance in AS1726-2017 Section 6.1.4.2								
300 µm	94%											
150 µm	85%											
75 µm	76%											



Testing performed by:		RD	Results reviewed by:	DBergen	Date reported:	8/06/2018
Cert. ref.:	1896865-002_BH01 (22-5-18)_TRA18-0129_PSD_18052810_Rep18016378				Approved signatory:	
	NATA accreditation number: 1961 - Site:1954 - Adelaide Accredited for compliance with ISO/IEC 17025 - Testing					
	THIS DOCUMENT SHALL ONLY BE REPRODUCED IN FULL					
				Daniel Bergen - Laboratory Technician		

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Web: www.golder.com.au

These tests were carried out in accordance with the Australian standards identified in this certificate.

Rep AS1289.3.6.1 - RL32

Soils testing - Particle size distribution & consistency limits test report

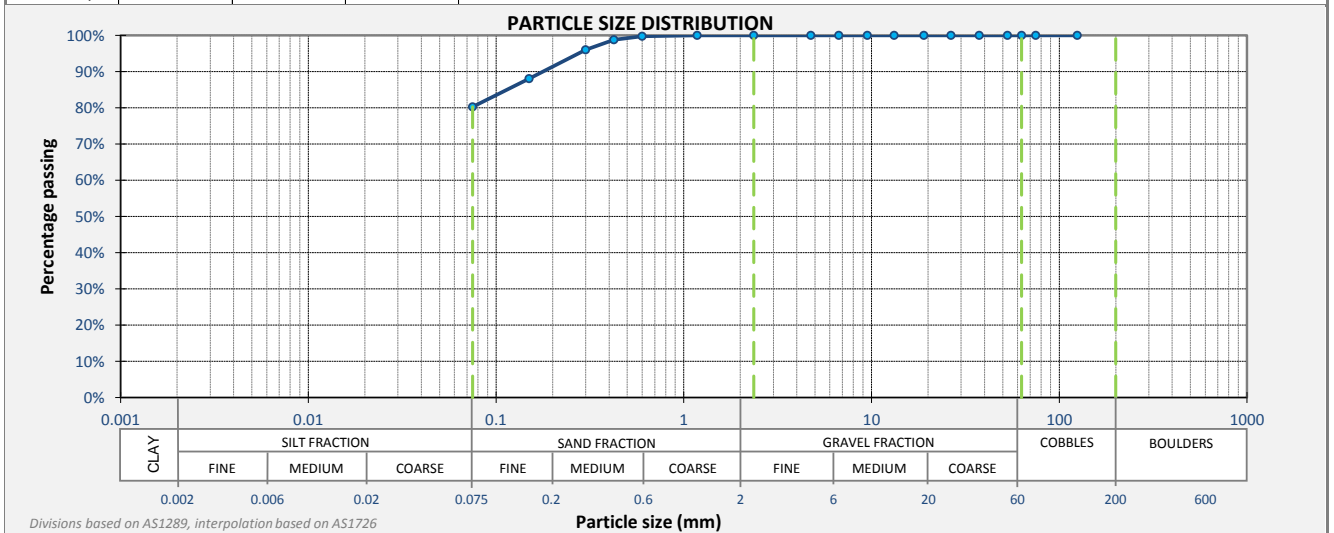
Standard method (by sieving)


AS1289.3.6.1, 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1 & AS 1726:2017 Section 6.1



Test request #:	TRA18-0129	Lab sample ID:	LADL2018052811	Golder Associates Pty Ltd ADELAIDE GEOTECHNICAL LABORATORY 118 Franklin Street, Adelaide, South Australia 5000
Client:	SMEC			
Client address:	Level 4, 19 Grenfell Street, Adelaide, SA, 5000			
Project ID:	1896865-002	Lab report ref.:	LADL_18016379	
Project name:	Storage Basin	Exploratory Hole	BH01 (22/5/18)	Sample depth (m): 4.70 - 5.00 Client sample ref: 3005628
Location:	Seaford	Project reference:	3005628	

Specimen description: (AS 1726:2017 Section 6.1)				(CH) CLAY, high plasticity, mottled red green grey, with fine to coarse grained sand				Sampling co-ordinates		Reduced Level		
								Easting (m)			Northing (m)	
PARTICLE SIZE DISTRIBUTION				AS 1289.3.6.1								
Sieve Size	Passing	LB S	UB S	Method:	AS 1289.2.1.1	AS 1289.3.1.2	AS 1289.3.2.1	AS 1289.3.3.1	AS 1289.3.4.1			
125 mm	100%				Moisture content	1 point Liquid limit	Plastic limit	Plasticity index	Linear shrinkage	Curling/ Crumbling/ Cracking		
75 mm	100%			Result:	32.3% As Rcvd.	81%	23%	58%	16.0%	Crumbling		
63 mm	100%			LB S:							-	
53 mm	100%			UB S:							-	
37.5 mm	100%			Att. preparation method:	Dry sieved		LSM length (mm):	250				
26.5 mm	100%			Specimen history/notes:	Preparation of specimen and testing performed on sample supplied to the laboratory							
19 mm	100%			Definitions:	LB S = Lower bound specification				N/A = Not applicable			
13.2 mm	100%				LSM = Linear shrinkage mould				ND = Not determined; SIB = Slip in bowl			
9.5 mm	100%				UB S = Upper bound specification				NO = Not obtainable; NP = Non plastic			
6.7 mm	100%			GRADING SUMMARY								
4.75 mm	100%			Fines	Sand*		Gravel*		Cobbles*			
2.36 mm	100%			(<75 µm)	(>75 µm - <2.36 mm)		(>2.36 mm - <63 mm)		(>63mm - <200 mm)			
1.18 mm	100%			80.3%	19.7%		0.0%		0.0%			
600 µm	100%			Proportions based on guidance in AS1726-2017 Section 6.1.4.2								
425 µm	99%											
300 µm	96%											
150 µm	88%											
75 µm	80%											



Testing performed by:		RD	Results reviewed by:		DBergen	Date reported:		8/06/2018
Cert. ref.:	1896865-002_BH01 (22-5-18)_TRA18-0129_PSD_18052811_Rep18016379					Approved signatory:		
	NATA accreditation number: 1961 - Site:1954 - Adelaide Accredited for compliance with ISO/IEC 17025 - Testing							
	THIS DOCUMENT SHALL ONLY BE REPRODUCED IN FULL							
Phone: +61 (08) 8213 2100		Fax: +61 (08) 8213 2101		E-mail: adlgeolab@golder.com.au		Web: www.golder.com.au		

Soils testing - Report of Emerson class number


Soil classification

AS 1289.3.8.1-2017





Test request ID: TRA18-0129	Lab sample ID: LADL201805289	Golder Associates Pty Ltd	
Client: SMEC		ADELAIDE GEOTECHNICAL LABORATORY	
Client address: Level 4, 19 Grenfell Street, Adelaide, SA, 5000		118 Franklin Street, Adelaide, South Australia 5000	
Project ID: 1896865-002	Lab report ref.: LADL_18016380		
Project name: Storage Basin	Exploratory Hole BH01 (22/5/18)	Sample depth (m): 1.70 - 2.00	Client sample ref:
Location: Seaford	Project reference: 3005628		
Specimen description (Based on visual and tactile assessment)	(CH) CLAY, high plasticity, pale grey brown, with fine to coarse grained sand, trace fine gravel	Sampling co-ordinates	
		Easting (m)	Reduced Level
		Northing (m)	

TEST REPORT - SUMMARY OF ANALYSIS

Visual reference 	Date sampled:	
	Date tested:	06/06/18
	Temperature (°C):	21.0°
	Type of water used:	Distilled
Observations / Notes		
Reaction to hydrochloric acid- Calcite		
<div style="border: 1px solid black; padding: 5px; text-align: center;"> Emerson class number Class 4 </div>		

Emerson Class:	Definition / Notes
Class 1	Air-dried crumbs of soil show a strong dispersing reaction, i.e., a colloidal cloud covers nearly the whole of the bottom of the beaker, usually in a very thin layer. The reaction should be evident within 10 minutes. In extreme cases all the water in the beaker becomes cloudy, leaving only a coarse residue in a cloud of clay.
Class 2	Air-dried crumbs of soil show a moderate to slight reaction. A moderate reaction consists of an easily recognizable cloud of colloids in suspension, usually spreading in thin streaks on the bottom of the beaker. A slight reaction consists of the bare hint of cloud in water at the surface of the crumbs.
Class 3	The soil remoulded at the plastic limit disperses in water.
Class 4	The remoulded soil does not disperse in water. Calcium carbonate (calcite) or calcium sulfate (gypsum) is present.
Class 5	The remoulded soil does not disperse in water and the 1:5 soil/water suspension remains dispersed after 10 minutes.
Class 6	The remoulded soil does not disperse in water and the 1:5 soil/water suspension begins to flocculate within 10 minutes.
Class 7	The air-dried crumbs of soil remain coherent in water and swell.
Class 8	The air-dried crumbs of soil remain coherent in water and do not swell.

Definitions: ND = Not determined Result reviewed by: DBergen Test performed by: RD Date reported: 08/06/2018

Cert. ref.: 1896865-002__TRA18-0129_Emerson_LADL201805289_R016380	Approved signatory:
 NATA accreditation number: 1961 - Site:1954 - Adelaide Accredited for compliance with ISO/IEC 17025 - Testing THIS DOCUMENT SHALL ONLY BE REPRODUCED IN FULL	 Daniel Bergen - Laboratory Technician

Soils testing - Report of Emerson class number


Soil classification

AS 1289.3.8.1-2017





Test request ID: TRA18-0129	Lab sample ID: LADL2018052810	Golder Associates Pty Ltd	
Client: SMEC	ADELAIDE GEOTECHNICAL LABORATORY 118 Franklin Street, Adelaide, South Australia 5000		
Client address: Level 4, 19 Grenfell Street, Adelaide, SA, 5000			
Project ID: 1896865-002	Lab report ref.: LADL_18016381		
Project name: Storage Basin	Exploratory Hole BH01 (22/5/18)	Sample depth (m): 2.70 - 3.00	Client sample ref:
Location: Seaford	Project reference: 3005628		
Specimen description (Based on visual and tactile assessment)	(CH) CLAY, high plasticity, grey, with fine to coarse grained sand	Sampling co-ordinates	
		Easting (m)	Northing (m)
		Reduced Level	

TEST REPORT - SUMMARY OF ANALYSIS

Visual reference 	Date sampled:	
	Date tested:	06/06/18
	Temperature (°C):	21.0°
	Type of water used:	Distilled
Observations / Notes		
<div style="border: 1px solid black; padding: 5px; text-align: center;"> Emerson class number Class 2 </div>		

Emerson Class:	Definition / Notes
Class 1	Air-dried crumbs of soil show a strong dispersing reaction, i.e., a colloidal cloud covers nearly the whole of the bottom of the beaker, usually in a very thin layer. The reaction should be evident within 10 minutes. In extreme cases all the water in the beaker becomes cloudy, leaving only a coarse residue in a cloud of clay.
Class 2	Air-dried crumbs of soil show a moderate to slight reaction. A moderate reaction consists of an easily recognizable cloud of colloids in suspension, usually spreading in thin streaks on the bottom of the beaker. A slight reaction consists of the bare hint of cloud in water at the surface of the crumbs.
Class 3	The soil remoulded at the plastic limit disperses in water.
Class 4	The remoulded soil does not disperse in water. Calcium carbonate (calcite) or calcium sulfate (gypsum) is present.
Class 5	The remoulded soil does not disperse in water and the 1:5 soil/water suspension remains dispersed after 10 minutes.
Class 6	The remoulded soil does not disperse in water and the 1:5 soil/water suspension begins to flocculate within 10 minutes.
Class 7	The air-dried crumbs of soil remain coherent in water and swell.
Class 8	The air-dried crumbs of soil remain coherent in water and do not swell.

Definitions: ND = Not determined Result reviewed by: **DBergen** Test performed by: **RD**
 Date reported: **08/06/2018**

Cert. ref.: 1896865-002__TRA18-0129_Emerson_LADL2018052810_R016381		Approved signatory:
	NATA accreditation number: 1961 - Site:1954 - Adelaide	 Daniel Bergen - Laboratory Technician
	Accredited for compliance with ISO/IEC 17025 - Testing	
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Soils testing - Report of Emerson class number


Soil classification

AS 1289.3.8.1-2017





Test request ID: TRA18-0129	Lab sample ID: LADL2018052811	Golder Associates Pty Ltd	
Client: SMEC	ADELAIDE GEOTECHNICAL LABORATORY		
Client address: Level 4, 19 Grenfell Street, Adelaide, SA, 5000	118 Franklin Street, Adelaide, South Australia 5000		
Project ID: 1896865-002	Lab report ref.: LADL_18016382		
Project name: Storage Basin	Exploratory Hole BH01 (22/5/18)	Sample depth (m): 4.70 - 5.00	Client sample ref:
Location: Seaford	Project reference: 3005628		
Specimen description (Based on visual and tactile assessment)	CLAY, Reddish green grey	Sampling co-ordinates	
		Easting (m)	Northing (m)
		Reduced Level	

TEST REPORT - SUMMARY OF ANALYSIS

Visual reference 	Date sampled:	
	Date tested:	06/06/18
	Temperature (°C):	21.0°
	Type of water used:	Distilled
Observations / Notes		
<div style="border: 1px solid black; padding: 5px; text-align: center;"> Emerson class number Class 2 </div>		

Emerson Class:	Definition / Notes
Class 1	Air-dried crumbs of soil show a strong dispersing reaction, i.e., a colloidal cloud covers nearly the whole of the bottom of the beaker, usually in a very thin layer. The reaction should be evident within 10 minutes. In extreme cases all the water in the beaker becomes cloudy, leaving only a coarse residue in a cloud of clay.
Class 2	Air-dried crumbs of soil show a moderate to slight reaction. A moderate reaction consists of an easily recognizable cloud of colloids in suspension, usually spreading in thin streaks on the bottom of the beaker. A slight reaction consists of the bare hint of cloud in water at the surface of the crumbs.
Class 3	The soil remoulded at the plastic limit disperses in water.
Class 4	The remoulded soil does not disperse in water. Calcium carbonate (calcite) or calcium sulfate (gypsum) is present.
Class 5	The remoulded soil does not disperse in water and the 1:5 soil/water suspension remains dispersed after 10 minutes.
Class 6	The remoulded soil does not disperse in water and the 1:5 soil/water suspension begins to flocculate within 10 minutes.
Class 7	The air-dried crumbs of soil remain coherent in water and swell.
Class 8	The air-dried crumbs of soil remain coherent in water and do not swell.

Definitions: ND = Not determined Result reviewed by: **DBergen** Test performed by: **RD** Date reported: **08/06/2018**

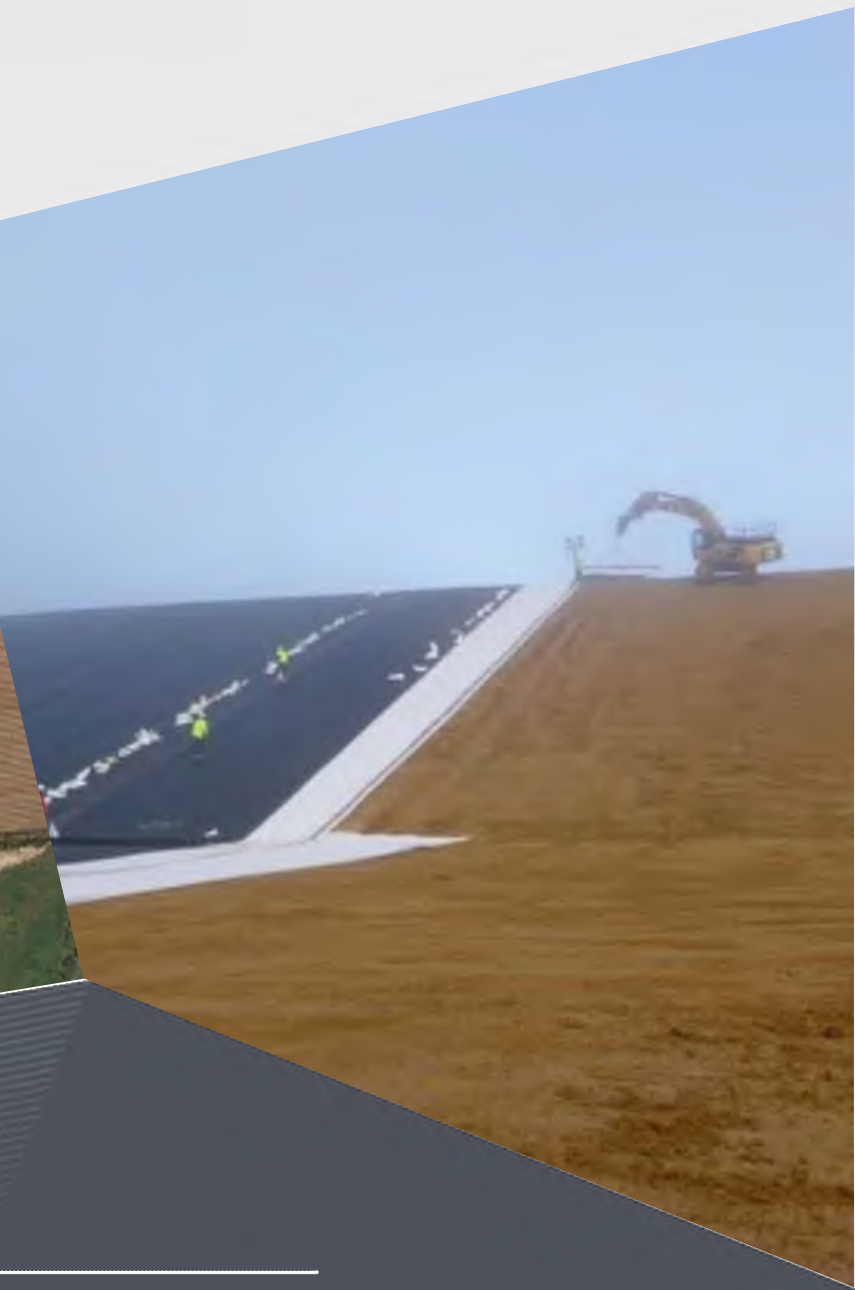
Cert. ref.: 1896865-002__TRA18-0129_Emerson_LADL2018052811_R016382		Approved signatory:
	NATA accreditation number: 1961 - Site:1954 - Adelaide	 Daniel Bergen - Laboratory Technician
	Accredited for compliance with ISO/IEC 17025 - Testing	
	THIS DOCUMENT SHALL ONLY BE REPRODUCED IN FULL	

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Appendix 8. Construction Report (SMEC)



Construction Report

SRWRA Storage Seaford

Reference No. WBWC PO-0073
Prepared for Water Utilities Australia
31 October 2018

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3 CONSTRUCTION METHOD 4

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1 Introduction

SMEC has been engaged by Water Utilities Australia (WUA) to prepare a construction excavation method Report for a new 600ML storage at Seaford Heights. The Willunga Basin Water storage for the Southern Region Waste Resource Authority (SRWRA) is currently in the Concept Design Phase with the work being completed by HydroPlan.

As the storage is located upstream of a residential population it is recognised that construction of the storage has potential implications for the surrounding residents. As such a Construction method assessment was undertaken based on the outcomes of a geotechnical investigation report:

- Geotechnical Investigations Report Draft (SMEC, June 2018)

Details of outcomes of the Construction Method Assessment are presented below.

2 Construction Activities

The Works associated with construction of the Seaford Storage are envisaged to comprise the following:

- Stripping of topsoil and unsuitable materials from embankment and reservoir footprint
- Excavation and preparation of foundation
- Embankment construction
- Inlet/Outlet works construction
- Overflow (spillway) construction
- Clearing of vegetation and stripping of topsoil along the spillway outfall chute
- Prepare surface for membrane
- Placement, welding and testing of geomembrane liner
- Landscaping

3 Construction Method

The results of the Draft Geotechnical Report identified the following sub-surface lithology

Table 2: Summary of sub-surface lithology

UNIT	BH1	BH2	BH3	BH4
Top Soil	0.0 m to ≈0.2 m	0.0 m to ≈0.2 m	0.0 m to ≈0.2 m	0.0 m to ≈0.2 m
Upper Clay	≈0.2 m - ≈2.5 m	≈0.2 m - 1.3 m	≈0.2 m - ≈2.5 m	≈0.2 m - ≈3.6 m
Hindmarsh / Ngalinga Clay	≈2.5 m - 7.5 m	Not Encountered	≈2.5 m - 7.8 m	Not Encountered
Clayey Sand	7.5 m – 8.0 m (EOH)	Not Encountered	7.8 - 8.06 m (EOH)	Not Encountered
Residual Soil		1.3 m – 1.6 m		3.6 m - 4.9 m
Siltstone / Sandstone		1.6 m – 8.1 m (EOH)		4.9 m - 8.0 m (EOH)

No groundwater was encountered within the depth investigated.

As noted in the Draft Geotechnical Investigations Report the natural clay soils encountered in the boreholes are expected to be generally excavatable using conventional machinery such as excavators and dozers. Slower production rates would be expected in the residual soils and the very low strength weathered rock. Should the medium strength siltstone unit be encountered the use of specialist rock breaking equipment may be required. The need for the use of drill and blast techniques for excavation of this unit is not considered likely.

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Appendix 9. Odour Assessment (ERM)



Craig Heidenreich
General Manager
Water Utilities Australia
Willunga Basin Water Company
CHeidenreich@wua.com.au

28 November 2018

Dear Craig

Re: Odour Assessment – SRWRA Treated Water Storage Dam

This letter report provides an odour assessment of a proposed 600 ML treated water storage dam at Seaford. The assessment is based on field odour intensity observations at four treated water storage dams in the area of Noarlunga, Willunga and Aldinga on 16 August 2018.

This letter report has been updated based on client comments and an updated dam layout plan.

If you require any clarification or further information, then please let me know.

Sincerely

A handwritten signature in blue ink, consisting of a stylized 'J' and 'M' followed by a horizontal line.

Johan Meline CAQP, MIEAust
Principal Consultant

SRWRA Treated Water Storage Dam Odour Assessment

Background and Introduction

Willunga Basin Water Company is planning for a new treated water storage dam at Seaford Heights near the existing Quarry Road storage dam. The location is south of Victor Harbor Road, west of Ostrich Farm Road, north of the SRWRA landfill and southeast of a new residential development, as shown in Figure 1 and Figure 2. Plans of the facility concept design are included as an attachment.

The capacity of the proposed dam is 600 ML and the purpose of the development is to provide Willunga Basin Water with additional winter storage capacity of water for irrigation purposes, to service nearby vineyards. The dam will contain treated water from Christies Beach wastewater treatment plant. Treated water from the Christies Beach treatment plant is currently stored and distributed for irrigation across the region by Willunga Basin Water. One storage facility is the Quarry Road dam to the north of the proposed location.

To address potential concerns regarding odour from the treated water storage dam, Willunga Basin Water Company engaged ERM to perform an odour assessment. As there is no South Australian recommended evaluation (buffer/separation) distance, site specific assessment is recommended. The odour assessment was based on field odour observations at current treated water storage facilities in the area of the proposed dam location. Dispersion modelling was not performed for the assessment since it is difficult to characterise emissions from low level non offensive odour sources¹.

The nearest existing sensitive receptor location is a residence to the south of the dam at a distance of 105 m from the water edge of the proposed dam maximum fill height.

The closest sensitive future receptors to the dam will be residents at the new residential development to the northwest at a distance of approximately 78 m from the water edge of the proposed dam maximum fill height.

The land proposed for the dam is in the Primary Production and Deferred Urban Zone.

¹ Odour impacts from low level non offensive odour sources, such as treated water storage lagoons, typically produce over predictions in separation distance requirements in dispersion modelling.



Figure 1: *SRWRA treated water storage dam site location*

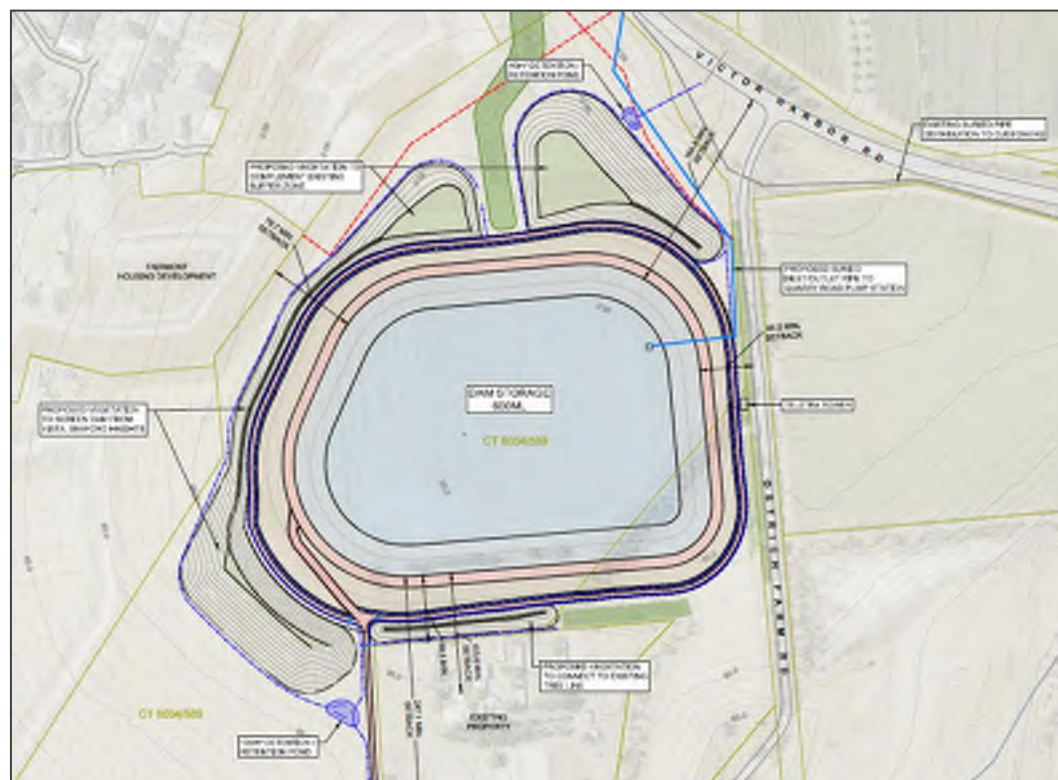


Figure 2: SRWRA treated water storage dam site layout (see attachment for full plan)

Odour Assessment Methodology

The odour assessment was based on field odour observations of existing nearby treated water storage dams. The results from the observations was evaluated against the separation distance to the nearest sensitive receptors, general settings of the area and wind data.

Field Odour Observations Assessment Methodology

The field odour observations methodology applied for the assessment was a modified version of the German Standard VDI 3490 (1993) method for odour surveys. The method standardises the odour logging approach by the adoption of a standard scale for describing odour intensity, as detailed in the German Standard VDI 3882, which relates to odour measurement. This method was selected as it enables the evaluation of odour over time rather than single point in time with discrete observations.

The German standard describes a procedure for logging odour in the field which involves noting the odour intensity based on a scale of 0 to 6 (see Table 1) every 10 seconds over a 10 minute period for a number of locations. In addition to making intensity observations, the observer also notes the character of the odour/odours observed, if that can be determined.

Table 1: *Odour intensity scale with interpretation*

Perceived Odour Strength	Intensity Rating	Interpretation Source: VDI 3490 (1993) and modified interpretations from Pitt (2014) ²
Extremely Strong	6	In normal circumstances, this should be very rare in a field situation. For an offensive type of odour, the reaction would be to immediately mitigate against further exposure until the exposure level is reduced. The odour cannot be tolerated.
Very Strong	5	The odour character is clearly recognisable. For an offensive type of odour, exposure to this level is considered unpleasant/undesirable to the point that action to mitigate against further exposure is considered or taken.
Strong	4	The odour character is clearly recognisable. For an offensive type of odour, exposure to this level would be considered unpleasant/undesirable.
Distinct	3	The odour character is clearly recognisable. Note that this must still apply even if in a different context or situation - for example, not knowing or expecting what type of odour may be present. The odour is tolerable – even for an offensive odour.
Weak	2	A detectable weak odour stronger than very weak and less strong than distinct.
Very Weak	1	Odour only just detectable.
Not Perceptible	0	No odour present.

Locations for the field odour observations were selected to cover one upwind location for reference of background odour and downwind locations at various distances from the targeted odour source.

In addition to recording odour intensity observations, wind conditions (wind direction and wind speed) were also recorded for each observation.

The results of the field odour intensity observations are summarised in the results section below. Result pie charts of the intensity observations for each observation location were plotted on an aerial image along with the wind direction at the time of the observation. This provides an overview of the observation

² Pitt, D. (2014). Field odour assessments for estimating odour concentrations. Air Quality and Climate Change, 48(1), 24-32.
VDI. (1993). Determination of odorants in ambient air by field inspections intensity VDI3940. Dusseldorf: Kommission Reinhaltung der Luft im VDI und DIN.

results summarising where odour was observed as well as the level of odour observed, frequency of different odour intensities and the wind directions.

Wind Data

Local wind data is relevant to consider in odour assessments as it indicates where impacts will occur. Annual prevailing wind directions as well as time of day and seasonal prevailing wind directions are relevant to consider from a potential exposure point of view. Wind data from the Noarlunga BoM weather station, the nearest weather station to site, is presented below.

Separation Distance Guidelines

Relevant SA EPA guidelines on separation distance requirements include:

- Evaluation Distances for Effective Air Quality and Noise Management (SA EPA, 2016)³
- Wastewater Lagoon Construction (SA EPA, 2014)⁴

The evaluation distances guideline states:

There is no recommended evaluation distance for recycled water storage lagoons, so a site-specific assessment is recommended.

This statement is further expanded on in the wastewater lagoon construction guideline:

Separation distances for recycled water storage lagoons are not specified. This is because air (odour) and noise issues are not generally associated with these lagoons, providing wastewater has been treated to minimise odour and they contain no mechanical treatment processes which generate noise. For recycled water storage lagoons a site-specific assessment should be undertaken to determine appropriate separation from sensitive receptors.

Wind Data

Wind data for the Noarlunga BoM weather station, approximately 4 km to the north of the proposed SRWRA storage dam location, is presented in Figure 3 to Figure 5. The data⁵ shows annual prevailing wind directions as north (N), east (E) and southeast (SE). These are broken down as follows:

- The prevailing wind direction in summer months is SE.
- The prevailing wind direction in autumn months is E.
- The prevailing wind direction in winter months is N.
- Overnight prevailing wind directions are E to SE.
- Day time prevailing wind directions are N and E in mornings and W with afternoon sea breezes.

For the nearest future sensitive receptors to the NW (the Seaford heights residential development), there is potential exposure with SE winds, especially in summer months. However, it should be observed that Noarlunga BoM station is located in a windy location (very low frequency of low wind speeds) and that the proposed SRWRA storage dam site location is located on hilltop at a higher elevation than the Noarlunga weather station, which should give greater exposure to winds. This means that the site location can be expected to be windier than Noarlunga and this provides good dispersion conditions.

³ SA EPA. (2016). Evaluation distances for effective air quality and noise management.

⁴ SA EPA. (2014). Wastewater Lagoons Construction.

⁵ Wind roses for 2009 included

The concept design drawings (see attached) show that there will be a banks (at the hill crest) between the storage dam and the nearby sensitive receptors. From this and the hilltop location, it follows that there should be no reason to suspect that there would be any directed drainage flows (and associated odour issues) in the direction towards the nearest sensitive receptors. The prevailing N winds show potential for exposure of the sensitive receptor to the south, however the N prevailing winds occur during wintertime daytime conditions with higher wind speeds in good dispersion conditions.

While there is potential exposure of the nearby sensitive receptors (with prevailing SE and N winds for part of the year), dispersion conditions at the elevated site location should be good and the residential receptors are not in locations, relative to the storage dam, that would pose any particular exposure risk⁶.

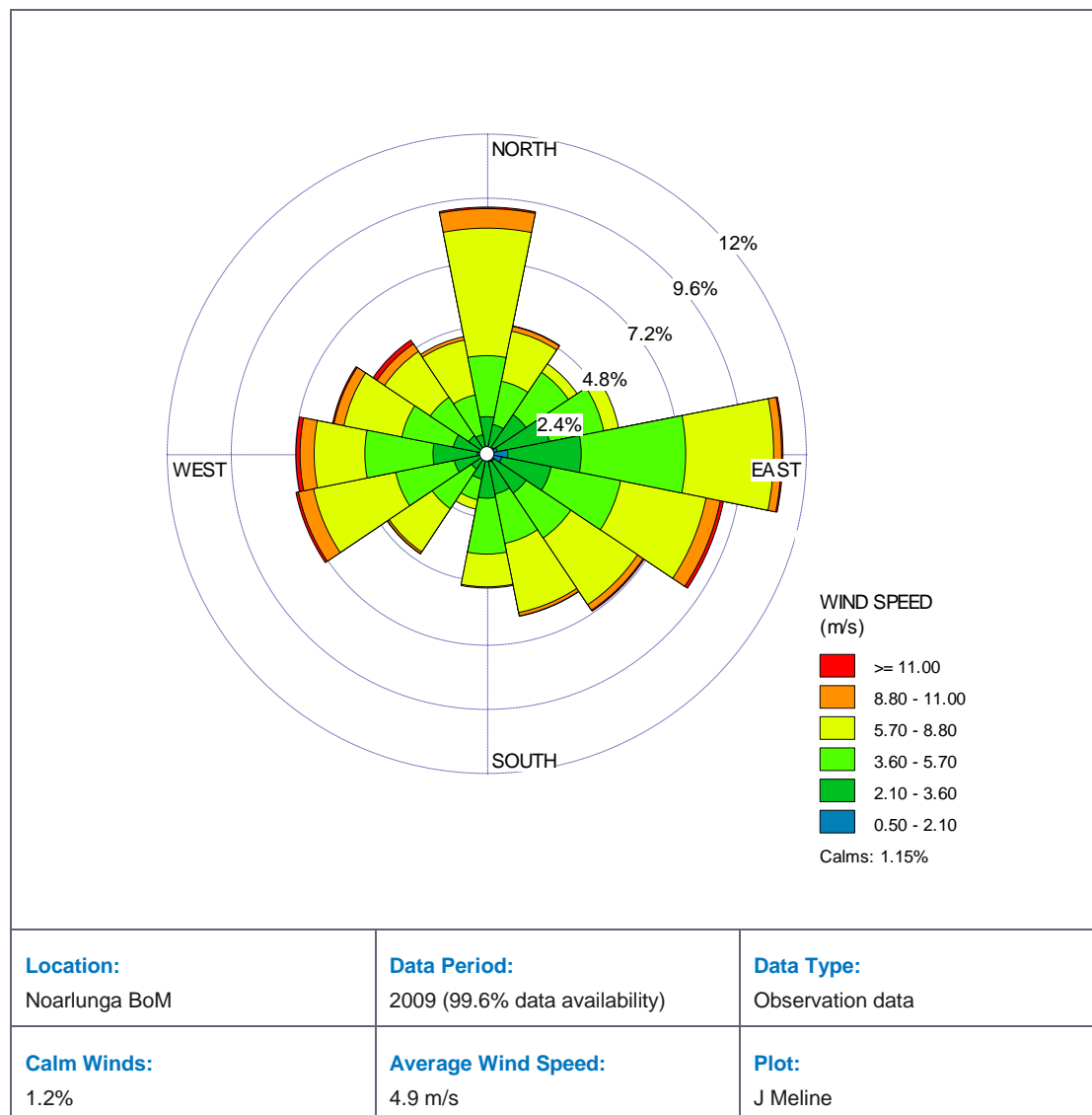


Figure 3: Annual wind rose for Noarlunga BoM

⁶ Examples of this would be the dam located in valley where there could be cold air drainage transporting odour to down gradient sensitive receptors or a situation with receptors on a hillside above the dam location where winds could blow an odour plume uphill and towards ground and receptors.

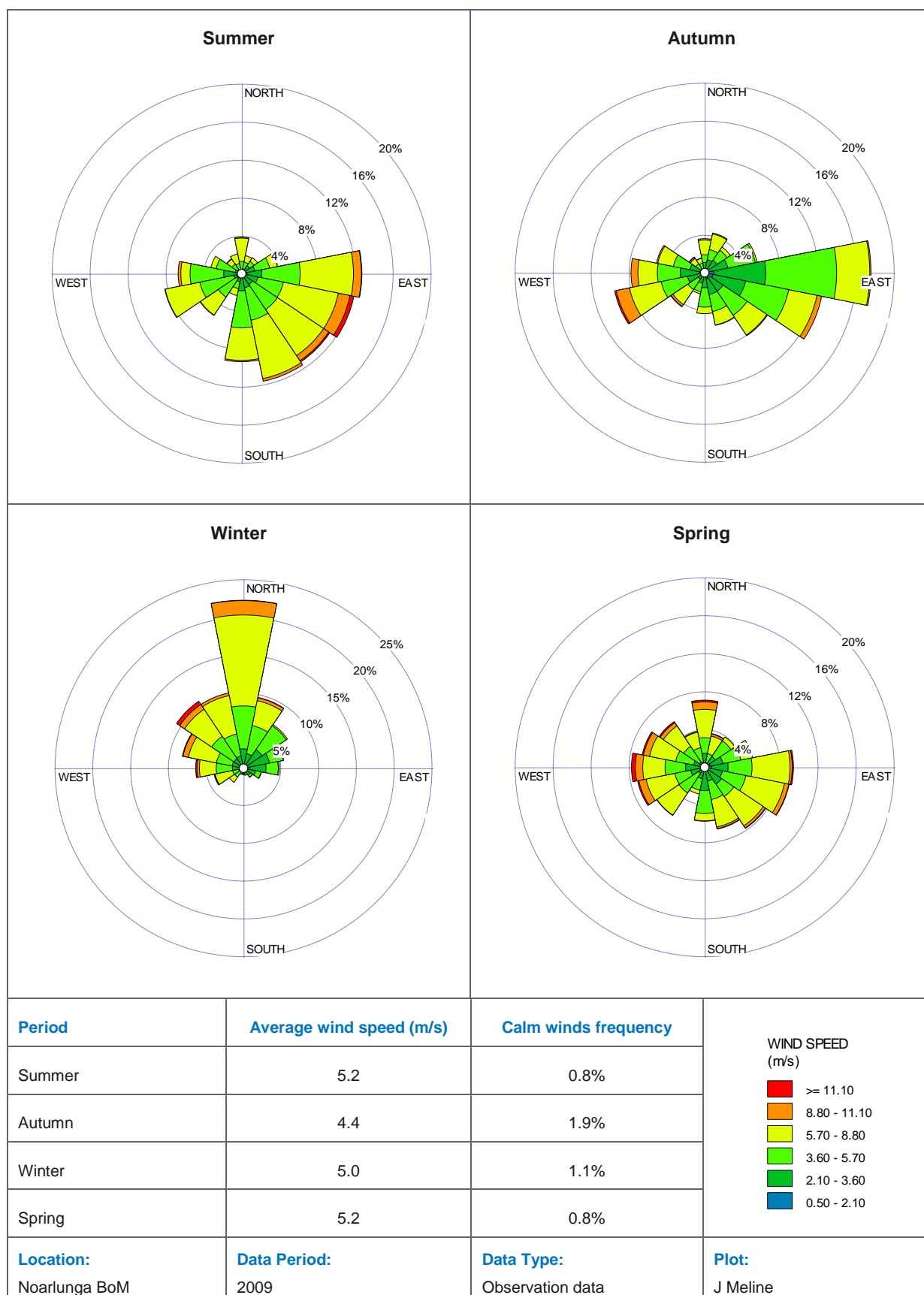


Figure 4: Seasonal wind roses for Noarlunga BoM

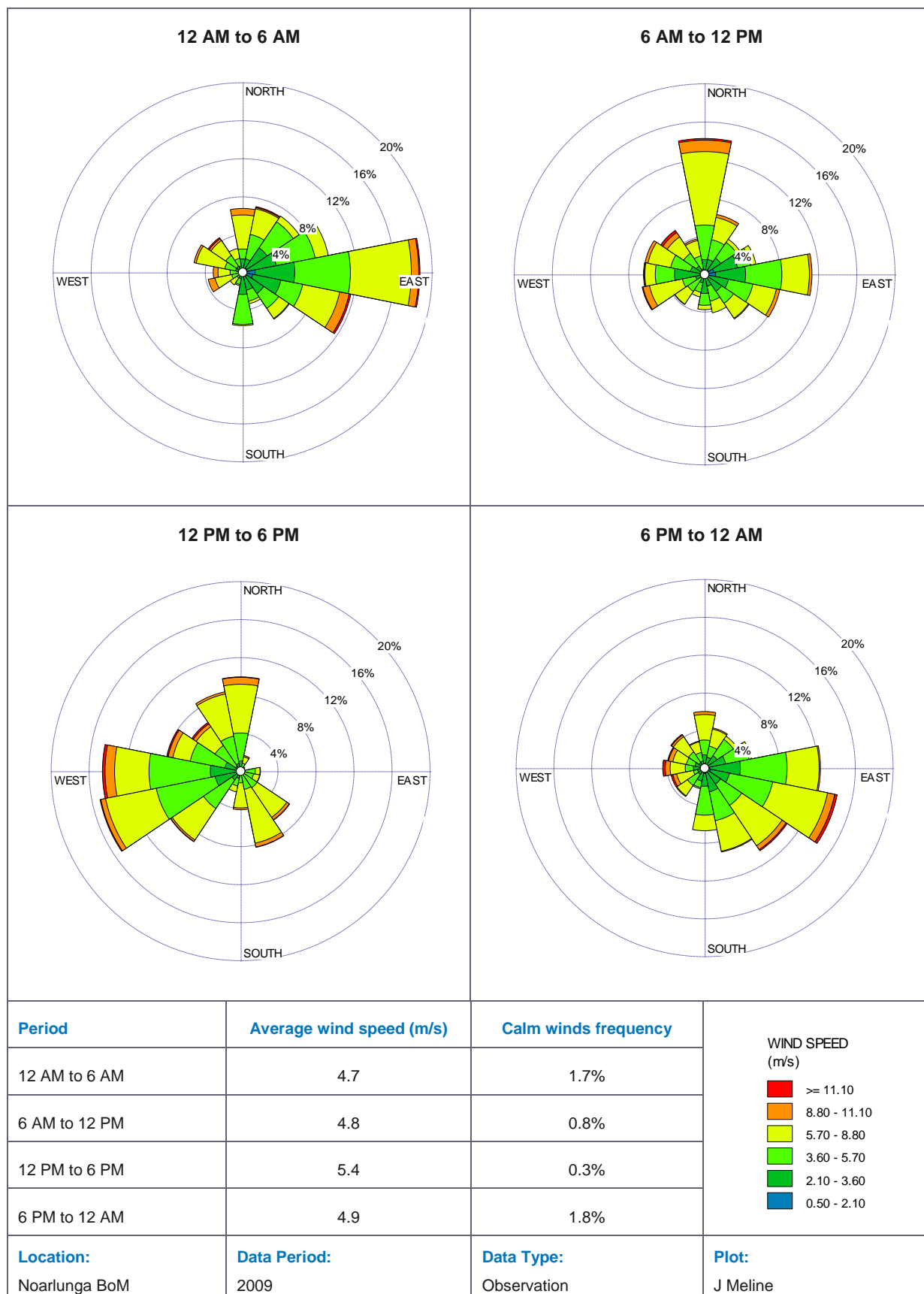


Figure 5: Time of day wind roses for Noarlunga BoM

Field Odour Intensity Observation Results

Field odour observations were performed on 16 August 2018 at the following treated water storage dams:

- Aldinga Storage Basin (south of the Aldinga WWTP)
- Quarry Road treated water storage dam (just north of the proposed SRWRA storage location)
- Little Road treated water storage dams (northwest of Willunga)

The log sheets for each observation location are provided as attachments.

General Observations

Odour from the treated water storage dams is recognisable, but not perceived as offensive, and typically present intermittently at low levels even very close to the dams. While the treated water is a product from a wastewater treatment plant, the odour from the storage dams is not perceived as wastewater related. The character of the odour of the treated water is closer in resemblance to muddy lake or pond water.

Aldinga Storage Basin

Site access was not available for the Aldinga Storage Basin south of the Aldinga WWTP. Odour observations were collected around the site perimeter along Plains and Hahn Road. Observations were performed early morning in near calm conditions (<0.5 m/s wind speed) with air movement from the north. There was no background odour observed (at upwind location) and no odour observed south (downwind) of the storage basin. The distance of observation from the treated water storage edge to the observation locations was approximately 110 m. The field odour observation results are summarised in Figure 6.

Quarry Road Treated Water Storage Dam

The water stored is treated water from Christies Beach WWTP, which is the same as for the proposed SRWRA storage dam. Conditions at the time of the observations were light WSW winds. The observations showed intermittent very weak to weak odours downwind from the dam with no odour observed for most of the durations. Closer to the water edge, odour was detected more frequently (about a quarter of the time) than at the site boundary. Very little odour was observed at the site boundary at distances of approximately 20 m to 40 m from the dam water edge.

Overall observations were perceived as low level odour and not of an offensive nature. The field odour observation results are summarised in Figure 7.

Little Road Treated Water Storage Dams

The water currently stored is treated water from the onsite Onkaparinga Council WWTP, but it is blended with Christies Beach water later in each season. Although the current water is not identical to the Christies Beach treated water, it is treated to the same quality as for the proposed storage dam.

Conditions at the time of the observations were light NW winds and odour observations were performed to the east of the storage dam along the boundary fence line and closer to the dam location to collect data on variations in the odour observations with distance from the water edge. The observations showed intermittent very weak to weak odours downwind from the dam with no odour observed for most of the durations. Closer to the water edge, odour was detected more frequently. Very little odour was observed at an approximate distance of 50 m from the dam water edge and no odour was observed at a distance of approximately 90 m from the dam water edge.

At the storage dam located south of the treatment plant at the site there was no odour observed at the downwind dam water edge. The field odour observation results are summarised in Figure 8.

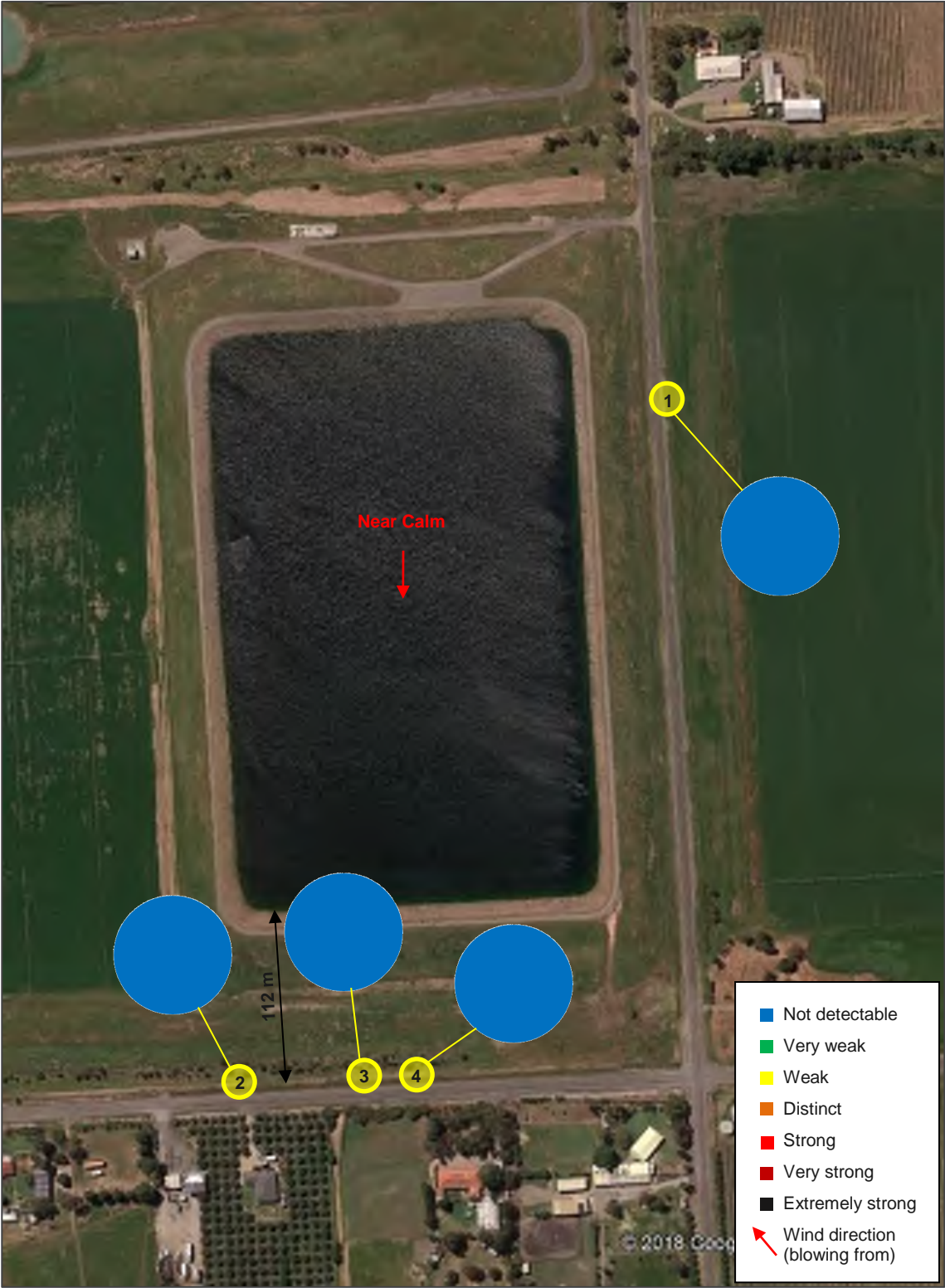


Figure 6: Aldinga Storage Basin field odour observation results

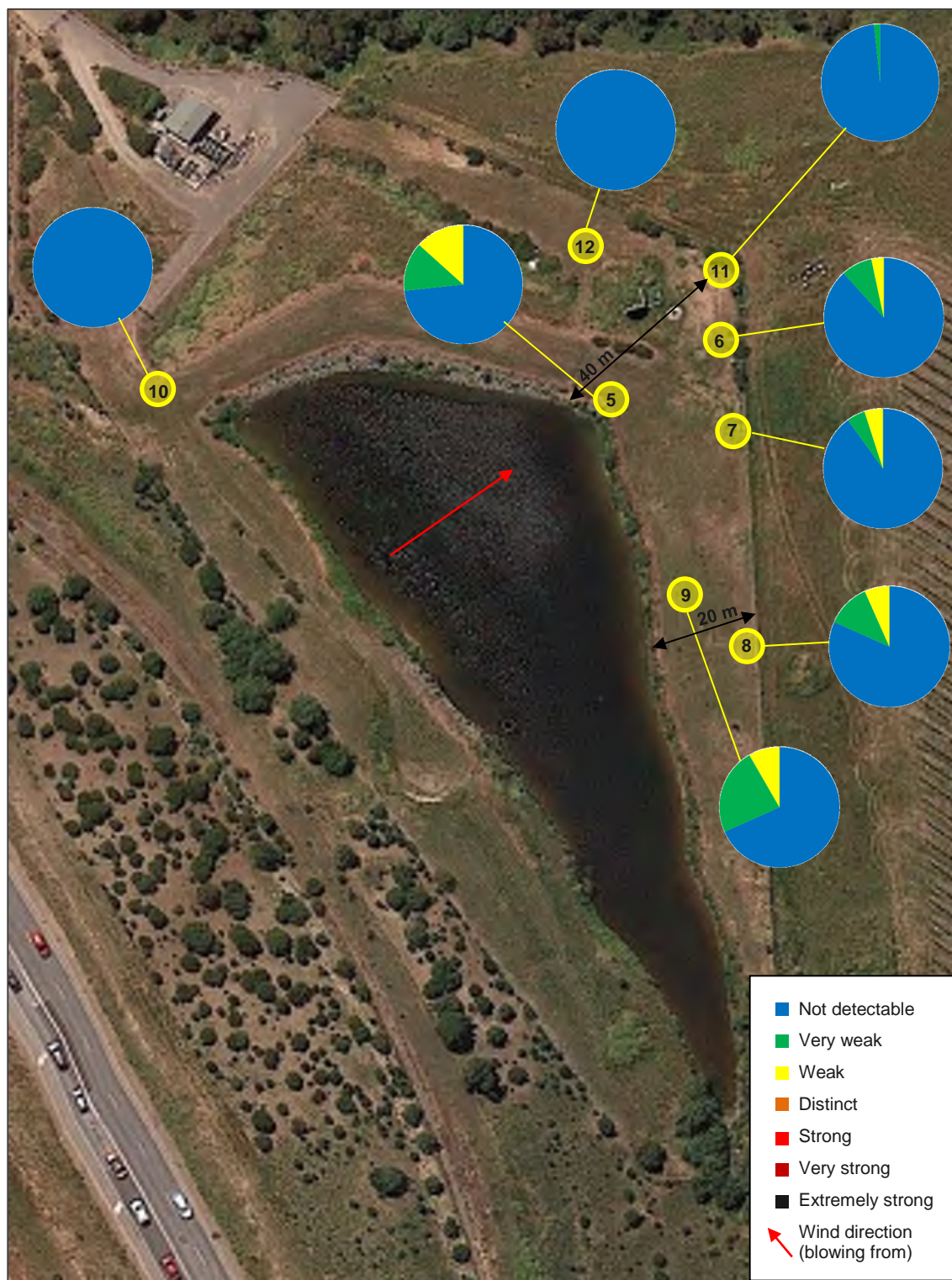


Figure 7: Quarry Road treated water storage dam field odour observation results



Figure 8: Little Road treated water storage dams field odour observation results

Conclusions and Recommendations

The field odour observations showed the following:

- There is odour associated with treated water storage dams. However, the character of the odour is not perceived as offensive, and it is not a wastewater related odour.
- The levels of odour observed were mostly low level and intermittent, especially at distance from the sources.
- At most locations no odour was observed for most of the time.
- No distinct or strong intensity odours were observed.

The review of the dam location and wind data review showed the following:

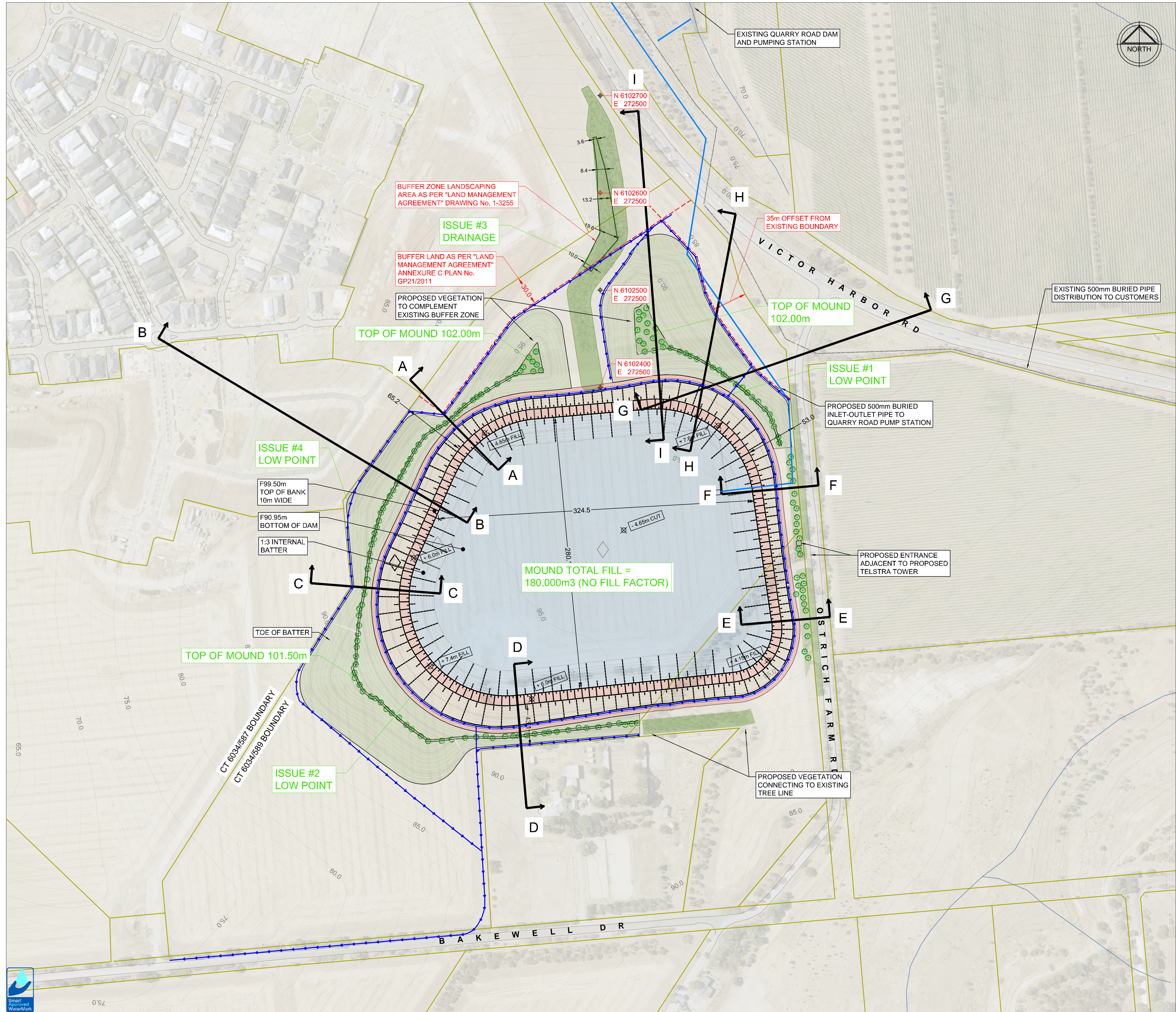
- The nearest sensitive receptors at the Seaford Height residential development, currently under construction, is at a distance of approximately 78 m from the water edge of the proposed dam maximum fill height.
- The nearest existing sensitive receptor location is a residence to the south of the dam at a distance of 105 m from the water edge of the proposed dam maximum fill height.
- The Seaford Heights residential development is in the summer time prevailing downwind wind direction and the sensitive receptor to the south is in the winter daytime prevailing downwind wind direction. However, dispersion conditions at the elevated hilltop location should be very good given the elevation and windy conditions.

From the field odour observations and the assessment it cannot be concluded that there will be no odour at the nearest sensitive receptor locations at the Seaford heights residential development as a result of the construction of the treated water storage dam as proposed. However, what the assessment shows is that any odour would be very low level (low odour concentration and intermittent) and not of an offensive nature.

Dispersion modelling was not performed for the assessment since it is difficult to characterise emissions and odour impacts from low level non offensive odour sources to then produce impact predictions that could be used for realistic separation distance requirements. However, for any dispersion modelling the applicable odour assessment criteria for the location would likely be 2 odour units. This means that a very low level of odour is acceptable at the location.

In accordance with operations to “good practice”, it is recommended that an Operations Management Plan, that includes odour management, be developed for the treated water storage dam. The Operations Management Plan should include routine water quality monitoring protocols and site inspections specifically targeting observation of odour for monitoring of performance. For operations and mitigations, details should be provided on preventative measures for maintenance of water quality and an incident response plan (should an odour event occur) should be included.

With an effective Operations Management Plan in place, there is a low risk of elevated odour from the proposed treated water storage.



SITeworks Legend

- PROPERTY LINE
- PROPOSED PIPELINE
- PROPOSED SWALE
- EXISTING PIPELINE
- BUFFER LAND BOUNDARY LINE

COORDINATES AS SHOWN ON DRAWING No. "1-3255" OF THE LAND MANAGEMENT AGREEMENT

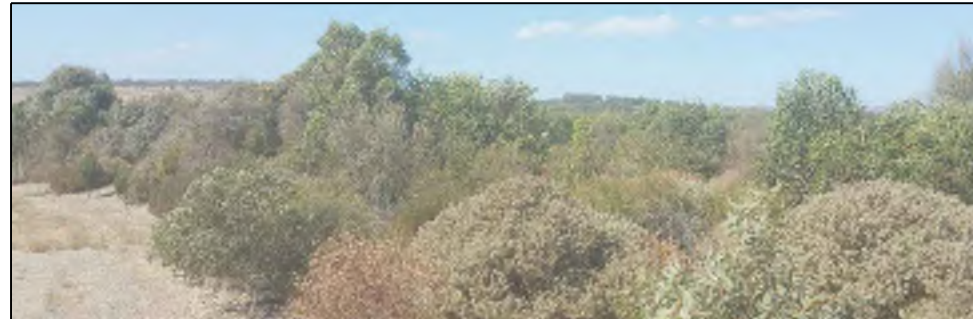
FINISHED SURFACE Legend

- RUBBLE AREA
- STORAGE AREA (PLASTIC LINED)
- OUTSIDE BATTER AREA

VEGETATION Legend

EXTENDED VEGETATION AREA: (FOR SCREENING - INDICATIVE ONLY)

EXAMPLE:



NOTE: VEGETATION PLAN TO BE AGREED WITH BIODIVERSITY McLaren VALE AND DEW. VEGETATION TO SCREEN A 1.8m HIGH SECURITY FENCE ON THE INTERNAL SIDE OF EXTENDED VEGETATION ALIGNMENT.

EXISTING VEGETATION AREA:

EXAMPLES:



SCALE 1:2000 ORIGINAL SIZE A1

REV	ISSUED	D.DWN	APRVD	REVISION DESCRIPTION	REV	ISSUED	D.DWN	APRVD	REVISION DESCRIPTION
0	20/09/2018	JT	JG/BH	FOR DISCUSSION	-	-	-	-	-

<http://hydroplan.com.au>

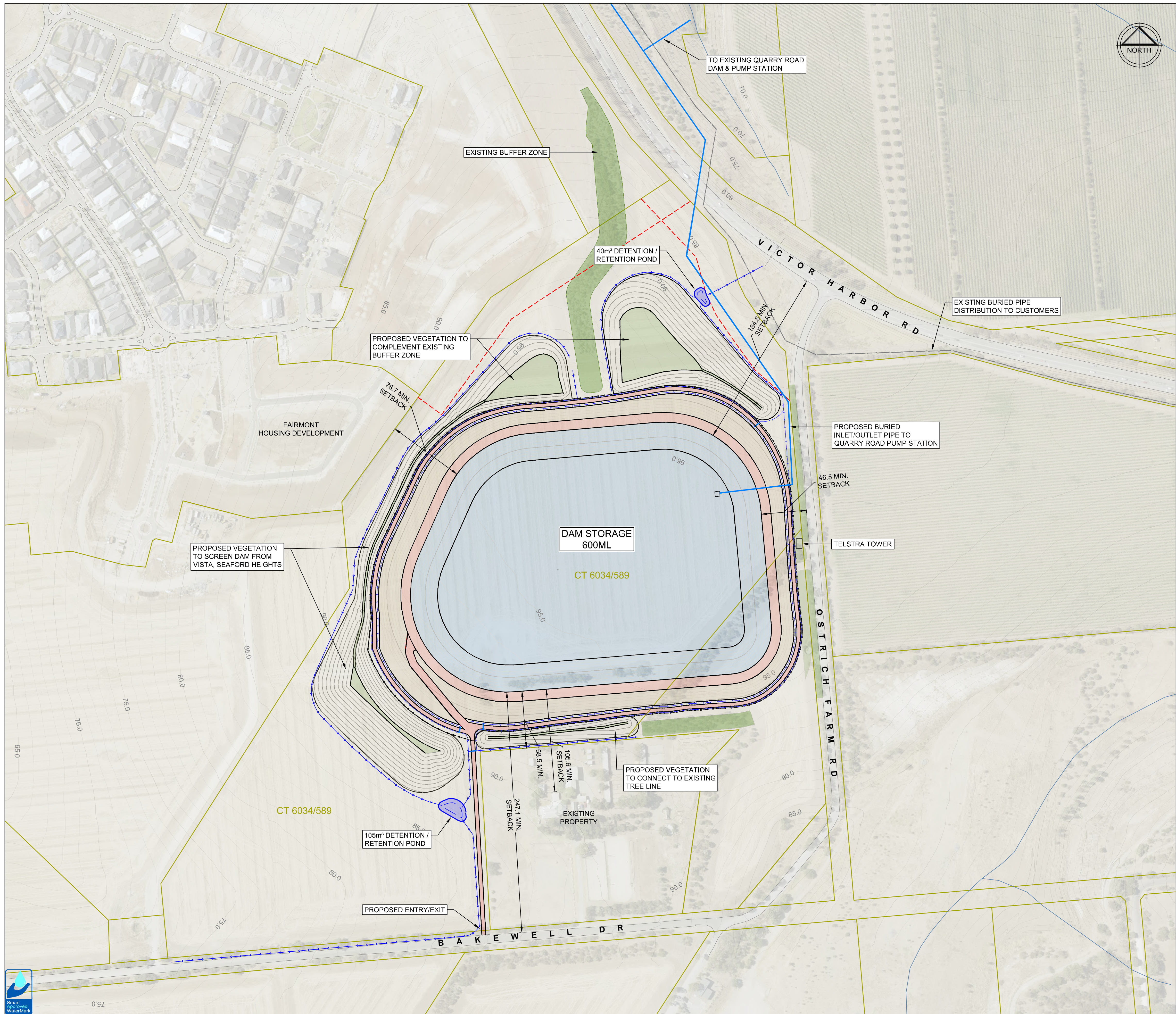
PERTH ADELAIDE SYDNEY BRISBANE BEIJING

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The arrangement and general details as shown on this drawing are essentially diagrammatic and must be applied to the circumstances as found on site.

DES/DRAWN: JT	CLIENT: WILLUNGA BASIN WATER
CHECKED: BH	
APPROVED: JG	PROJECT: SRWRA STORAGE
DATE: 29/03/2018	CONCEPT DESIGN PLAN WITH MOUNDS
DRAFT REF: 2-WBW-d4	DRAWING No. 14689-SK017
	SHEET 1 OF 3
	REVISION 0

Drawing file: Z:\WBW\14689 SRWRA Dam\Drawings\SK013-d7 (57MM - Mounds) dwg - 16/11/2018 5:08 PM Original Size: ISO Full Bleed A1 (841.00 X 594.00 MM)



SITeworks Legend

- PROPERTY LINE
- PROPOSED PIPELINE
- PROPOSED SWALE
- EXISTING PIPELINE
- BUFFER LAND BOUNDARY LINE

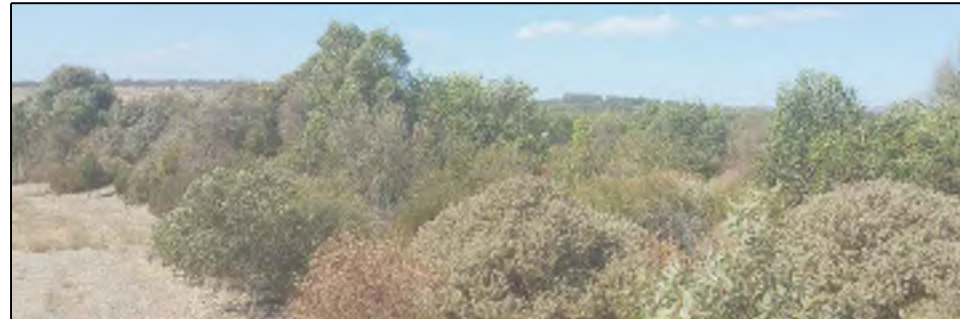
FINISHED SURFACE Legend

- RUBBLE AREA
- STORAGE AREA (PLASTIC LINED)
- OUTSIDE BATTER AREA

VEGETATION Legend

EXTENDED VEGETATION AREA:
(FOR SCREENING - INDICATIVE ONLY)

EXAMPLE:



NOTE: VEGETATION PLAN TO BE AGREED WITH BIODIVERSITY McLaren VALE AND DEW. VEGETATION TO SCREEN A 1.8m HIGH SECURITY FENCE ON THE INTERNAL SIDE OF EXTENDED VEGETATION ALIGNMENT.


EXISTING VEGETATION AREA:

EXAMPLES:



SCALE 1:2000 ORIGINAL SIZE A1

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2	22/10/2018	JT	JG/BH	FOR DISCUSSION					
1	03/10/2018	JT	JG/BH	FOR DISCUSSION					
0	20/09/2018	JT	JG/BH	FOR DISCUSSION					



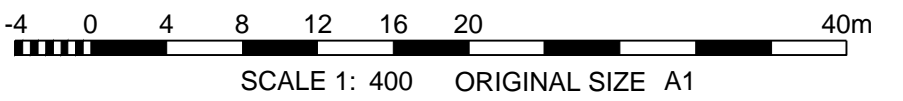
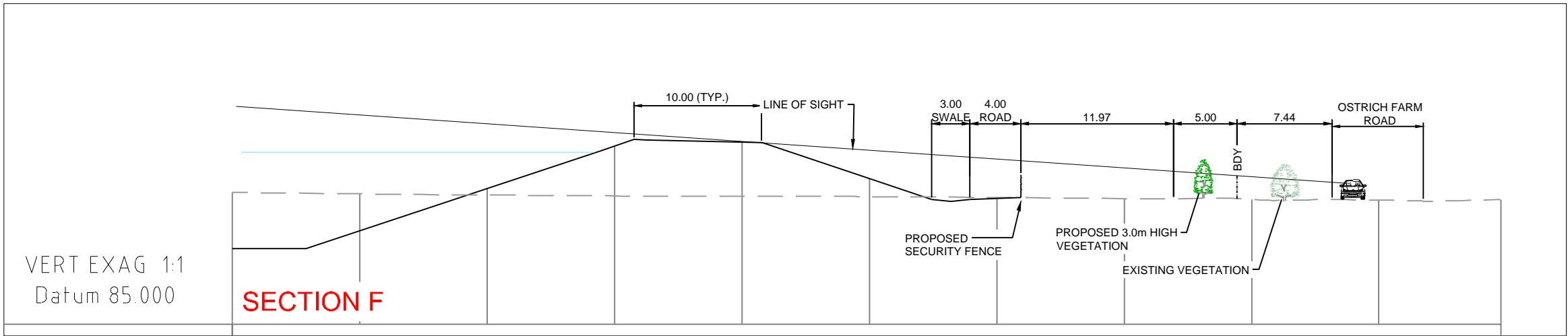
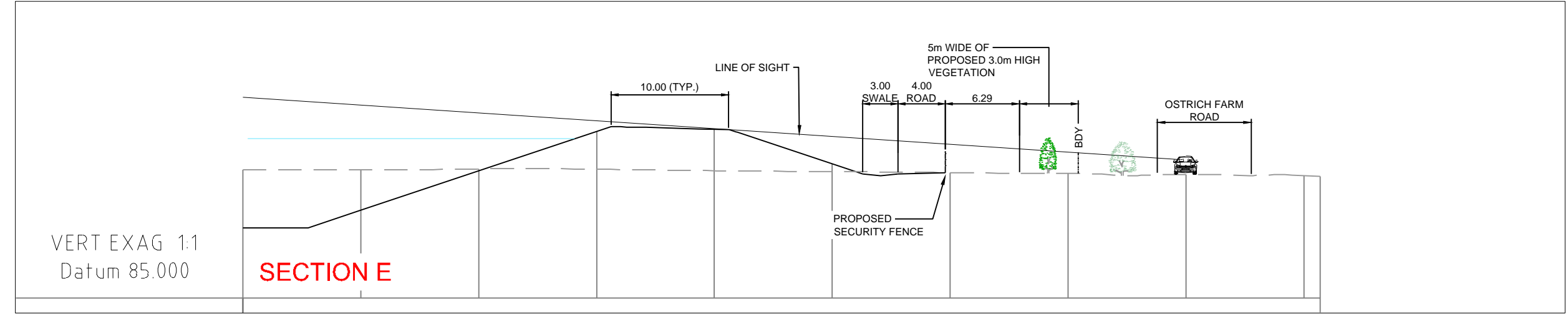
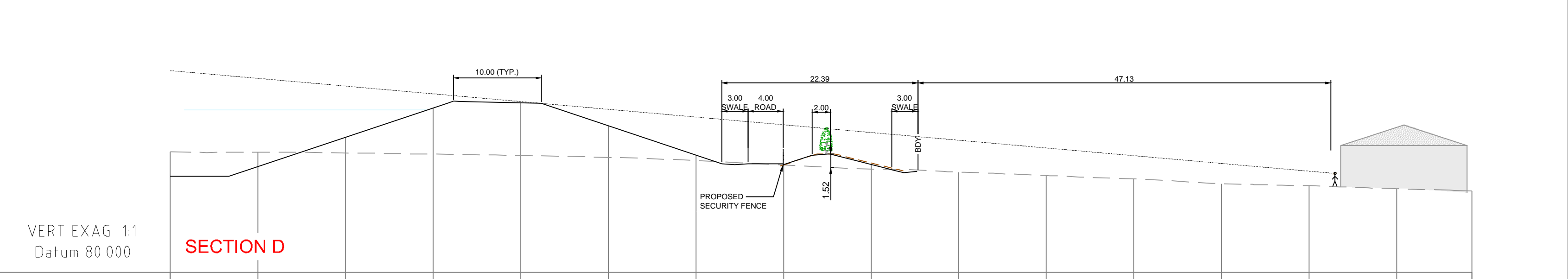
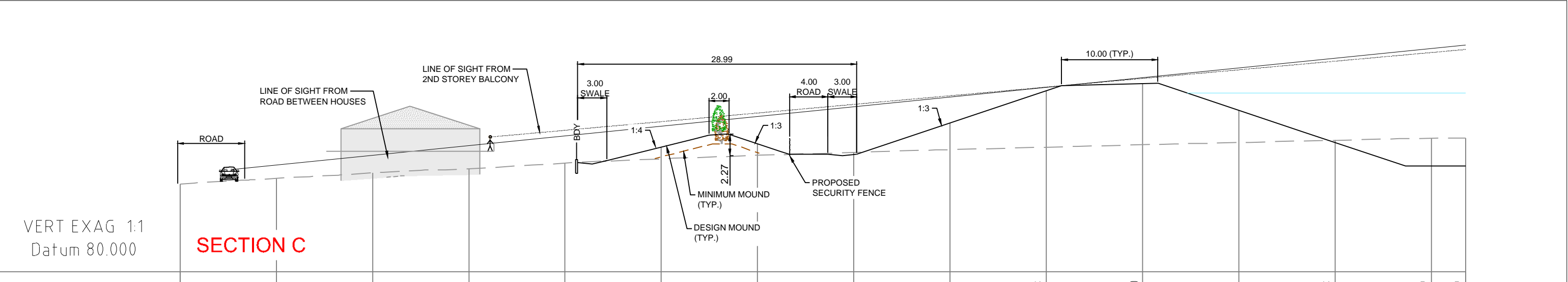
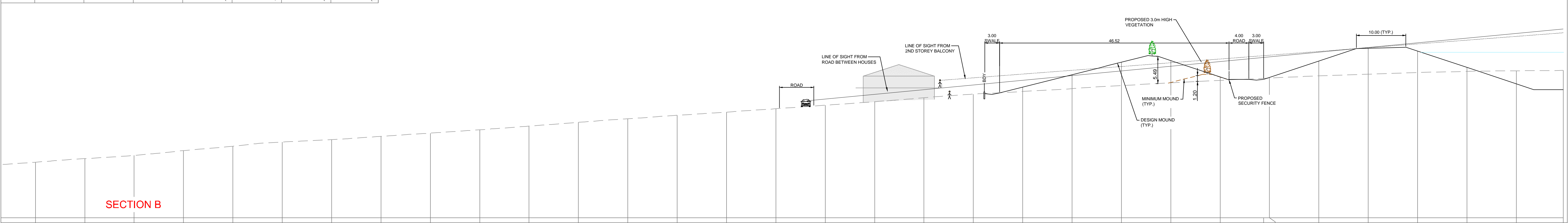
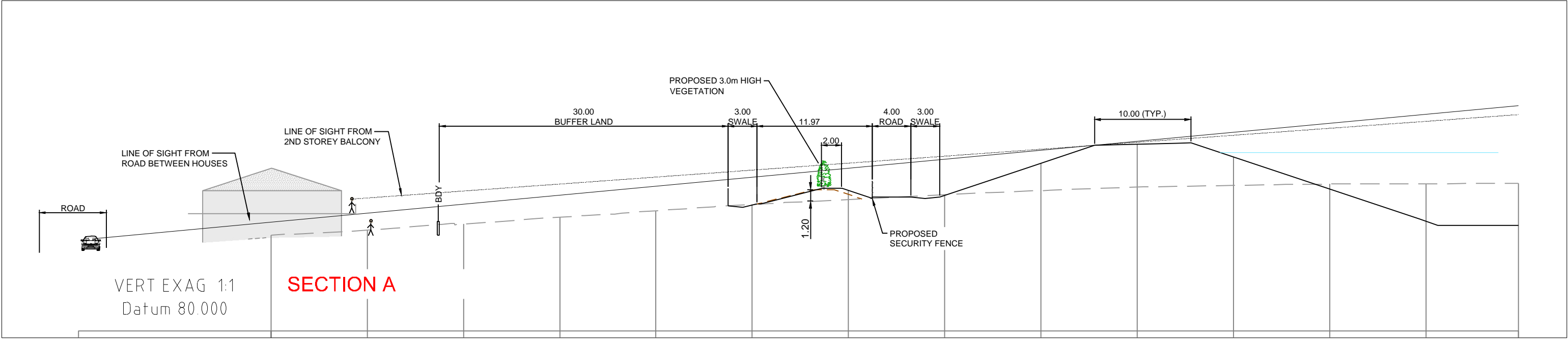
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DES/DRAWN:	JT	CLIENT: WILLUNGA BASIN WATER					
CHECKED:	BH	PROJECT: SRWRA STORAGE CONCEPT DESIGN PLAN WITH MOUNDS					
APPROVED:	JG						
DATE:	29/03/2018						
DRAFT REF:	2-WBW-d7	DRAWING No.	14689-SK017	SHEET	1 OF 1	REVISION	3

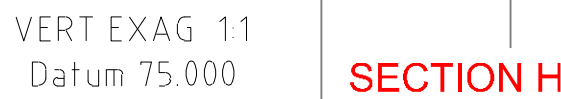
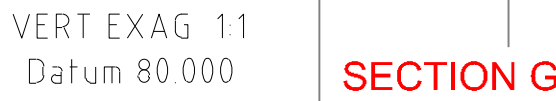


0	??/09/2018	JT	JG/BH	FOR DISCUSSION	-				-
REV	ISSUED	D.DWN	APRVD	REVISION DESCRIPTION	REV	ISSUED	D.DWN	APRVD	REVISION DESCRIPTION

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COPYRIGHT	DES/DRAWN:	CLIENT:
This document is and shall remain the property of HYDRO-PLAN PTY. LTD. The document may only be used for the purpose for which it was commissioned and in accordance with the terms of engagement for the commission.	JT	WILLUNGA BASIN WATER
The arrangement and general details as shown on this drawing are essentially diagrammatic and must be applied to the circumstances as found on site.	CHECKED:	PROJECT:
	BH	SRWRA STORAGE
	APPROVED:	CONCEPT DESIGN PLAN WITH SECTION VIEWS
	JG	
	DATE:	
	29/03/2018	
	DRAFT REF:	
	2-WBW-d4	

[illegible]

Field Odour Intensity Observation Log Sheet

Panelist Name: Johan Meline
 Date: 16/08/2018
 Start Time: 6:59
 Site Code: 1 Aldinga Storage Basin
 GPS Location: X: 271,302 Y: 6,091,617 54H

Wind Speed: near calm
 Wind Direction: N
 Temperature: 9 °C

Intensity Scale:

0	1	2	3	4	5	6
Not Detectable	Very Weak	Weak	Distinct	Strong	Very Strong	Extremely Strong

Perceived Odour Source:

Targeted odour: treated water storage odour

Photo:
 (in Wdir blowing from)



Time	Intensity	Source	Time	Intensity	Source	Time	Intensity	Source
0:10	0		3:30	0		6:50	0	
0:20	0		3:40	0		7:00	0	
0:30	0		3:50	0		7:10	0	
0:40	0		4:00	0		7:20	0	
0:50	0		4:10	0		7:30	0	
1:00	0		4:20	0		7:40	0	
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1:20	0		4:40	0		8:00	0	
1:30	0		4:50	0		8:10	0	
1:40	0		5:00	0		8:20	0	
1:50	0		5:10	0		8:30	0	
2:00	0		5:20	0		8:40	0	
2:10	0		5:30	0		8:50	0	
2:20	0		5:40	0		9:00	0	
2:30	0		5:50	0		9:10	0	
2:40	0		6:00	0		9:20	0	
2:50	0		6:10	0		9:30	0	
3:00	0		6:20	0		9:40	0	
3:10	0		6:30	0		9:50	0	
3:20	0		6:40	0		10:00	0	

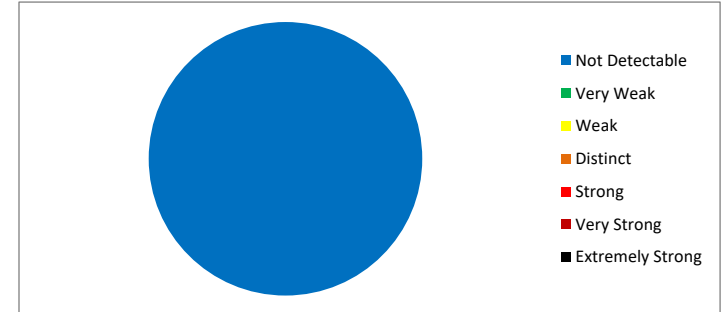
Colour coding of intensity observations:

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0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

Summary odour intensity observations:

Intensity	No obs	%	Descriptor
0	60	100%	Not Detectable
1	0	0%	Very Weak
2	0	0%	Weak
3	0	0%	Distinct
4	0	0%	Strong
5	0	0%	Very Strong
6	0	0%	Extremely Strong
	60	100%	

Plot of percentages of odour intensity observations:



Field Odour Intensity Observation Log Sheet

Panelist Name: Johan Meline
 Date: 16/08/2018
 Start Time: 7:19
 Site Code: 2 Aldinga Storage Basin
 GPS Location: X: 271,037 Y: 6,091,175 54H

Wind Speed: near calm
 Wind Direction: N
 Temperature: 9 °C

Intensity Scale:

0	1	2	3	4	5	6
Not Detectable	Very Weak	Weak	Distinct	Strong	Very Strong	Extremely Strong

Perceived Odour Source:

Targeted odour: treated water storage odour

Photo:
 (in Wdir blowing from)



Time	Intensity	Source	Time	Intensity	Source	Time	Intensity	Source
0:10	0		3:30	0		6:50	0	
0:20	0		3:40	0		7:00	0	
0:30	0		3:50	0		7:10	0	
0:40	0		4:00	0		7:20	0	
0:50	0		4:10	0		7:30	0	
1:00	0		4:20	0		7:40	0	
1:10	0		4:30	0		7:50	0	
1:20	0		4:40	0		8:00	0	
1:30	0		4:50	0		8:10	0	
1:40	0		5:00	0		8:20	0	
1:50	0		5:10	0		8:30	0	
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2:10	0		5:30	0		8:50	0	
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2:50	0		6:10	0		9:30	0	
3:00	0		6:20	0		9:40	0	
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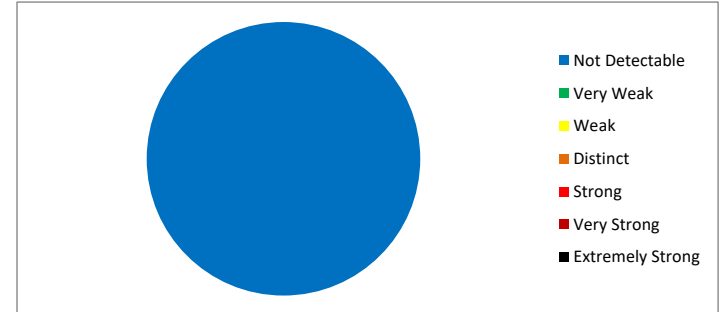
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0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

Summary odour intensity observations:

Intensity	No obs	%	Descriptor
0	60	100%	Not Detectable
1	0	0%	Very Weak
2	0	0%	Weak
3	0	0%	Distinct
4	0	0%	Strong
5	0	0%	Very Strong
6	0	0%	Extremely Strong
	60	100%	

Plot of percentages of odour intensity observations:



Field Odour Intensity Observation Log Sheet

Panelist Name: Johan Meline
 Date: 16/08/2018
 Start Time: 7:28
 Site Code: 3 Aldinga Storage Basin
 GPS Location: X: 271,121 Y: 6,091,184 54H
 Intensity Scale:

Wind Speed: near calm
 Wind Direction: N
 Temperature: 9 °C

Photo:
 (in Wdir blowing from)



0	1	2	3	4	5	6
Not Detectable	Very Weak	Weak	Distinct	Strong	Very Strong	Extremely Strong

Perceived Odour Source:

Targeted odour: treated water storage odour

Time	Intensity	Source	Time	Intensity	Source	Time	Intensity	Source
0:10	0		3:30	0		6:50	0	
0:20	0		3:40	0		7:00	0	
0:30	0		3:50	0		7:10	0	
0:40	0		4:00	0		7:20	0	
0:50	0		4:10	0		7:30	0	
1:00	0		4:20	0		7:40	0	
1:10	0		4:30	0		7:50	0	
1:20	0		4:40	0		8:00	0	
1:30	0		4:50	0		8:10	0	
1:40	0		5:00	0		8:20	0	
1:50	0		5:10	0		8:30	0	
2:00	0		5:20	0		8:40	0	
2:10	0		5:30	0		8:50	0	
2:20	0		5:40	0		9:00	0	
2:30	0		5:50	0		9:10	0	
2:40	0		6:00	0		9:20	0	
2:50	0		6:10	0		9:30	0	
3:00	0		6:20	0		9:40	0	
3:10	0		6:30	0		9:50	0	
3:20	0		6:40	0		10:00	0	

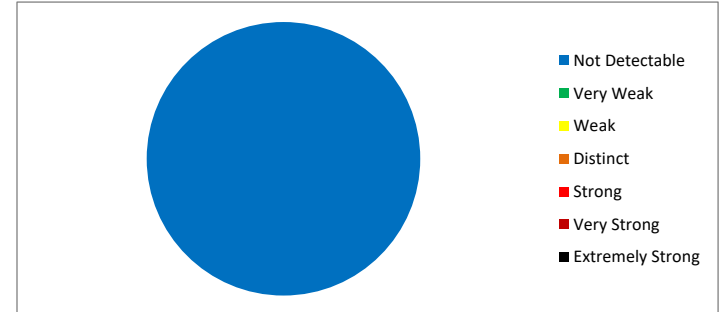
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0	0	0	0	0
0	0	0	0	0
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0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

Summary odour intensity observations:

Intensity	No obs	%	Descriptor
0	60	100%	Not Detectable
1	0	0%	Very Weak
2	0	0%	Weak
3	0	0%	Distinct
4	0	0%	Strong
5	0	0%	Very Strong
6	0	0%	Extremely Strong
	60	100%	

Plot of percentages of odour intensity observations:



Field Odour Intensity Observation Log Sheet

Panelist Name: Johan Meline
 Date: 16/08/2018
 Start Time: 8:08
 Site Code: 4 Aldinga Storage Basin
 GPS Location: X: 271,150 Y: 6,091,185 54H

Wind Speed: near calm
 Wind Direction: N
 Temperature: 10 °C

Intensity Scale:

0	1	2	3	4	5	6
Not Detectable	Very Weak	Weak	Distinct	Strong	Very Strong	Extremely Strong

Perceived Odour Source:

Targeted odour: treated water storage odour

Photo:
 (in Wdir blowing from)



Time	Intensity	Source	Time	Intensity	Source	Time	Intensity	Source
0:10	0		3:30	0		6:50	0	
0:20	0		3:40	0		7:00	0	
0:30	0		3:50	0		7:10	0	
0:40	0		4:00	0		7:20	0	
0:50	0		4:10	0		7:30	0	
1:00	0		4:20	0		7:40	0	
1:10	0		4:30	0		7:50	0	
1:20	0		4:40	0		8:00	0	
1:30	0		4:50	0		8:10	0	
1:40	0		5:00	0		8:20	0	
1:50	0		5:10	0		8:30	0	
2:00	0		5:20	0		8:40	0	
2:10	0		5:30	0		8:50	0	
2:20	0		5:40	0		9:00	0	
2:30	0		5:50	0		9:10	0	
2:40	0		6:00	0		9:20	0	
2:50	0		6:10	0		9:30	0	
3:00	0		6:20	0		9:40	0	
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3:20	0		6:40	0		10:00	0	

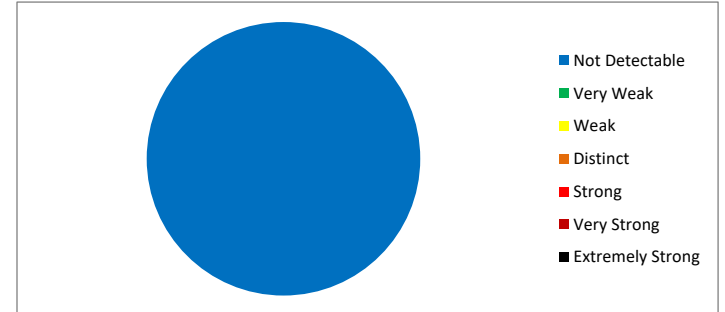
Colour coding of intensity observations:

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0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

Summary odour intensity observations:

Intensity	No obs	%	Descriptor
0	60	100%	Not Detectable
1	0	0%	Very Weak
2	0	0%	Weak
3	0	0%	Distinct
4	0	0%	Strong
5	0	0%	Very Strong
6	0	0%	Extremely Strong
	60	100%	

Plot of percentages of odour intensity observations:



Field Odour Intensity Observation Log Sheet

Panelist Name: Johan Meline
 Date: 16/08/2018
 Start Time: 9:00
 Site Code: 5 Quarry Road Storage Dam
 GPS Location: X: 272,574 Y: 6,102,913 54H
 Intensity Scale:

Wind Speed: 1-2 m/s
 Wind Direction: WSW
 Temperature: 11 °C

Photo:
 (in Wdir blowing from)



0	1	2	3	4	5	6
Not Detectable	Very Weak	Weak	Distinct	Strong	Very Strong	Extremely Strong

Perceived Odour Source:

Targeted odour: treated water storage odour

Time	Intensity	Source	Time	Intensity	Source	Time	Intensity	Source
0:10	0		3:30	2		6:50	1	
0:20	2		3:40	2		7:00	1	
0:30	0		3:50	0		7:10	0	
0:40	1		4:00	1		7:20	0	
0:50	0		4:10	2		7:30	0	
1:00	0		4:20	0		7:40	0	
1:10	0		4:30	0		7:50	0	
1:20	0		4:40	0		8:00	1	
1:30	1		4:50	0		8:10	2	
1:40	0		5:00	0		8:20	1	
1:50	0		5:10	2		8:30	0	
2:00	0		5:20	0		8:40	0	
2:10	0		5:30	0		8:50	0	
2:20	0		5:40	0		9:00	0	
2:30	0		5:50	0		9:10	0	
2:40	0		6:00	0		9:20	0	
2:50	0		6:10	0		9:30	2	
3:00	0		6:20	0		9:40	1	
3:10	0		6:30	0		9:50	0	
3:20	0		6:40	2		10:00	0	

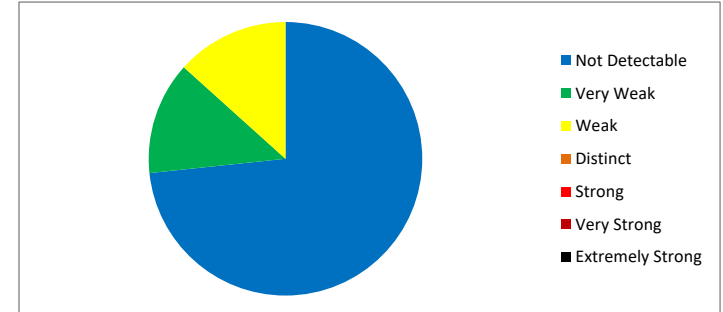
Colour coding of intensity observations:

0	0	2	0	2
2	0	0	0	1
0	0	0	0	0
1	0	0	2	0
0	0	0	1	0
0	0	0	1	0
0	0	2	0	0
0	0	0	0	0
1	2	0	0	2
0	2	0	0	1
0	0	0	0	0
0	1	0	1	0

Summary odour intensity observations:

Intensity	No obs	%	Descriptor
0	44	73%	Not Detectable
1	8	13%	Very Weak
2	8	13%	Weak
3	0	0%	Distinct
4	0	0%	Strong
5	0	0%	Very Strong
6	0	0%	Extremely Strong
60		100%	

Plot of percentages of odour intensity observations:



Field Odour Intensity Observation Log Sheet

Panelist Name: Johan Meline
 Date: 16/08/2018
 Start Time: 9:11
 Site Code: 6 Quarry Road Storage Dam
 GPS Location: X: 272,596 Y: 6,102,920 54H

Wind Speed: 1-2 m/s
 Wind Direction: WSW
 Temperature: 11 °C

Intensity Scale:

0	1	2	3	4	5	6
Not Detectable	Very Weak	Weak	Distinct	Strong	Very Strong	Extremely Strong

Perceived Odour Source:

Targeted odour: treated water storage odour

Photo:

(in Wdir blowing from)



Time	Intensity	Source	Time	Intensity	Source	Time	Intensity	Source
0:10	0		3:30	0		6:50	0	
0:20	0		3:40	0		7:00	0	
0:30	0		3:50	0		7:10	2	
0:40	0		4:00	0		7:20	1	
0:50	0		4:10	0		7:30	1	
1:00	0		4:20	0		7:40	0	
1:10	0		4:30	0		7:50	0	
1:20	1		4:40	0		8:00	0	
1:30	0		4:50	0		8:10	0	
1:40	0		5:00	0		8:20	0	
1:50	0		5:10	0		8:30	0	
2:00	0		5:20	0		8:40	0	
2:10	0		5:30	0		8:50	0	
2:20	0		5:40	0		9:00	0	
2:30	1		5:50	0		9:10	0	
2:40	0		6:00	1		9:20	0	
2:50	0		6:10	2		9:30	0	
3:00	0		6:20	0		9:40	0	
3:10	0		6:30	0		9:50	0	
3:20	0		6:40	0		10:00	0	

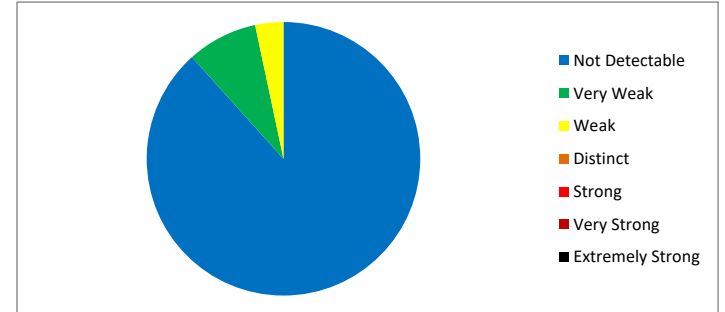
Colour coding of intensity observations:

0	0	0	2	0
0	0	0	0	0
0	1	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	2	0
1	0	0	1	0
0	0	0	1	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	1	0	0

Summary odour intensity observations:

Intensity	No obs	%	Descriptor
0	53	88%	Not Detectable
1	5	8%	Very Weak
2	2	3%	Weak
3	0	0%	Distinct
4	0	0%	Strong
5	0	0%	Very Strong
6	0	0%	Extremely Strong
60		100%	

Plot of percentages of odour intensity observations:



Field Odour Intensity Observation Log Sheet

Panelist Name: Johan Meline
 Date: 16/08/2018
 Start Time: 9:22
 Site Code: 7 Quarry Road Storage Dam
 GPS Location: X: 272,599 Y: 6,102,903 54H
 Intensity Scale:

Wind Speed: 1-2 m/s
 Wind Direction: WSW
 Temperature: 12 °C

Photo:
 (in Wdir blowing from)



0	1	2	3	4	5	6
Not Detectable	Very Weak	Weak	Distinct	Strong	Very Strong	Extremely Strong

Perceived Odour Source:

Targeted odour: treated water storage odour

Time	Intensity	Source	Time	Intensity	Source	Time	Intensity	Source
0:10	2		3:30	0		6:50	0	
0:20	2		3:40	0		7:00	0	
0:30	0		3:50	0		7:10	0	
0:40	0		4:00	0		7:20	0	
0:50	0		4:10	0		7:30	0	
1:00	0		4:20	0		7:40	0	
1:10	0		4:30	0		7:50	0	
1:20	0		4:40	1		8:00	0	
1:30	0		4:50	0		8:10	1	
1:40	0		5:00	0		8:20	0	
1:50	0		5:10	0		8:30	0	
2:00	0		5:20	0		8:40	0	
2:10	0		5:30	0		8:50	0	
2:20	2		5:40	0		9:00	0	
2:30	0		5:50	0		9:10	0	
2:40	0		6:00	1		9:20	0	
2:50	0		6:10	0		9:30	0	
3:00	0		6:20	0		9:40	0	
3:10	0		6:30	0		9:50	0	
3:20	0		6:40	0		10:00	0	

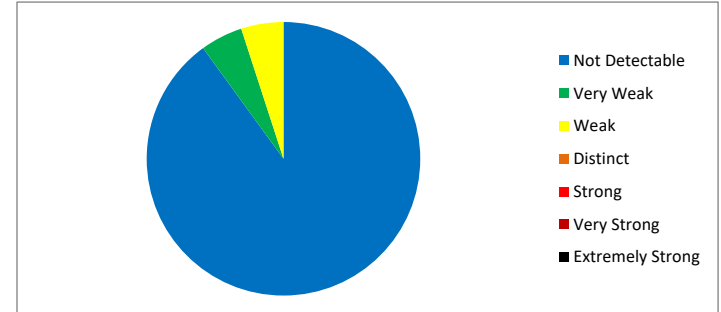
Colour coding of intensity observations:

2	0	0	0	1
2	2	0	0	0
0	0	0	0	0
0	0	1	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	1	0	0

Summary odour intensity observations:

Intensity	No obs	%	Descriptor
0	54	90%	Not Detectable
1	3	5%	Very Weak
2	3	5%	Weak
3	0	0%	Distinct
4	0	0%	Strong
5	0	0%	Very Strong
6	0	0%	Extremely Strong
	60	100%	

Plot of percentages of odour intensity observations:



Field Odour Intensity Observation Log Sheet

Panelist Name: Johan Meline
 Date: 16/08/2018
 Start Time: 9:34
 Site Code: 8 Quarry Road Storage Dam
 GPS Location: X: 272,601 Y: 6,102,864 54H
 Intensity Scale:

Wind Speed: 1-2 m/s
 Wind Direction: WSW
 Temperature: 12 °C

Photo:
 (in Wdir blowing from)



0	1	2	3	4	5	6
Not Detectable	Very Weak	Weak	Distinct	Strong	Very Strong	Extremely Strong

Perceived Odour Source:
 Targeted odour: treated water storage odour

Time	Intensity	Source	Time	Intensity	Source	Time	Intensity	Source
0:10	0		3:30	1		6:50	0	
0:20	0		3:40	2		7:00	1	
0:30	0		3:50	1		7:10	0	
0:40	2		4:00	0		7:20	0	
0:50	2		4:10	0		7:30	0	
1:00	0		4:20	0		7:40	0	
1:10	0		4:30	1		7:50	0	
1:20	0		4:40	0		8:00	0	
1:30	0		4:50	0		8:10	0	
1:40	0		5:00	0		8:20	0	
1:50	1		5:10	0		8:30	0	
2:00	0		5:20	0		8:40	0	
2:10	0		5:30	0		8:50	0	
2:20	0		5:40	0		9:00	0	
2:30	1		5:50	0		9:10	0	
2:40	0		6:00	0		9:20	0	
2:50	0		6:10	2		9:30	0	
3:00	0		6:20	0		9:40	1	
3:10	0		6:30	0		9:50	0	
3:20	0		6:40	0		10:00	0	

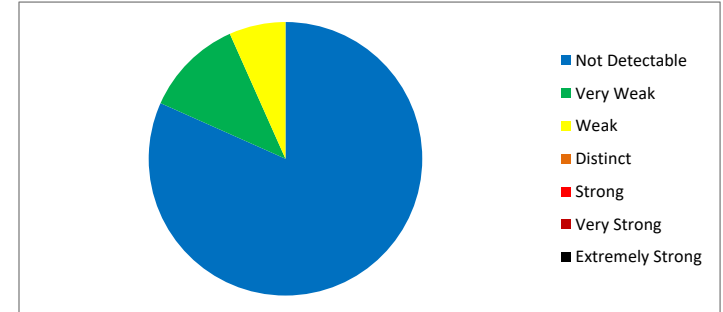
Colour coding of intensity observations:

0	0	0	2	0
0	0	0	0	0
0	1	1	0	0
2	0	0	0	0
2	0	0	0	0
0	0	0	1	0
0	0	0	0	0
0	0	0	0	0
0	1	0	0	0
0	2	0	0	1
1	1	0	0	0
0	0	0	0	0

Summary odour intensity observations:

Intensity	No obs	%	Descriptor
0	49	82%	Not Detectable
1	7	12%	Very Weak
2	4	7%	Weak
3	0	0%	Distinct
4	0	0%	Strong
5	0	0%	Very Strong
6	0	0%	Extremely Strong
60		100%	

Plot of percentages of odour intensity observations:



Field Odour Intensity Observation Log Sheet

Panelist Name: Johan Meline
 Date: 16/08/2018
 Start Time: 9:45
 Site Code: 9 Quarry Road Storage Dam
 GPS Location: X: 272,587 Y: 6,102,873 54H

Wind Speed: 1-2 m/s
 Wind Direction: WSW
 Temperature: 13 °C

Photo:
 (in Wdir blowing from)



0	1	2	3	4	5	6
Not Detectable	Very Weak	Weak	Distinct	Strong	Very Strong	Extremely Strong

Perceived Odour Source:

Targeted odour: treated water storage odour

Time	Intensity	Source	Time	Intensity	Source	Time	Intensity	Source
0:10	0		3:30	0		6:50	1	
0:20	0		3:40	0		7:00	1	
0:30	1		3:50	0		7:10	2	
0:40	1		4:00	1		7:20	0	
0:50	0		4:10	2		7:30	0	
1:00	0		4:20	0		7:40	0	
1:10	0		4:30	1		7:50	0	
1:20	0		4:40	2		8:00	0	
1:30	0		4:50	0		8:10	0	
1:40	0		5:00	0		8:20	0	
1:50	1		5:10	0		8:30	0	
2:00	2		5:20	0		8:40	0	
2:10	1		5:30	0		8:50	0	
2:20	0		5:40	0		9:00	1	
2:30	1		5:50	0		9:10	1	
2:40	0		6:00	0		9:20	0	
2:50	2		6:10	0		9:30	1	
3:00	0		6:20	0		9:40	0	
3:10	0		6:30	0		9:50	1	
3:20	0		6:40	0		10:00	1	

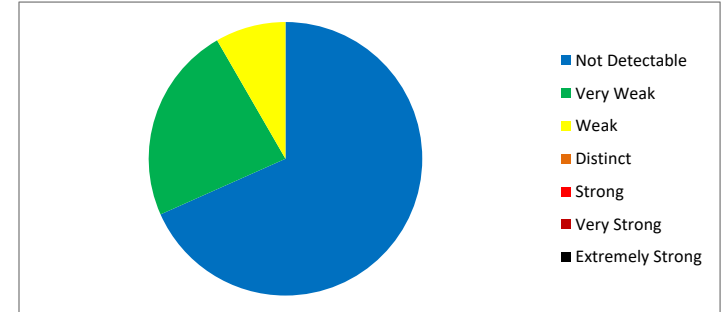
Colour coding of intensity observations:

0	1	2	0	0
0	0	0	0	0
1	1	1	0	0
1	0	2	0	0
0	2	0	1	0
0	0	0	1	1
0	0	0	2	1
0	0	0	0	0
0	0	0	0	1
0	0	0	0	0
1	0	0	0	1
2	1	0	0	1

Summary odour intensity observations:

Intensity	No obs	%	Descriptor
0	41	68%	Not Detectable
1	14	23%	Very Weak
2	5	8%	Weak
3	0	0%	Distinct
4	0	0%	Strong
5	0	0%	Very Strong
6	0	0%	Extremely Strong
60		100%	

Plot of percentages of odour intensity observations:



Field Odour Intensity Observation Log Sheet

Panelist Name: Johan Meline
 Date: 16/08/2018
 Start Time: 9:57
 Site Code: 10 Quarry Road Storage Dam
 GPS Location: X: 272,487 Y: 6,102,910 54H
 Intensity Scale:

Wind Speed: 1-2 m/s
 Wind Direction: WSW
 Temperature: 13 °C

Photo:
 (in Wdir blowing from)

0	1	2	3	4	5	6
Not Detectable	Very Weak	Weak	Distinct	Strong	Very Strong	Extremely Strong

Perceived Odour Source:

Targeted odour: treated water storage odour



Time	Intensity	Source	Time	Intensity	Source	Time	Intensity	Source
0:10	0		3:30	0		6:50	0	
0:20	0		3:40	0		7:00	0	
0:30	0		3:50	0		7:10	0	
0:40	0		4:00	0		7:20	0	
0:50	0		4:10	0		7:30	0	
1:00	0		4:20	0		7:40	0	
1:10	0		4:30	0		7:50	0	
1:20	0		4:40	0		8:00	0	
1:30	0		4:50	0		8:10	0	
1:40	0		5:00	0		8:20	0	
1:50	0		5:10	0		8:30	0	
2:00	0		5:20	0		8:40	0	
2:10	0		5:30	0		8:50	0	
2:20	0		5:40	0		9:00	0	
2:30	0		5:50	0		9:10	0	
2:40	0		6:00	0		9:20	0	
2:50	0		6:10	0		9:30	0	
3:00	0		6:20	0		9:40	0	
3:10	0		6:30	0		9:50	0	
3:20	0		6:40	0		10:00	0	

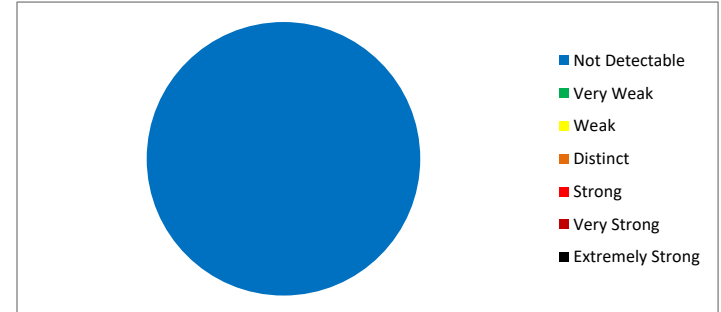
Colour coding of intensity observations:

0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

Summary odour intensity observations:

Intensity	No obs	%	Descriptor
0	60	100%	Not Detectable
1	0	0%	Very Weak
2	0	0%	Weak
3	0	0%	Distinct
4	0	0%	Strong
5	0	0%	Very Strong
6	0	0%	Extremely Strong
	60	100%	

Plot of percentages of odour intensity observations:



Field Odour Intensity Observation Log Sheet

Panelist Name: Johan Meline
 Date: 16/08/2018
 Start Time: 10:10
 Site Code: 11 Quarry Road Storage Dam
 GPS Location: X: 272,597 Y: 6,102,935 54H

Wind Speed: 1-2 m/s
 Wind Direction: WSW
 Temperature: 13 °C

Photo:
 (in Wdir blowing from)



0	1	2	3	4	5	6
Not Detectable	Very Weak	Weak	Distinct	Strong	Very Strong	Extremely Strong

Perceived Odour Source:

Targeted odour: treated water storage odour

Time	Intensity	Source	Time	Intensity	Source	Time	Intensity	Source
0:10	0		3:30	0		6:50	0	
0:20	0		3:40	0		7:00	0	
0:30	0		3:50	0		7:10	1	
0:40	0		4:00	0		7:20	0	
0:50	0		4:10	0		7:30	0	
1:00	0		4:20	0		7:40	0	
1:10	0		4:30	0		7:50	0	
1:20	0		4:40	0		8:00	0	
1:30	0		4:50	0		8:10	0	
1:40	0		5:00	0		8:20	0	
1:50	0		5:10	0		8:30	0	
2:00	0		5:20	0		8:40	0	
2:10	0		5:30	0		8:50	0	
2:20	0		5:40	0		9:00	0	
2:30	0		5:50	0		9:10	0	
2:40	0		6:00	0		9:20	0	
2:50	0		6:10	0		9:30	0	
3:00	0		6:20	0		9:40	0	
3:10	0		6:30	0		9:50	0	
3:20	0		6:40	0		10:00	0	

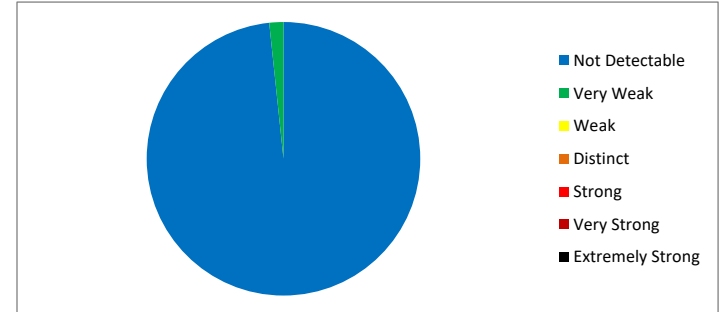
Colour coding of intensity observations:

0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	1	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

Summary odour intensity observations:

Intensity	No obs	%	Descriptor
0	59	98%	Not Detectable
1	1	2%	Very Weak
2	0	0%	Weak
3	0	0%	Distinct
4	0	0%	Strong
5	0	0%	Very Strong
6	0	0%	Extremely Strong
	60	100%	

Plot of percentages of odour intensity observations:



Field Odour Intensity Observation Log Sheet

Panelist Name: Johan Meline
 Date: 16/08/2018
 Start Time: 10:21
 Site Code: 12 Quarry Road Storage Dam
 GPS Location: X: 272,566 Y: 6,102,937 54H

Wind Speed: 1-2 m/s
 Wind Direction: WSW
 Temperature: 13 °C

Intensity Scale:

0	1	2	3	4	5	6
Not Detectable	Very Weak	Weak	Distinct	Strong	Very Strong	Extremely Strong

Perceived Odour Source:

Targeted odour: treated water storage odour

Photo:
 (in Wdir blowing from)



Time	Intensity	Source	Time	Intensity	Source	Time	Intensity	Source
0:10	0		3:30	0		6:50	0	
0:20	0		3:40	0		7:00	0	
0:30	0		3:50	0		7:10	0	
0:40	0		4:00	0		7:20	0	
0:50	0		4:10	0		7:30	0	
1:00	0		4:20	0		7:40	0	
1:10	0		4:30	0		7:50	0	
1:20	0		4:40	0		8:00	0	
1:30	0		4:50	0		8:10	0	
1:40	0		5:00	0		8:20	0	
1:50	0		5:10	0		8:30	0	
2:00	0		5:20	0		8:40	0	
2:10	0		5:30	0		8:50	0	
2:20	0		5:40	0		9:00	0	
2:30	0		5:50	0		9:10	0	
2:40	0		6:00	0		9:20	0	
2:50	0		6:10	0		9:30	0	
3:00	0		6:20	0		9:40	0	
3:10	0		6:30	0		9:50	0	
3:20	0		6:40	0		10:00	0	

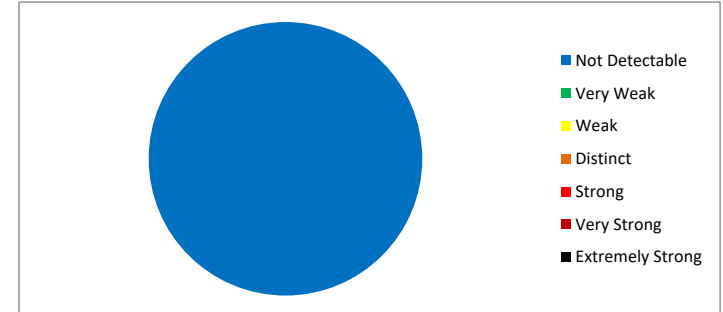
Colour coding of intensity observations:

0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

Summary odour intensity observations:

Intensity	No obs	%	Descriptor
0	60	100%	Not Detectable
1	0	0%	Very Weak
2	0	0%	Weak
3	0	0%	Distinct
4	0	0%	Strong
5	0	0%	Very Strong
6	0	0%	Extremely Strong
	60	100%	

Plot of percentages of odour intensity observations:



Field Odour Intensity Observation Log Sheet

Panelist Name: Johan Meline
 Date: 16/08/2018
 Start Time: 14:41
 Site Code: 13 Little Road Storage Dam
 GPS Location: X: 275,942 Y: 6,095,083 54H

Wind Speed: 1-3 m/s
 Wind Direction: NW
 Temperature: 13 °C

Intensity Scale:

0	1	2	3	4	5	6
Not Detectable	Very Weak	Weak	Distinct	Strong	Very Strong	Extremely Strong

Perceived Odour Source:

Targeted odour: treated water storage odour

Photo:

(in Wdir blowing from)



Time	Intensity	Source	Time	Intensity	Source	Time	Intensity	Source
0:10	0		3:30	0		6:50	0	
0:20	0		3:40	0		7:00	0	
0:30	0		3:50	0		7:10	0	
0:40	0		4:00	0		7:20	0	
0:50	0		4:10	0		7:30	0	
1:00	0		4:20	0		7:40	0	
1:10	0		4:30	0		7:50	0	
1:20	0		4:40	0		8:00	0	
1:30	0		4:50	0		8:10	0	
1:40	0		5:00	0		8:20	0	
1:50	0		5:10	0		8:30	0	
2:00	0		5:20	0		8:40	0	
2:10	0		5:30	0		8:50	0	
2:20	0		5:40	0		9:00	0	
2:30	0		5:50	0		9:10	0	
2:40	0		6:00	0		9:20	0	
2:50	0		6:10	0		9:30	0	
3:00	0		6:20	0		9:40	0	
3:10	0		6:30	0		9:50	0	
3:20	0		6:40	0		10:00	0	

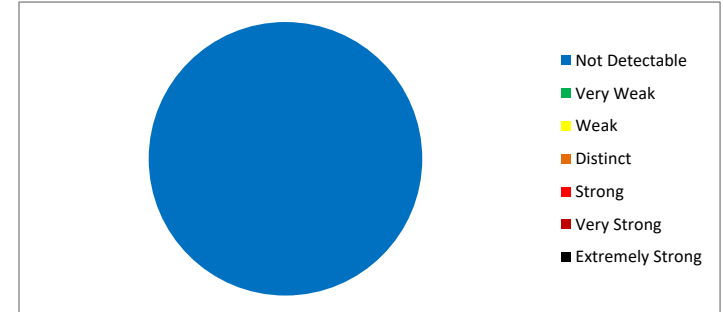
Colour coding of intensity observations:

0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

Summary odour intensity observations:

Intensity	No obs	%	Descriptor
0	60	100%	Not Detectable
1	0	0%	Very Weak
2	0	0%	Weak
3	0	0%	Distinct
4	0	0%	Strong
5	0	0%	Very Strong
6	0	0%	Extremely Strong
	60	100%	

Plot of percentages of odour intensity observations:



Field Odour Intensity Observation Log Sheet

Panelist Name: Johan Meline
 Date: 16/08/2018
 Start Time: 14:59
 Site Code: 14 Little Road Storage Dam
 GPS Location: X: 275,983 Y: 6,094,910 54H

Wind Speed: 1-3 m/s
 Wind Direction: NW
 Temperature: 13 °C

Photo:
 (in Wdir blowing from)



0	1	2	3	4	5	6
Not Detectable	Very Weak	Weak	Distinct	Strong	Very Strong	Extremely Strong

Perceived Odour Source:
 Targeted odour: treated water storage odour

Time	Intensity	Source	Time	Intensity	Source	Time	Intensity	Source
0:10	0		3:30	0		6:50	0	
0:20	0		3:40	0		7:00	0	
0:30	0		3:50	0		7:10	0	
0:40	0		4:00	0		7:20	0	
0:50	0		4:10	0		7:30	0	
1:00	0		4:20	0		7:40	1	
1:10	0		4:30	1		7:50	0	
1:20	0		4:40	0		8:00	0	
1:30	0		4:50	0		8:10	0	
1:40	0		5:00	0		8:20	0	
1:50	0		5:10	0		8:30	0	
2:00	0		5:20	0		8:40	0	
2:10	0		5:30	0		8:50	0	
2:20	0		5:40	0		9:00	0	
2:30	0		5:50	0		9:10	0	
2:40	0		6:00	0		9:20	0	
2:50	0		6:10	1		9:30	0	
3:00	0		6:20	0		9:40	0	
3:10	1		6:30	0		9:50	0	
3:20	0		6:40	0		10:00	0	

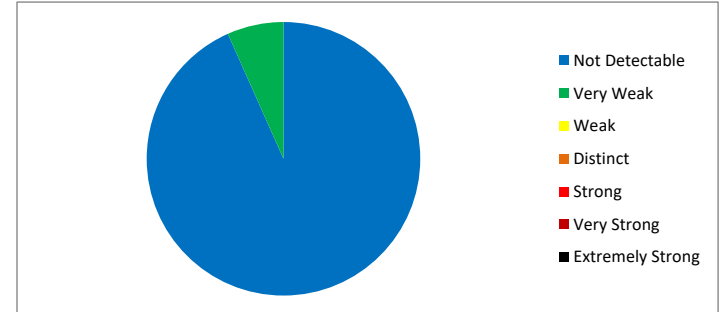
Colour coding of intensity observations:

0	0	0	1	0
0	0	0	0	0
0	0	1	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	1	0	0	0
0	0	0	0	0
0	0	0	1	0
0	0	0	0	0
0	0	0	0	0

Summary odour intensity observations:

Intensity	No obs	%	Descriptor
0	56	93%	Not Detectable
1	4	7%	Very Weak
2	0	0%	Weak
3	0	0%	Distinct
4	0	0%	Strong
5	0	0%	Very Strong
6	0	0%	Extremely Strong
60		100%	

Plot of percentages of odour intensity observations:



Field Odour Intensity Observation Log Sheet

Panelist Name: Johan Meline
 Date: 16/08/2018
 Start Time: 15:10
 Site Code: 15 Little Road Storage Dam
 GPS Location: X: 275,997 Y: 6,094,837 54H
 Intensity Scale:

Wind Speed: 1-3 m/s
 Wind Direction: NW
 Temperature: 13 °C

Photo:
 (in Wdir blowing from)



0	1	2	3	4	5	6
Not Detectable	Very Weak	Weak	Distinct	Strong	Very Strong	Extremely Strong

Perceived Odour Source:

Targeted odour: treated water storage odour

Time	Intensity	Source	Time	Intensity	Source	Time	Intensity	Source
0:10	0		3:30	0		6:50	0	
0:20	0		3:40	0		7:00	0	
0:30	0		3:50	0		7:10	0	
0:40	0		4:00	0		7:20	0	
0:50	0		4:10	0		7:30	0	
1:00	0		4:20	0		7:40	0	
1:10	0		4:30	0		7:50	0	
1:20	0		4:40	0		8:00	0	
1:30	0		4:50	0		8:10	0	
1:40	0		5:00	0		8:20	0	
1:50	0		5:10	0		8:30	0	
2:00	0		5:20	0		8:40	0	
2:10	0		5:30	0		8:50	0	
2:20	0		5:40	0		9:00	0	
2:30	0		5:50	0		9:10	0	
2:40	0		6:00	0		9:20	0	
2:50	0		6:10	0		9:30	0	
3:00	0		6:20	0		9:40	0	
3:10	0		6:30	0		9:50	0	
3:20	0		6:40	0		10:00	0	

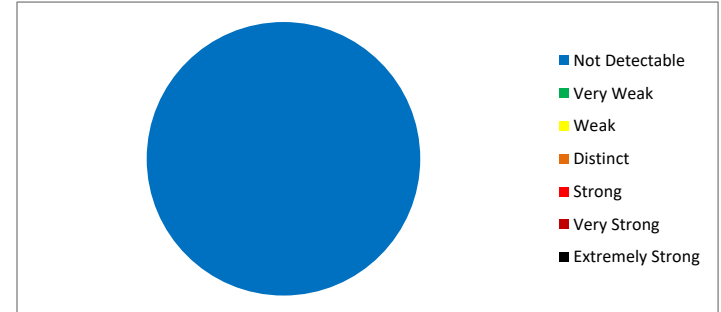
Colour coding of intensity observations:

0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

Summary odour intensity observations:

Intensity	No obs	%	Descriptor
0	60	100%	Not Detectable
1	0	0%	Very Weak
2	0	0%	Weak
3	0	0%	Distinct
4	0	0%	Strong
5	0	0%	Very Strong
6	0	0%	Extremely Strong
	60	100%	

Plot of percentages of odour intensity observations:



Field Odour Intensity Observation Log Sheet

Panelist Name: Johan Meline
 Date: 16/08/2018
 Start Time: 15:21
 Site Code: 16 Little Road Storage Dam
 GPS Location: X: 275,968 Y: 6,094,862 54H
 Intensity Scale:

Wind Speed: 1-3 m/s
 Wind Direction: NW
 Temperature: 13 °C

Photo:
 (in Wdir blowing from)



0	1	2	3	4	5	6
Not Detectable	Very Weak	Weak	Distinct	Strong	Very Strong	Extremely Strong

Perceived Odour Source:

Targeted odour: treated water storage odour

Time	Intensity	Source	Time	Intensity	Source	Time	Intensity	Source
0:10	1		3:30	0		6:50	0	
0:20	2		3:40	1		7:00	0	
0:30	0		3:50	0		7:10	0	
0:40	1		4:00	0		7:20	0	
0:50	0		4:10	1		7:30	0	
1:00	0		4:20	1		7:40	0	
1:10	0		4:30	0		7:50	0	
1:20	0		4:40	0		8:00	0	
1:30	0		4:50	0		8:10	1	
1:40	0		5:00	0		8:20	0	
1:50	0		5:10	0		8:30	0	
2:00	0		5:20	0		8:40	2	
2:10	0		5:30	0		8:50	0	
2:20	0		5:40	0		9:00	0	
2:30	0		5:50	0		9:10	0	
2:40	0		6:00	0		9:20	0	
2:50	0		6:10	0		9:30	0	
3:00	0		6:20	0		9:40	0	
3:10	0		6:30	1		9:50	0	
3:20	0		6:40	1		10:00	0	

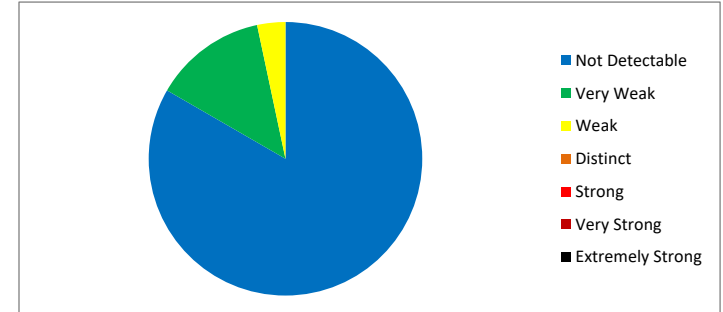
Colour coding of intensity observations:

1	0	1	0	1
2	0	1	0	0
0	0	0	1	0
1	0	0	1	2
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	1	0	0	0
0	0	0	0	0
0	0	0	0	0

Summary odour intensity observations:

Intensity	No obs	%	Descriptor
0	50	83%	Not Detectable
1	8	13%	Very Weak
2	2	3%	Weak
3	0	0%	Distinct
4	0	0%	Strong
5	0	0%	Very Strong
6	0	0%	Extremely Strong
60		100%	

Plot of percentages of odour intensity observations:



Field Odour Intensity Observation Log Sheet

Panelist Name: Johan Meline
 Date: 16/08/2018
 Start Time: 15:37
 Site Code: 17 Little Road Storage Dam
 GPS Location: X: 275,959 Y: 6,094,885 54H
 Intensity Scale:

Wind Speed: 1-3 m/s
 Wind Direction: NW
 Temperature: 12 °C

Photo:
 (in Wdir blowing from)



0	1	2	3	4	5	6
Not Detectable	Very Weak	Weak	Distinct	Strong	Very Strong	Extremely Strong

Perceived Odour Source:
 Targeted odour: treated water storage odour

Time	Intensity	Source	Time	Intensity	Source	Time	Intensity	Source
0:10	0		3:30	1		6:50	0	
0:20	0		3:40	0		7:00	1	
0:30	0		3:50	0		7:10	1	
0:40	1		4:00	0		7:20	0	
0:50	0		4:10	0		7:30	0	
1:00	0		4:20	0		7:40	1	
1:10	0		4:30	1		7:50	0	
1:20	0		4:40	0		8:00	0	
1:30	0		4:50	0		8:10	0	
1:40	0		5:00	0		8:20	0	
1:50	1		5:10	0		8:30	0	
2:00	1		5:20	0		8:40	0	
2:10	1		5:30	0		8:50	0	
2:20	1		5:40	1		9:00	0	
2:30	1		5:50	0		9:10	0	
2:40	0		6:00	0		9:20	0	
2:50	0		6:10	0		9:30	1	
3:00	0		6:20	0		9:40	0	
3:10	1		6:30	0		9:50	0	
3:20	0		6:40	0		10:00	0	

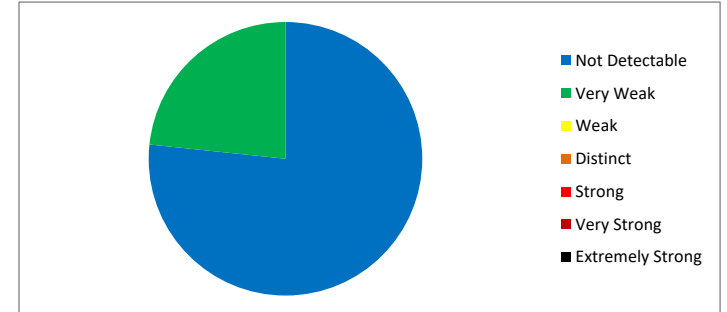
Colour coding of intensity observations:

0	1	0	0	0
0	1	0	0	0
0	1	1	0	0
1	0	0	0	0
0	0	0	0	0
0	0	0	1	0
0	1	0	1	0
0	0	0	0	0
0	1	0	0	1
0	0	1	1	0
1	0	0	0	0
1	0	0	0	0

Summary odour intensity observations:

Intensity	No obs	%	Descriptor
0	46	77%	Not Detectable
1	14	23%	Very Weak
2	0	0%	Weak
3	0	0%	Distinct
4	0	0%	Strong
5	0	0%	Very Strong
6	0	0%	Extremely Strong
60		100%	

Plot of percentages of odour intensity observations:



Field Odour Intensity Observation Log Sheet

Panelist Name: Johan Meline
 Date: 16/08/2018
 Start Time: 15:50
 Site Code: 18 Little Road Storage Dam
 GPS Location: X: 275,949 Y: 6,094,881 54H
 Intensity Scale:

Wind Speed: 1-3 m/s
 Wind Direction: NW
 Temperature: 12 °C

Photo:
 (in Wdir blowing from)



0	1	2	3	4	5	6
Not Detectable	Very Weak	Weak	Distinct	Strong	Very Strong	Extremely Strong

Perceived Odour Source:

Targeted odour: treated water storage odour

Time	Intensity	Source	Time	Intensity	Source	Time	Intensity	Source
0:10	0		3:30	1		6:50	0	
0:20	0		3:40	0		7:00	1	
0:30	1		3:50	0		7:10	0	
0:40	1		4:00	0		7:20	0	
0:50	0		4:10	1		7:30	0	
1:00	1		4:20	0		7:40	2	
1:10	0		4:30	0		7:50	1	
1:20	0		4:40	1		8:00	0	
1:30	0		4:50	2		8:10	0	
1:40	0		5:00	1		8:20	0	
1:50	1		5:10	0		8:30	1	
2:00	1		5:20	1		8:40	1	
2:10	1		5:30	1		8:50	1	
2:20	2		5:40	1		9:00	0	
2:30	0		5:50	0		9:10	1	
2:40	1		6:00	0		9:20	1	
2:50	0		6:10	0		9:30	1	
3:00	0		6:20	1		9:40	0	
3:10	1		6:30	1		9:50	1	
3:20	1		6:40	1		10:00	0	

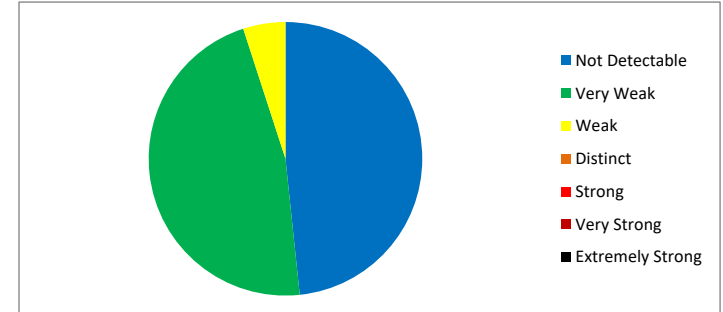
Colour coding of intensity observations:

0	1	1	0	0
0	2	0	1	0
1	0	0	1	1
1	1	1	1	1
0	0	2	0	1
1	0	1	1	0
0	1	0	0	1
0	1	1	0	1
0	1	1	0	1
0	0	1	2	0
1	0	0	1	1
1	0	0	0	0

Summary odour intensity observations:

Intensity	No obs	%	Descriptor
0	29	48%	Not Detectable
1	28	47%	Very Weak
2	3	5%	Weak
3	0	0%	Distinct
4	0	0%	Strong
5	0	0%	Very Strong
6	0	0%	Extremely Strong
60		100%	

Plot of percentages of odour intensity observations:



Field Odour Intensity Observation Log Sheet

Panelist Name: Johan Meline
 Date: 16/08/2018
 Start Time: 16:01
 Site Code: 19 Little Road Storage Dam
 GPS Location: X: 275,930 Y: 6,094,889 54H
 Intensity Scale:

Wind Speed: 2-4 m/s
 Wind Direction: NW
 Temperature: 12 °C

Photo:
 (in Wdir blowing from)



0	1	2	3	4	5	6
Not Detectable	Very Weak	Weak	Distinct	Strong	Very Strong	Extremely Strong

Perceived Odour Source:

Targeted odour: treated water storage odour

Time	Intensity	Source	Time	Intensity	Source	Time	Intensity	Source
0:10	1		3:30	0		6:50	0	
0:20	1		3:40	2		7:00	0	
0:30	1		3:50	1		7:10	0	
0:40	1		4:00	1		7:20	0	
0:50	1		4:10	1		7:30	1	
1:00	1		4:20	1		7:40	1	
1:10	1		4:30	0		7:50	1	
1:20	1		4:40	1		8:00	1	
1:30	1		4:50	1		8:10	1	
1:40	1		5:00	1		8:20	1	
1:50	1		5:10	0		8:30	1	
2:00	1		5:20	1		8:40	0	
2:10	0		5:30	1		8:50	0	
2:20	0		5:40	2		9:00	0	
2:30	0		5:50	1		9:10	0	
2:40	1		6:00	1		9:20	0	
2:50	0		6:10	1		9:30	0	
3:00	1		6:20	0		9:40	1	
3:10	1		6:30	0		9:50	0	
3:20	1		6:40	0		10:00	0	

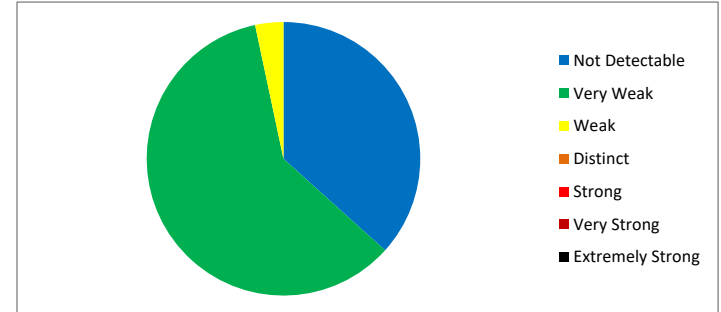
Colour coding of intensity observations:

1	0	1	1	1
1	0	1	0	1
1	0	0	0	1
1	1	1	0	0
1	0	1	0	0
1	1	1	0	0
1	1	0	0	0
1	1	1	0	0
1	1	1	0	0
1	0	1	1	0
1	2	2	1	1
1	1	1	1	0
1	1	1	1	0

Summary odour intensity observations:

Intensity	No obs	%	Descriptor
0	22	37%	Not Detectable
1	36	60%	Very Weak
2	2	3%	Weak
3	0	0%	Distinct
4	0	0%	Strong
5	0	0%	Very Strong
6	0	0%	Extremely Strong
60		100%	

Plot of percentages of odour intensity observations:



Field Odour Intensity Observation Log Sheet

Panelist Name: Johan Meline
 Date: 16/08/2018
 Start Time: 16:47
 Site Code: 20 Little Road Storage Dam
 GPS Location: X: 276,008 Y: 6,094,582 54H

Wind Speed: 2 m/s
 Wind Direction: NW
 Temperature: 12 °C

Intensity Scale:

0	1	2	3	4	5	6
Not Detectable	Very Weak	Weak	Distinct	Strong	Very Strong	Extremely Strong

Perceived Odour Source:

Targeted odour: treated water storage odour

Photo:

(in Wdir blowing from)



Time	Intensity	Source	Time	Intensity	Source	Time	Intensity	Source
0:10	0		3:30	0		6:50	0	
0:20	0		3:40	0		7:00	0	
0:30	0		3:50	0		7:10	0	
0:40	0		4:00	0		7:20	0	
0:50	0		4:10	0		7:30	0	
1:00	0		4:20	0		7:40	0	
1:10	0		4:30	0		7:50	0	
1:20	0		4:40	0		8:00	0	
1:30	0		4:50	0		8:10	0	
1:40	0		5:00	0		8:20	0	
1:50	0		5:10	0		8:30	0	
2:00	0		5:20	0		8:40	0	
2:10	0		5:30	0		8:50	0	
2:20	0		5:40	0		9:00	0	
2:30	0		5:50	0		9:10	0	
2:40	0		6:00	0		9:20	0	
2:50	0		6:10	0		9:30	0	
3:00	0		6:20	0		9:40	0	
3:10	0		6:30	0		9:50	0	
3:20	0		6:40	0		10:00	0	

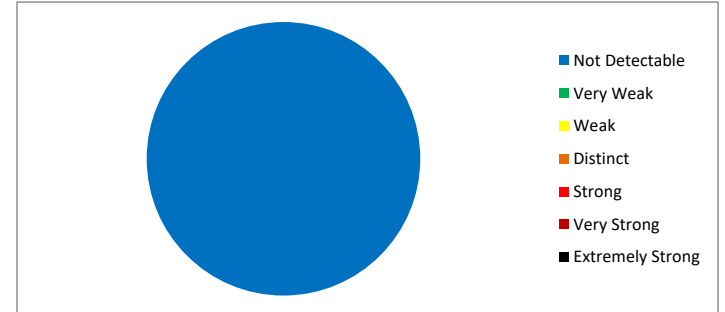
Colour coding of intensity observations:

0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

Summary odour intensity observations:

Intensity	No obs	%	Descriptor
0	60	100%	Not Detectable
1	0	0%	Very Weak
2	0	0%	Weak
3	0	0%	Distinct
4	0	0%	Strong
5	0	0%	Very Strong
6	0	0%	Extremely Strong
	60	100%	

Plot of percentages of odour intensity observations:



Field Odour Intensity Observation Log Sheet

Panelist Name: Johan Meline
 Date: 16/08/2018
 Start Time: 16:58
 Site Code: 21 Little Road Storage Dam
 GPS Location: X: 276,009 Y: 6,094,603 54H

Wind Speed: 2-3 m/s
 Wind Direction: NW
 Temperature: 12 °C

Photo:
 (in Wdir blowing from)



0	1	2	3	4	5	6
Not Detectable	Very Weak	Weak	Distinct	Strong	Very Strong	Extremely Strong

Perceived Odour Source:

Targeted odour: treated water storage odour

Time	Intensity	Source	Time	Intensity	Source	Time	Intensity	Source
0:10	0		3:30	0		6:50	0	
0:20	0		3:40	0		7:00	0	
0:30	0		3:50	0		7:10	0	
0:40	0		4:00	0		7:20	0	
0:50	0		4:10	0		7:30	0	
1:00	0		4:20	0		7:40	0	
1:10	0		4:30	0		7:50	0	
1:20	0		4:40	0		8:00	0	
1:30	0		4:50	0		8:10	0	
1:40	0		5:00	0		8:20	0	
1:50	0		5:10	0		8:30	0	
2:00	0		5:20	0		8:40	0	
2:10	0		5:30	0		8:50	0	
2:20	0		5:40	0		9:00	0	
2:30	0		5:50	0		9:10	0	
2:40	0		6:00	0		9:20	0	
2:50	0		6:10	0		9:30	0	
3:00	0		6:20	0		9:40	0	
3:10	0		6:30	0		9:50	0	
3:20	0		6:40	0		10:00	0	

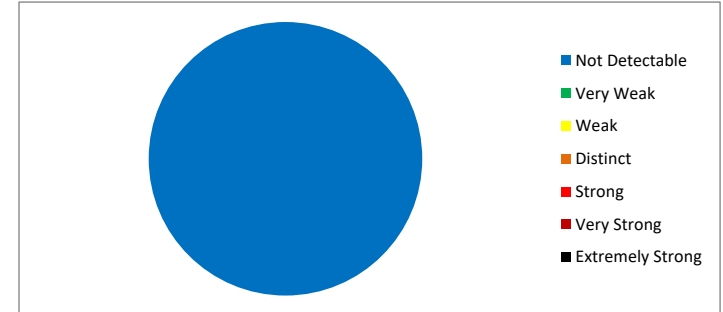
Colour coding of intensity observations:

0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

Summary odour intensity observations:

Intensity	No obs	%	Descriptor
0	60	100%	Not Detectable
1	0	0%	Very Weak
2	0	0%	Weak
3	0	0%	Distinct
4	0	0%	Strong
5	0	0%	Very Strong
6	0	0%	Extremely Strong
	60	100%	

Plot of percentages of odour intensity observations:



Appendix 10. SA Health Approval for use of Recycled Water



eA985824

Mr Craig Heidenreich
General Manager
Willunga Basin Water Company Pty Ltd
178 Main Road
MCLAREN VALE SA 5171

Public Health Services

Citi Centre Building
11 Hindmarsh Square
Adelaide SA 5000

PO Box 6
Rundle Mail SA 5000
DX 243

Tel 08 8226 7100
Fax 08 8226 7102
ABN 97 643 356 590
www.health.sa.gov.au

Dear Mr Heidenreich,

**VARIATION TO THE APPROVAL FOR THE USE OF RECYCLED WATER
THROUGH THE WILLUNGA BASIN PIPELINE SYSTEM BY WILLUNGA
BASIN WATER COMPANY**

Pursuant to the South Australian Public Health (Wastewater) Regulations 2013, the approval granted to Willunga Basin Water Company (WBWC) for the use of recycled water through the Willunga Basin Pipeline [7 October 2016] has been varied to include additional uses. These are dust suppression, municipal irrigation and private landscape irrigation in accord with the information submitted to the Department for Health and Ageing in September 2017. Clauses 2, 4 and 5 have been varied as below:

2. The recycled water can be used for the following
 - drip irrigation of grapevines, fruit trees, nut crops and flowers.
 - dust suppression with restricted public access
 - restricted municipal spray irrigation
 - restricted spray irrigation of gardens and landscapes.

There is to be no direct contact of the recycled water with any grapes, nuts or fruit harvested and supplied for human consumption without further processing. Spray irrigation is not to be used for food crops. Additional uses of the recycled water require prior approval from the Department for Health and Ageing.

4. With regard to access and signage;
 - 4.1 Public access is to be prevented during spray irrigation and dust suppression activities
 - 4.2 The irrigated areas are to be signposted to indicate recycled water is being used for irrigation – do not drink
 - 4.3 Accessible taps and fittings are to be marked to indicate recycled water-do not drink
 - 4.4 Recycled water for dust suppression should be carted in a dedicated vehicle/vessel and marked to indicate that the contents are not suitable for drinking.

5. Spray and spray drift from irrigation is to be contained within the boundaries of the irrigation site and runoff and ponding of recycled water is to be prevented. Irrigation should not be undertaken in windy conditions.

All other conditions remain the same. A copy of the amended approval is attached.

Approved by

Date 29 September 2017



Dr David Cunliffe
Principal Water Quality Advisor, Public Health

Delegate of the Minister for Health, pursuant to the South Australian Public Health (Wastewater) Regulations 2013



eA985824

Mr Craig Heidenreich
General Manager
Willunga Basin Water Company Pty Ltd
178 Main Road
MCLAREN VALE SA 5171

Public Health Services

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Dear Mr Heidenreich,

**VARIATION TO THE APPROVAL FOR THE USE OF RECYCLED WATER
THROUGH THE WILLUNGA BASIN PIPELINE SYSTEM BY WILLUNGA
BASIN WATER COMPANY**

Pursuant to the South Australian Public Health (Wastewater) Regulations 2013, approval is granted to Willunga Basin Water Company (WBWC) for the use of recycled water through the Willunga Basin Pipeline. The approval issued to WBWC on 7 October 2016 has been rescinded and is now replaced by this approval. The approval is subject to the following conditions:

1. The Willunga Basin Water Company will take responsibility for the operation of the scheme including the proper use of recycled water by each participant.
2. The recycled water is only to be used for the following
 - drip irrigation of grapevines, fruit trees, nut crops and flowers
 - dust suppression with restricted public access
 - restricted municipal spray irrigation
 - restricted spray irrigation of landscapes and gardens

There is to be no direct contact of the recycled water with any grapes, nuts or fruit harvested and supplied for human consumption without further processing. Spray irrigation is not to be used for food crops. Additional uses of the recycled water require prior approval from the Department for Health and Ageing.

3. The Willunga Basin Water Company is to provide the Department for Health and Ageing with a list of properties or sites irrigated with recycled water on an annual (financial year) basis.

4. With regard to access and signage;
 - 4.1 Public access is to be prevented during spray irrigation and dust suppression activities
 - 4.2 The irrigated areas are to be signposted to indicate recycled water is being used for irrigation – do not drink
 - 4.3 Accessible taps and fittings are to be marked to indicate recycled water-do not drink.
 - 4.4 Recycled water for dust suppression should be carted in a dedicated vehicle/vessel and marked to indicate that the contents are not suitable for drinking.
5. Spray and spray drift from irrigation is to be contained within the boundaries of the irrigation site and runoff and ponding of recycled water is to be prevented. Irrigation should not be undertaken in windy conditions.
6. The sources of the water distributed by the pipeline are
 - 6.1 the Christies Beach Wastewater Treatment Plant
 - 6.2 the Willunga Wastewater Treatment Plant
 - 6.3 the Aldinga Wastewater Treatment Plant and
 - 6.4 the Sellicks Beach Wastewater Treatment Plant.

These source waters are to contain ≤ 100 *E.coli* per 100 mL (median value). Water from Christies Beach, Willunga and Sellicks Beach is to contain ≤ 20 mg/L BOD₅ (mean value) and ≤ 30 mg/L suspended solids (mean value) while water from Aldinga is to contain ≤ 20 mg/L soluble BOD₅ (mean value). Water produced by Sellicks Beach will have a total chlorine residual of ≥ 1 mg/L. Water quality will be tested by the suppliers.

7. Recycled water from the irrigation system must not be allowed to contaminate potable water outlets. There will be no cross connections with any other water supply without backflow prevention to protect that supply as specified in AS3500 and in the case of public mains water supplies without approval from the South Australian Water Corporation.
8. The recycled water distribution system including associated fittings is to be marked or colour coded to indicate the carriage of reclaimed (or recycled) water. Leakage of water from the pipeline is to be prevented and drainage is only to be undertaken in a manner approved by the Environment Protection Agency and the Department for Health and Ageing.
9. Storage dams within the recycled water distribution system are to be sealed to prevent leakage of recycled water, will be protected from stormwater and will not be allowed to overtop the embankments. The storages are to incorporate minimum embankment freeboards of 600 mm above design storage capacity.

The storages are not to provide a source of offensive odours or nuisance conditions including breeding of vectors such as mosquitoes. The storages are to be protected against ingress of human and animal waste and stock access is to be prevented. The storages are to be enclosed by man-proof

fencing and are to be signposted other to indicate, reclaimed (or recycled) water storage – no swimming.

10. All employees, irrigators and others who could potentially be exposed to recycled water are to be instructed in appropriate health and safety procedures pursuant to the *Work Health and Safety Act 2012*.
11. Non-compliance with any of the conditions for approval is to be rectified immediately and is to be reported to the Department for Health and Ageing as soon as practicable and within 24 hours of the failure being detected.
12. Pursuant to the South Australian Public Health (Wastewater) Regulations 2013, the Department for Health and Ageing reserves the right to revoke all or any of the approval conditions and require the repair, replacement, rectification, alteration of the system or part thereof:
 - 12.1 at any time should the system or component thereof not be manufactured, installed and/or operated in accordance with the approval conditions; or
 - 12.2 at any time the system is defective and not able to perform the function for which the approval is issued; or
 - 12.3 it is operated in a manner that is prejudicial to public and environmental health or raises environmental nuisance.

Approved by

Date 29 September 2017



Dr David Cunliffe
Principal Water Quality Advisor, Public Health

Delegate of the Minister for Health, pursuant to the South Australian Public Health (Wastewater) Regulations 2013.

NOTE 1: The approval issued does not alleviate responsibilities for obtaining relevant approvals, permits or licenses under other Acts or Regulations.

Appendix 11. SA Health Correspondence

From: [Craig Heidenreich](#)
To: [Richard Dwyer](#)
Subject: FW: Proposed Water Storage Facility
Date: Thursday, 24 January 2019 12:22:15 PM
Attachments: [image003.png](#)
[image004.png](#)

FYI -

Craig Heidenreich
General Manager | Water Utilities Australia



Telephone +61 8 7999 8555
Mobile +61 439 399 974
Address Suite 1005, 147 Pirie Street, Adelaide SA 5000
Email cheidenreich@wua.com.au | **Website** waterutilitiesgroup.com.au



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From: Health:Public Health Water Quality <waterquality@sa.gov.au>
Sent: Wednesday, 22 August 2018 8:44 AM
To: Craig Heidenreich <CHeidenreich@wua.com.au>
Cc: Health:Public Health Water Quality <waterquality@sa.gov.au>
Subject: RE: Proposed Water Storage Facility

Hi Craig

As outlined in your proposal there are no fundamental differences from a public health perspective between the Bowering Hill Dam and the new proposal. SA Health considers that based on the proposed design the storage does not present any significant public health risks

Best Regards

David Cunliffe

Dr David Cunliffe
Principal Water Quality Adviser
Public Health Services
SA Health
david.cunliffe@sa.gov.au
61 8 8226 7153

From: Craig Heidenreich [<mailto:CHeidenreich@wua.com.au>]
Sent: Thursday, 2 August 2018 4:42 PM
To: Cunliffe, David (Health)

Cc: Health:Public Health Water Quality
Subject: RE: Proposed Water Storage Facility

Hi David,

The Bowering Hill Dam did not proceed due to the inability of WBWC to secure access to the land. We did not progress through the Development Application process in full. We have subsequently investigated another site which is adjacent to WBWC's existing Quarry Road Pump Station. The proposal incorporated a 600ML treated water storage dam and drawings of the proposed dam are attached.

As with the Bowering Hill Dam the storage is around 9m deep and incorporates a 1:3 internal batter for the dam walls and due to different soil conditions the facility will be plastic lined with an under-drain system for leak protection.

The site is adjacent to the Seaford Vista housing estate with the top of bank being set-back 57m from the boundary of the estate. A native buffer planting is proposed around the storage dam as shown on the drawings. Attached is a regional map showing the proposed site relative to the housing estate.

The only difference fundamental between the Bowering Hill proposal and this proposal is the proximity to the Seaford Vista housing estate.

Can you advise SA Health's position on this proposal noting your prior advice on the Bowering Hill proposal.

Please advise if you would like to meet to discuss this proposal before responding.

Regards, Craig.

Craig Heidenreich
General Manager | Water Utilities Australia



Telephone +61 8 7999 8555

Mobile +61 439 399 974

Address Suite 1005, 147 Pirie Street, Adelaide SA 5000

Email cheidenreich@wua.com.au | **Website** waterutilitiesgroup.com.au



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From: Cunliffe, David (Health) <David.Cunliffe@sa.gov.au>

Sent: Wednesday, 19 July 2017 2:41 PM

To: Craig Heidenreich <CHeidenreich@wua.com.au>
Cc: Health:Public Health Water Quality <waterquality@sa.gov.au>
Subject: RE: Proposed Water Storage Facility

Hi Craig,

Based on the information provided the Bowering Hill Dam should represent a low risk for supporting mosquito breeding.

The key to reducing risk is incorporation of specific design features. Past experience in South Australia has shown that these design features are effective in controlling/preventing mosquito growth in storages that collect or hold recycled water. The design features that you have described for Bowering Hill Dam are consistent with those required to minimise mosquito breeding. It is suggested that this could be confirmed by regular visits to the storage particularly during the first year of operation.

Best Regards

David Cunliffe

Dr David Cunliffe
Principal Water Quality Adviser
Public Health Services
SA Health
david.cunliffe@sa.gov.au
61 8 8226 7153

From: Craig Heidenreich [<mailto:CHeidenreich@wua.com.au>]
Sent: Wednesday, 19 July 2017 11:38 AM
To: Cunliffe, David (Health)
Cc: Health:Public Health Water Quality
Subject: Proposed Water Storage Facility
Importance: High

Hi David,

Willunga Basin Water are currently planning an expansion of the supply infrastructure for the McLaren Vale Region. The plans currently contemplate a large above ground water storage located on the corner of Iverene Road and Old Coach Road north of Aldinga.

We have a website that has been developed for consultation which is www.boweringhilldam.org.au which has information on the exact location, design, etc. The design on this site contemplates a 1,200ML storage and while this is not necessarily the final design, the information is indicative of the facility we are considering.

I note the condition below in WBWC's current SA Health Approval dated 7 October 2017.

9. Storage dams within the recycled water distribution system are to be sealed to prevent leakage of recycled water, will be protected from stormwater and will not be allowed to overtop the embankments. The storages are to incorporate minimum embankment freeboards of 600 mm above design storage capacity.

The storages are not to provide a source of offensive odours or nuisance conditions including breeding of vectors such as mosquitoes. The storages are to be protected against ingress of human and animal waste and stock access is to be prevented. The storages are to be enclosed by man-proof fencing and are to be signposted other to indicate, reclaimed (or recycled) water storage – no swimming.

There is some concern in the local community on a number of issues and one particular issue is the potential for mosquito and associated virus outbreaks and would like some feedback on experiences SA Health has had when these treated wastewater storages have been constructed elsewhere across the state.

SA Health have published a guidance document on mosquito management called the "South Australian Integrated Mosquito Management Resource Package 2006". This document provides some guidance for the construction of man-made water storages which includes the following recommendations:

- **Construction should occur away from "people intensive" areas such as high density residential area, schools and aged care facilities.**

The Bowering Hill Dam is located at least 1 km from a high density residential area, school or aged care facility. There is a caravan park approximately 800m to the west of the land and there are 6 properties within 500m of the site.

- **Wetlands should be constructed in open areas subject to wind action.**

The Bowering Hill Dams are at the top of a rise and will be exposed to wind action in particular sea breezes given its proximity to the coast.

- **Shallow water and dense vegetation is attractive to mosquitos whereas deeper, open water bodies with steep margins free from vegetation are less appealing as a habitat source.**
- **Wetlands should be greater than 60cm in depth overall and with steep sides to discourage mosquito breeding.**

The Bowering Hill Dam is 9m deep with a 1 in 3 internal bank gradient. The banks will be rock lined and will be kept free from vegetation. The design will be almost identical to the design of the 850ML storage dam at the Aldinga WWTP.

- **Choose vegetation that will not vigorously invade the water body or the surrounding banks and requires minimal maintenance.**

The Bowering Hill Dam will be rock lined and will be filled and emptied on an annual basis. By

having the water level move up and down regularly any mosquito larvae that might build up on the rock lining will be exposed to sunlight. The draining of the dams occurs in summer when water demand is high and the exposure of the larvae to sunlight will be most effective. This will also limit grass growth and enable spraying to occur to minimise grass growth.

I also note the requirement for the facility not to provide a source of offensive odours. The treated wastewater to be stored in the lagoon will be from Christies Beach WWTP which has been stored at the Aldinga site for a number of years. Due to the co-location of the storage with the Aldinga wastewater treatment plant there is some confusion in the community around the odours that arise from the wastewater plant which has sludge lagoons etc. as compared to a stand-alone treated wastewater storage facility. From an operational perspective, WBWC is inclined to draw water from the storages and not leave stored water to accumulate for a number of years due to the impact of long term evaporation on water salinity which is an issue for our customers. In the case of this storage we can choose to use this water rather than drawing water from CBWWTP in wetter years to ensure we continually turn over the storage contents to avoid excessive aged water accumulating.

In regard to access the suite will be secured with a 6ft high fence and suitable signage will be applied consistent with our other facilities.

Given the current reference sites for large water storages in McLaren Vale are co-located with wastewater treatment facilities (i.e. Aldinga and Willunga), can you comment on SA Health's position on this proposed water storage facility in particular with regard to the potential risk of mosquito's or other public health related diseases and the risk of odours from such a facility where they have been constructed elsewhere across the state.

Thanks, Craig.

Craig Heidenreich
General Manager | Water Utilities Australia



Telephone +61 8 7999 8555

Mobile +61 439 399 974

Address Suite 1005, 147 Pirie Street, Adelaide SA 5000

Email cheidenreich@wua.com.au | **Website** waterutilitiesgroup.com.au



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Appendix 12. Arborist Report (Arborman)



Reference Number:
ATS5240-BakDrPTA

24 September 2018

Ekistics
Attn: Richard Dwyer Managing Director
PO Box 32
Goodwood SA 5034

Dear Richard,

Re: Bakewell Drive, Seaford Heights – Regulated and Significant Trees

I have inspected the trees noted at the above address on Monday 24 September 2018 and made observations in relation to their legislative control status under the *Development Act 1993* pertaining to Regulated and Significant Trees and the *Native Vegetation Act 1991*.

There are approximately 200 juvenile trees located within the windbreak and a row of mature olive trees also noted at site. The juvenile trees are planted specimens and are all less than two metres in circumference, these trees are therefore not controlled by the *Development Act 1993* or the *Native Vegetation Act 1991*.

The mature olive trees within the site have been planted for the purpose of fruit production; these trees are exempt from control as per the *Development Act 1993*. As the trees are planted specimens they are not identified as native vegetation. The trees are not controlled by the *Development Act 1993* or the *Native Vegetation Act 1991* and therefore their removal is permitted and no approval from the local council or the Native Vegetation Council is required.

Thank you for the opportunity to provide this information. Should you have any questions or require further information, please contact me and I will be happy to assist.

Yours sincerely

JASON WILLIAMS
Consulting Arboriculturist
Diploma of Arboriculture
Graduate Certificate in Arboriculture
ISA- Tree Risk Assessment Qualified
Arboriculture Australia Licensed Consulting Arborist AL-2703



Tree Location



Identified Trees



Mature olive trees

Planted trees within the windbreak



Appendix 13. Visual Impact Assessment (WAX Design)



18SHD (Seaford Heights Dam)

Visual Impact Assessment of the Proposed SRWRA Water Storage at Seaford Heights

Prepared for Water Utilities Australia

By Warwick Digby Charles Keates

17 October 2018

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1 Introduction and Background

1 Introduction and Background

1.1 Relevant Experience of Warwick Keates

- 1.1.1 Warwick is a director of WAX Design with over 25 years' experience in Landscape Architecture practising in South Australia, Australia, Middle East and the United Kingdom. During this period of time, he has prepared numerous visual impact and landscape assessments for Planning Appeals, Expert Witness Statements and Environmental Impact Assessments.
- 1.1.2 Warwick has prepared visual assessments for a variety of developments, including major road corridors, telecommunication towers, residential developments, significant trees, wind farms and numerous mine expansions. During the course of his employment, he has appeared as an expert witness before the Environment, Resources and Development Court and Development Assessment Commission on numerous occasions. Warwick has also made presentations at Parliamentary Hearings, both in Australia and the United Kingdom and presented a number of papers on visual impact assessment.

1.2 Qualifications

- 1.2.1 Graduate Diploma in Landscape Architecture 1990, Leeds Polytechnic, UK
- 1.2.2 Bachelor of Landscape Architecture (Honours) 1988, Leeds Polytechnic, UK

1.3 Affiliations

- 1.3.1 Associate Member of the Australian Institute of Landscape Architects (Past President of the South Australian Chapter)
- 1.3.2 Registered Landscape Architect
- 1.3.3 Member of the Landscape Institute (United Kingdom)

1.4 Visual Impact Assessment Methodology

- 1.4.1 The visual assessment methodology uses site observations and Global Positioning System (GPS) to identify the extent to which the proposed development is visible in the locality and over what distance. Using the GPS and site investigations the location and visual extent of the subject land within the locality were assessed.
- 1.4.2 This methodology quantifies where the subject land is in the locality (relative distance between proposed development and viewpoint) and whether it is visible and to what extent.
- 1.4.3 The visual character and extent are assessed and discussed in Section 3 of this report. This allows a detailed understanding to the visual effect of the proposed development to be developed.
- 1.4.4 The visual assessment contained in this report has been undertaken on site. It should be noted that due to the differences between viewing the subject land on site in person and the constraints of reproducing this photographically at a smaller scale and on paper, the site photos and photomontages contained in this report can only give an indication of the visual effects and should be taken into consideration alongside the visual assessment discussion and analysis.

1.5 Relevant Documents

- 1.5.1 In forming my opinion and the preparation of the Visual Impact Assessment, I have viewed the following documentation:

1 Introduction and Background

- Hydroplan Drawing No. 14689-SK017. Date 29 March 2018. Concept Plan
- Ekistics DPTI Sponsor Request, dated 9 August 2018
- Arborman Tree Solutions Report, dated 24 September 2018

1.6 Locality

1.6.1 In assessing the landscape character of the site, a landscape character locality has been determined in which the subject land sits. This includes the following as indicated in Figure 1:

- The edge of Robinson Road to the north of the subject land
- Land to the north, incorporating the Onkaparinga River Valley
- The surrounding vineyards and hills to the east, including the Victor Harbor Road corridor
- The northern portion of the SRWRA landfill site and the local ridgelines and fields
- Main South Road and associated residential development forming the western edge



Figure 1: Locality plan

2 Landscape Character and Site Context

2 Landscape Character and Site Context

2.1 Description of Development

- 2.1.1 The proposed development is currently in the concept design phase and entails the development of a 600mL water storage dam. The proposed dam will measure 325 metres in length, 295m in width and 8.5 metres in depth.
- 2.1.2 The dam will be constructed as a 'turkey's nest' with the top of the dam embankment elevated above the natural ground level of the subject land. The dam will sit approximately 5 metres higher than the existing ground level.
- 2.1.3 As a result of the sloping site, the dam embankments vary in height above ground level, varying between 4.15m to 7.60m.
- 2.1.4 The dam will be constructed with a 1 in 3 internal batter which will be plastic lined. There will be an external 1 in 3 slope surrounding the dam which will be constructed with compacted earth. At the base of this dam embankment will be an access road, security fencing and a swale to collect stormwater runoff.
- 2.1.5 Adjacent the dam embankment and access road will be a series of constructed earth mounds of varying heights (depending on existing ground level) between 1.4m – 7.8m at a slope of 1 in 4. These will be constructed using the excess fill excavated for the dam and will be vegetated with plants and trees in order to minimise visual impacts of the dam embankment. At the base of the mounds opposite the dam embankment, there will be a 3m wide swale which will collect stormwater runoff and direct it towards detention basins and off of the subject land.
- 2.1.6 The proposed mounds will be vegetated with site appropriate plant species which are currently present within the existing landscape buffer. These will grow to a mature height which will help to facilitate the visual management of the development.

2.2 The Site Context

- 2.2.1 The subject land is located on Bakewell Drive, Seaford Heights and comprises portion of Certificate of Title Volume 6034 Folio 589 (Allotment 108 of Deposited Plan 80592) and Certificate of Title Volume 5829 Folio 936 (Allotment 102 of Deposited Plan 46795). The subject land is proposed to include a 600mL water storage dam developed on a portion of the allotment. The subject land is located within the Onkaparinga Council area.
- 2.2.2 The subject land is formed by a wide gently sloping hilltop and ridgeline that extends in a north-south direction, parallel to the coastline. There are no discernible features and the land contains few topographic or vegetation elements. The existing land cover is arable cropping which results in seasonal variations in vegetation retention, harvesting and other agricultural operations on the land.
- 2.2.3 The existing landscape character of the locality is defined by the undulating agricultural landscape which contains vineyards, fields, valleys and significant belts of vegetation located on large allotments that follow the underlying topography of the hills environment.
- 2.2.4 The allotments typically include areas of vegetation along the cadastral boundaries with cleared land to allow for cropping or wine production.
- 2.2.5 The northern edge of the locality falls away to form the Onkaparinga River Valley resulting in panoramic views to the ocean and the suburbs of Old Noarlunga and Seaford.

2 Landscape Character and Site Context

- 2.2.6 To the west, a new residential subdivision is currently being developed by the Fairmont Group. The Vista development will include over 1,100 residential allotments. The development is located on a sloping allotment which falls away to the west towards the coast. The development is directly adjacent the subject land to the west.



Figure 2: View looking west towards the wide ridgeline of the subject land

2 Landscape Character and Site Context

2.3 The Subject Land and Development

- 2.3.1 The subject land is approximately 21 hectares in size and is currently used for primary production in the form of agricultural cropping.
- 2.3.2 Located on a portion of the allotment to the north is a landscape buffer. This area of vegetation was established under a Land Management Agreement to provide a buffer between the residential edge of the Vista development and McLaren Vale. The primary function of the vegetation is to interrupt views from Victor Harbor Road towards the urban edge of Seaford Heights to maintain the rural landscape character of McLaren Vale and reduce the impacts of urban development.
- 2.3.3 The mounding and vegetation provides a low screen 2-3m in height. The variety of species is well established and the visual effect provides significant amenity and visual screening to the locality.



Figure 3: Landscape buffer

- 2.3.4 The subject land contains a belt of mature Olive trees towards the southern boundary. There are no regulated or significant trees located on the subject land according to a report provided by Arborman Tree Solutions dated 24 September 2018. Other than vegetation along the cadastral boundaries, the vast majority of the subject land has been cleared to enable agricultural cropping.
- 2.3.5 The topography of the subject land is formed by a wide rolling hill, with the site of the proposed development at a high point above surrounding allotments. This increases the visual prominence of the subject land across the wider locality.

2 Landscape Character and Site Context

2.4 Adjoining Properties and Landscape Context

- 2.4.1 The Vista development is located to the west of the subject land and includes numerous residential allotments of various sizes, small areas of public open space and a neighbourhood centre. The underlying topography of the site has resulted in the construction of high retaining walls (up to 2m) across the eastern half of the site as well as benching to allow for level residential allotments. Retaining walls are located on the boundary between the subject land and the Vista development. This limits views from Vista into the subject land as residential rooflines, retaining walls and fencing disrupt views forming a built form boundary to the western edge of the subject land.
- 2.4.2 The property to the south at Allotment 10, Bakewell Road is the State Heritage listed Ostrich Farm which is situated on approximately 4 hectares of land. The property contains the original farm house as well as horse stables and training yards. The locations of these structures are in close proximity to the boundary with the subject land which forms a landscape backdrop to the property.
- 2.4.3 Ostrich farm is located at a lower elevation to the subject land and such has views of the subject land which rises to the north and north west.



Figure 4: Ostrich Farm

- 2.4.4 On the southern side of Bakewell Road is the SRWRA landfill site which is responsible for providing and operating waste management operations for the Onkaparinga, Marion and Holdfast Bay Councils. The landfill site is located on land which is significantly lower than the subject land and Ostrich Farm. The development of screening mounds and buffer planting means that the SRWRA landfill site is not visible from the subject land.

3 Visual Impact Assessment

3 Visual Assessment

3.1.1 The visual assessment considers the visibility of the proposed development and the contribution to the amenity of the locality that the proposed development will make. This assessment has been considered in relation to the viewpoints indicated in Appendix A.

3.2 Description of development, form and landscape

3.2.1 The visual character of the subject land to the south is defined by the Victor Harbor Road corridor from the intersection with Main South Road (indicated in Figure 5) where there are glimpsed views towards the subject land and the proposed development. The embankment of the proposed dam will sit at a height 4.45 metres above the existing ground level at this point, forming a new elevated landform backdrop. While the development of the dam embankment will create a new landform, the associated vegetated landscape mounds surrounding the development will add to the existing screening provided by the landscape buffer that has been developed in association with the Vista development.

3.2.2 Further along Victor Harbor Road, the visual character to the south is dominated by the Vista development which creates significant visual change within the local area. The undulating agricultural landscape which contains vineyards, open fields, valleys and significant belts of vegetation is replaced by a modified landform of benching, fence lines and patches of modified open space that facilitates the residential development, contrasting with the rural character of the landscape.



Figure 5: Victor Harbor Road looking south

3.2.3 At the intersection of Ostrich Farm Road and Victor Harbor Road, the existing landscape character is defined by the gently undulating landforms that create a rolling landscape that is typical of the locality. The existing vegetation colour is defined by arable cropping with belts of vegetation to cadastral boundaries and roads.

3 Visual Impact Assessment

- 3.2.4 Ostrich Farm Road is lined on both sides with established vegetation ranging in height between 6m-10m. This creates a significant screen to the road corridor with glimpsed views into the adjoining fields and towards the proposed development. The proposed dam embankment will result in a significant modification to the existing land form. The new landform associated with the proposed dam will be visual up to 6.25 metres above the existing highest point of the subject land.



Figure 6: Ostrich Farm Road at the intersection with Victor Harbor Road.

3 Visual Impact Assessment



Figure 7: Ostrich Farm Road illustrating screening vegetation to road corridor

- 3.2.5 At the corner of Ostrich Farm and Victor Harbor Road, the road sits on a 5 metre high road embankment elevated above the surrounding land. The local embankments associated with the road corridor typically measure between 4 metres and 6 metres. These landforms impact the visual character of the locality particularly to the east of the subject land. The profile of the existing landform is typically 1:2, rather than the slope profiles that are proposed for the dam embankment.
- 3.2.6 To the north-west of the subject land, Victor Harbor Road passes through a cutting close to the northern boundary of the subject land and the existing landscape buffer. Travelling south, the subject land forms part of the local rural landscape and the entrance to McLaren Vale. To the east, the landscape is dominated by the undulating landscape and vineyards of the McLaren Vale and to the west, including the subject land, the agricultural cropping and gently sloping profile of the fields.



Figure 8: View of the subject land from Victor Harbor Road

3 Visual Impact Assessment

- 3.2.7 Adjacent the subject land, Victor Harbor Road has a speed limit of 80km/hr which means that the duration of visibility of the subject land is significantly limited for a number of seconds with the views being oblique to the west. The existing landscape character is recognised as part of the agricultural landscape and there are few visual attractors from the viewpoint that draw your attention to the subject land.
- 3.2.8 The topography and elevation of the road corridor provides distant views north across the Onkaparinga Valley towards the coast. The progressive development of the Onkaparinga basin is clearly visible, including the infrastructure associated with the Seaford Rail Link. These views remain the dominant focus of the road corridor and visual character.



Figure 9: View from Victor Harbor Road which sits on a 5m high embankment, north across the Onkaparinga Valley. The subject site is located behind.

- 3.2.9 It is important to note that within the locality of the viewpoint and the subject land there are a number of modified landforms associated with the road corridor including 6-7 metre high cutting embankments as well as fill embankments. The landscape character is defined by the underlying agricultural land use with views to adjacent fields that contain vineyards and shelter belt planting.
- 3.2.10 The visual screening associated with the tree lined cadastral boundary to the adjacent vineyards as well as local landforms associated with the road corridor provide a degree of screening to the south western edge of the road corridor.
- 3.2.11 When viewed from Bakewell Road, the existing landscape character of the subject land is defined by the rolling agricultural landscape that exists around the subject land and to the west and south west of the development.
- 3.2.12 The elevated topography of the subject land forms a rolling hilltop with a wide gently sloping profile which forms the horizon line to the north. Vegetation associated with the Ostrich Farm is notable to the north and west of the site when view from Bakewell Road.

3 Visual Impact Assessment

- 3.2.13 From Bakewell Road, the subject land forms the horizon to the locality with a single land cover creating a visual monoculture. Views are mid-range extending over a few hundred metres. This visual character will continue after the development of the dam with views extending over several hundred metres. While the depth of field and topography will be altered, the establishment of landscape mounds with trees and shrubs will significantly increase the landscape amenity and visual diversity in the locality.
- 3.2.14 From Bakewell Road, the proposed development will be viewed as an increase in the landform associated with the hill. The extent of the sloped profile and arrangement of the vegetation will result in a defined belt of vegetation forming a new horizon line located approximately 7.8 metres above the existing landform, with an existing ground level RL89.20 and proposed level RL97.00.
- 3.2.15 In many regards the visual effect will be the addition of a high belt of vegetation above the existing agricultural ridgeline. The extent of cropping may be retained or slightly modified with additional vegetation being located above or on the existing horizon line.



Figure 10: View looking north-east from the northern edge of Bakewell Road

- 3.2.16 From Ostrich Farm, there are views of the southern edge of the subject land. These views contain a number of mature planted olive trees of a height of between 6-10 metres. The trees provide a visual buffer within the landscape screening views north and south from a vegetated horizon line.
- 3.2.17 The development of the site will result in the removal of these planted olive trees however the proposed land form of the dam embankment will provide opportunities for additional landforms and vegetation screening. The proposed development will introduce new landscape elements into the landscape above the existing horizon line. While the modification of the topography and vegetation is likely to create a moderate degree of visual change, due to its elevated location, the profiling of the proposed landform and screening vegetation will significantly reduce the visual effect. At the same time, the vegetated landscape mounds will increase the landscape character and amenity replacing the arable skyline with an undulating vegetative screen.

3 Visual Impact Assessment

- 3.2.18 From locations along Main South Road close to Bakewell Road, the site of the proposed development will not be visible as local ridgelines create screens. It is also important to note that the land to the west of the subject land will be redeveloped as part of the Vista development. This will result in retaining walls, buildings and road corridors altering the landscape and limiting the visibility towards the proposed development from Main South Road. As stated previously, the proposed development will create an elevated vegetated horizon line which is complimentary to the existing landscape character.
- 3.2.19 The built form development along Robinson Road which forms the northern edge of the Vista development creates a defined urban form. The two storey dwellings and large commercial buildings reduce the visibility of the subject land forming an urban corridor. Views and the visual character are focused along the road corridor.
- 3.2.20 At the highest point of the Vista development, the subject land is screened by the existing retaining walls and fencing. It is important to note that the houses to the eastern side of roads such as Cotterell Road are permitted to be two storeys and therefore may have the potential to look over the adjoining retaining walls and onto the proposed landscape mounds. The orientation of the houses as well as the allotments focus views to the west towards the coastline. It is anticipated that bedrooms or study's or utility rooms would be located to the rear of the property with potential views to the proposed landscape mounds and the south east.



Figure 11: View from Cotterell Road allotments with fence line forming boundary with the subject land

- 3.2.21 The current allotment boundary of Vista and the subject land contains a Colorbond fence sitting on a retaining wall which results in the fence sky lining line along the local horizon. The proposed development will alter the local topography creating a vegetated screen above the fence line. This will result in an elevated landscape skyline which will significantly offset the visual effect of the current fence in terms of landscape character and amenity. Furthermore, the proposed vegetation treatments of the dam embankment will provide a landscape backdrop that will offset the uniformity and urban form of the existing fence line on future houses.

3 Visual Impact Assessment

3.2.22 Throughout Vista, the visual character is contained. Views typically exist along road corridors, however, the urban form of the development results in short road lengths before the road changes alignment reducing the visual corridor. The elevated topography creates a stepped built form increasing the visual containment of the buildings throughout Vista. The result is that the rooflines form the horizon line rather than the surrounding landscape character or the subject land. Views to the surrounding landscape to the north, south and east are extensively screened with glimpsed views to the southern vales afforded due to the lack of current development.

3.2.23 When the residential development is fully complete, the sense of visual enclosure will increase with limited views to the surrounding landscape. The existing topography, resulting residential development and presence of the coastline to the west increases the visual character and built form focus to the west away from the subject land.



Figure 12: Views from Cotterell Road towards the coast, the subject land is located directly behind this viewpoint

3.2.24 There are glimpsed views towards the subject land at the intersection of Main South Road and Robinson Road. While the subject land is not currently visible behind the linear form of the boundary fencing, the proposed development will form an elevated topography behind the fence line. The fence line forms a horizontal visual element that reinforces the residential edge of the Vista development.

3.2.25 The potential introduction of an elevated vegetated landform will reduce the visual effect and dominance of the urban form to the east. With appropriate landscape treatments the interface between the Vista development and the McLaren Vale edge will be reduced with a visual layering creating a backdrop of trees and shrubs rather than the defined horizon line of the fencing and rooflines.

3 Visual Impact Assessment



Figure 13: Views from the intersection of Main South Road and Robinson Road

3.3 Management of Visual Impacts

- 3.3.1 The visual effect of the proposed development will be mitigated through the addition of a series of vegetated landscape mounds in front of the dam embankments. The mounds will be constructed using the excess fill created during the excavation of the dam and will be located directly adjacent the dam embankment. The slope of each mound is 1 in 4 and varies in height between 1.6m-7.8m. A plan of the proposed development is located in Appendix C.
- 3.3.2 The mounds have been designed in positions which disrupt views of the dam embankment from viewpoints along Victor Harbor Road and Bakewell Road as well as the Vista development. The mounds will respond to the local topography and landscape character by presenting as a series of hills with vegetation. A list of the proposed species is located in Appendix B.
- 3.3.3 The landscape treatments, selected boundary treatments and species selection will reduce and limit the visibility of the dam embankment from viewpoints on Victor Harbor Road and Bakewell Road.
- 3.3.4 The introduction of the new landscape into the locality will be seen within the context of the wider landscape character. Existing ridgelines and hills to the north and east are covered with belts of vegetation and trees that provide amenity to the local landscape character. The proposed mounds and vegetated treatments aim to replicate these existing landscape characters providing areas of vegetation over elevated landforms.
- 3.3.5 The proposed development will create an extension of the existing vegetation buffer and vegetated horizon line when viewed from Main South Road and the Vista development. In many regards the Vista development provides the dominant visual impact along the Main South Road corridor.

3 Visual Impact Assessment

- 3.3.6 The development of the proposed site offers the opportunity to increase the vegetation character and screening associated with the land management agreement buffer planting area. The use of native species as well as tree and shrub species will significantly increase the landscape amenity, removing the monoculture of the existing arable cropping and replacing it with a diverse native vegetation character that will increase the visual amenity as well as provide increased habitat biodiversity.
- 3.3.7 As the dam will be elevated above the surrounding locality, the water within the dam will not be visible from any external points and in combination with the proposed landscape mounds, there will not be any indication that the subject land contains a water storage dam.

4 Development Plan Assessment

4 Development Plan Assessment

4.1 Relevant Development Plan provisions

- 4.1.1 The following provisions of the Onkaparinga Council Development Plan (consolidated 20 February 2018) have been considered as the most relevant to the assessment of the visual impact of the proposed development.

4.2 Primary Production Zone

4.2.1 Objectives:

- 4 Protection of primary production from encroachment by incompatible land uses and protection of scenic qualities or rural landscapes
- 6 The enhancement of the rural character, key scenic routes, scenic surrounds to townships, amenity and prominent landscape for the enjoyment of residents.

4.2.2 Principles of Development Control:

- 4 Development within the zone should be compatible with its use as a water catchment and storage area and with its values as an area of agricultural production and scenic beauty.
- 6 Development which would remove productive land from agriculture or diminish its overall productivity for primary production should not be undertaken unless the land is required for essential public purposes.
- 16 The excavation and/or filling of land should:
 - (a) be kept to a minimum and be limited to no greater than 1.5 metres so as to preserve the natural form of the land and the native vegetation.
 - (b) only be undertaken in order to reduce the visual impact of buildings, including structures, or in order to construct water storage facilities for use on the allotment.
 - (d) result in stable scree slopes which are covered with top soil and landscaped so as to preserve and enhance the natural character or assist in the re-establishment of the natural character of the region.
- 40 Excavation and earthworks should take place in a manner that is not extensively visible from surrounding localities.
- 41 The appearance of land, buildings and objects should not impair the amenity of the locality in which they are situated.
- 42 The rural character, comprising natural features and man-made activities, should be preserved by careful siting, design and landscaping of new building development and/or intensive land uses.
- 61 Landscape buffers located adjacent a residential or urban zone should be designed taking into account the nature, source and frequency of potential adverse impacts; prevailing winds in the locality; topography of the area; existing vegetation and the presence of potentially sensitive adjacent uses.

4 Development Plan Assessment

Assessment

- 4.2.3 The proposed development will incorporate a series of landscape mounds surrounding the perimeter of the water storage dam. These will be constructed with the excess fill created by excavating the site of the dam and will enable views of the dam embankment to be screened by vegetation which replicate the topography and landscape vegetation cover within the locality. This will ensure the protection of the scenic qualities of the locality and enhancement of the landscape character, as well as providing additional amenity to the subject land.
- 4.2.4 The dam will be compatible with the use of the area as a water catchment and storage area, whilst maintaining scenic quality within the locality.
- 4.2.5 The zone mentions that the excavation and/or filling of land should not exceed 1.5 metres above the natural ground level so as to preserve the natural form of the land and the native vegetation. The proposal includes mounds up to 7.8 metres in height. Whilst this is larger than anticipated in the zone, they are being constructed in response to the underlying topography of the land and will be used to introduce significantly areas of native vegetation to the subject land. The construction of the dam will result in large amounts of excess fill which will be used in the mounds, reducing the visual impact of the dam embankment and protecting the character of the locality.
- 4.2.6 The neighbouring residential zone has been taken into consideration when designing the location and size of the landscape mounds to reduce views of the dam embankment from these areas. The proposed design incorporated a series of vegetated landscape mounds which will increase the landscape amenity and will provide a vegetated backdrop to the residential zone when viewed from the west.

4.3 Siting and Visibility

4.3.1 Objectives:

- 1 Protection of scenically attractive areas, particularly natural, rural and coastal landscapes.

4.3.2 Principles of Development Control:

- 1 Development should be sited and designed to minimise its visual impact on:
 - (a) The natural, rural or heritage character of the area
 - (b) Areas of high visual or scenic value, particularly rural and coastal areas
 - (c) Views from the coast, near-shore waters, public reserves, tourist routes and walking trails

Assessment

- 4.3.3 The development seeks to protect the scenically attractive entrance to the McLaren Vale region by incorporating the landscape mounds surrounding the development to the north, west and south. The existing belt of established trees along Ostrich Farm Road to the east will limit views to the dam from this direction. The landscape mounds seek to increase and complement the amenity of the area and the natural character of the Onkaparinga Valley.

4 Development Plan Assessment

4.4 Character Preservation District Overlay

4.4.1 Objectives:

- 1 A district where:
 - (a) scenic and rural landscapes are highly valued, retained and protected
 - (b) development near entrances to towns and settlements does not diminish the rural setting, character and heritage values associated with those towns and settlements.

4.4.2 Objectives:

- 1 Development in the district should:
 - (a) when located near townships, contribute towards and maintain the identity of those townships
 - (b) retain the predominant rural landscape character and function

Assessment

- 4.4.3 With the development being located at the entrance to the McLaren Vale region, it is important to maintain the scenic qualities of the Character Preservation District. This has been taken into consideration with the design and location of each of the landscape mounds which seek protect and retain the rural landscape character and disrupting views towards the dam.
- 4.4.4 The landscape treatments include a series of mounds which will be constructed adjacent the dam embankment and will disrupt views of the embankment. The mounds will be planted with native vegetation and will increase the amenity of the proposed development from viewpoints on Victor Harbor Road and Bakewell Road. This approach replaces the existing arable cropping land with trees and shrubs to reflect the pockets of remnant vegetation east of Victor Harbor Road.

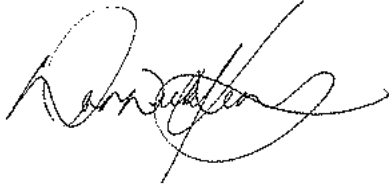
5 Conclusion and Opinion

5 Conclusion and Opinion

- 5.1.1 The assessment of the landscape character surrounding the subject land provides an understanding of the locality. The subject land is situated in the Primary Production Zone within the Onkaparinga Council, adjacent a residential housing development and other primary production allotments. The topography of the subject land varies, with a wide ridgeline forming a high point within the subject land. This results in the location of the dam being at a higher elevation than surrounding allotments, increasing the potential visibility of the development within the locality.
- 5.1.2 The visual assessment that has been undertaken highlights the potential issues associated with the visual effect of the dam within the defined locality. The 'turkey's nest' style of development and the elevation of the subject land results in the dam embankment being visible from certain areas within the locality. Engineering requirements state that these embankments must be free of vegetation. To lessen the visual impact of the dam embankments on the surrounding locality, a series of landscape mounds have been designed to the north, west and southern extents of the dam embankment using the excess fill created from excavating the dam. This allows for extensive planting of native vegetation and trees on the landscape mounds which reflects the rural and remnant vegetation of the surrounding locality.
- 5.1.3 Any potential views towards the dam embankment will be disrupted by the addition of these vegetated landscape mounds. Whilst the extent of mounding is quite large, with mounds ranging between 1.6m-7.8m above ground with a slope profile of 1 in 4, this is directly related to the scale of the proposed development and is required to adequately screen views towards the dam. The designs of the landscape mounds have taken into account the natural topography of the area and will replicate this through the addition of vegetated hills within the locality. .
- 5.1.4 The assessment acknowledges that the proposed dam embankment is of a larger form than surrounding topographic features or development in the locality. This could result in the embankment being visually prominent from viewpoints along Victor Harbor Road, Bakewell Drive and Vista without other design measures such as the landscape mounds. This approach will enhance the rural character of the locality with the planting of large areas of native vegetation.
- 5.1.5 The design and built form of the Vista development contains large retaining walls, fencing and roof lines which visually detract from the existing rural character of the area. Views towards the subject land from Vista are constrained by residential built form and the alignment of the road network, which provide small glimpses of the subject land. These will be further limited with the construction of more housing. The proposal will result in an elevated vegetated backdrop above the existing fence line which will significantly offset the visual effect of the current fencing and built form in terms of landscape character and amenity.
- 5.1.6 In conclusion, the development of a series of vegetated landscape mounds to the north, west and south as well as the retention of the existing tree line to the east. These landscape elements will adequately screen the proposed development from views on Victor Harbor Road, Bakewell Drive and from Vista. The subject land will be viewed as a series of landscape mounds with vegetated ridges above the existing arable land. This is reminiscent of the surrounding locality which contains many vegetated ridges, hills, vineyards and cropping land.

5 Conclusion and Opinion

I declare that I have made all enquiries which I believe are desirable and appropriate and that no matters of significance which I regard as relevant have, to my knowledge, been withheld as part of the preparation of this report.

A handwritten signature in black ink, appearing to read 'Warwick Keates', written in a cursive style.

Warwick Keates, BA (Hons), Grad.Dip.LA, MLI, AAILA

17 October 2018

Appendix A

Appendix A: GPS Locations

Waypoint (red) superimposed on Google Earth mapping



Figure 14: GPS Location and Tracks superimposed on Google Earth mapping

Appendix B

Appendix B: Proposed plant species

Trees



Acacia pycnantha

Width x height: 6m x 6m
Growing rate: FG
Density/Spacing: Specimen
Supply size: Tube

Description: fast growing shrub or small tree, which can be grown on recharge sites and a wide range of shallow soils



Allocasuarina verticillata

Width x height: 6m x 8m
Growing rate: MG
Density/Spacing: Specimen
Supply size: 45L

Description: A tree that can be grown on a range of sites. It is considered to have moderate growth rates and is a useful windbreak or shelterbelt species.



Bursaria spinosa

Width x height: 3m x 4m
Growing rate: FG
Density/Spacing: Specimen
Supply size: 140mm

Description: Once established bursarias are extremely hardy and will last 30-50 years.



Callitris gracilis

Width x height: 8m x 20m
Growing rate: MG
Density/Spacing: Specimen
Supply size: 45L

Description: The native pine can be used as a shelter tree, for shade or a windbreak, for stabilisation of dune country or as an excellent feature tree for large gardens or parks.



Dodonaea viscosa

Width x height: 3m x 4m
Growing rate: FG
Density/Spacing: 1 per m²
Supply size: 140mm

Description: A relatively fast growing shrub with an ability to pioneer degraded sites. Many of the subspecies are extremely frost and drought tolerant and are also considered a valuable source of pollen.



Eucalyptus porosa

Width x height: 12m x 14m
Growing rate:
Density/Spacing: Specimen
Supply size: 45L

Description: A robust, dark-barked mallee which can grow into an impressive single-trunked tree.

Maximum width x maximum height e.g. 4m x 4m

FG fast growing – 1-2 meters in first year

MG moderate growth – 1 meter in first year

SG slow growth – 50cm – 1 meter in first year

Trees



Pittosporum angustifolium

Width x height: 5m x 10m
Growing rate: SG
Density/Spacing: Specimen
Supply size: 140mm

Description: Usually attains about 6 m in height but is reported to grow up to 10 m tall. It grows across a wide range of habitats, often on sandy soils.



Melaleuca lanceolata

Width x height: 5m x 8m
Growing rate: FG
Density/Spacing: Specimen
Supply size: 200mm

Description: A relatively fast growing species. Has a dense canopy. Natural stands provide a particularly useful shelter as a windbreak on windy, near coastal sites.

Understorey



Acacia acinacea

Width x height: 4m x 2.5m
Growing rate: FG
Density/Spacing: 1 per m²
Supply size: 140-250mm

Description: A fast growing, frost and drought tolerant, nitrogen-fixing shrub. It is in demand in revegetation programs in some parts of it range for its ability to pioneer degraded sites.



Adriana quadripartita

Width x height: 3m x 2m
Growing rate:
Density/Spacing: 1 per m²
Supply size: 240-250mm

Description: A shrub species which is endemic to southern Australia.



Atriplex semibaccata

Width x height: 3m x 0.3m
Growing rate: FG
Density/Spacing: 2 per m²
Supply size: 140-250mm

Description: Soil and erosion control. Effective weed control.



Enchylaena tomentosa

Width x height: 1.5m x 1m
Growing rate:
Density/Spacing: 3 per m²
Supply size: 140-250mm

Description: Extremely hardy low shrub or ground cover for areas of neglect, particularly tolerant of coastal locations and calcareous soils.

Maximum width x maximum height e.g. 4m x 4m
FG fast growing – 1-2 meters in first year
MG moderate growth – 1 meter in first year
SG slow growth – 50cm – 1 meter in first year

Understorey



Goodenia albiflora

Width x height: 1m x 1m
Growing rate:
Density/Spacing: 3 per m²
Supply size: 140-250mm

Description: A hardy and contrasting foliage plant.



Olearia ramulosa

Width x height: 1m x 1.5m
Growing rate:
Density/Spacing: 2 per m²
Supply size: 140-250mm

Description: A dense, formal, rounded, aromatic shrub with small white daisy flowers in late autumn.



Rhagodia candolleana

Width x height: 2m x 1m
Growing rate:
Density/Spacing: 2 per m²
Supply size: 140-250mm

Description: Can be used as a background shrub in mixed planting, suitable for coastal locations as a wind-break and soil control.



Rhagodia parabolica

Width x height: 5m x 3m
Growing rate: MG
Density/Spacing: 1 per m²
Supply size: 140-250mm

Description: A pale, grey-green, densely foliated spreading shrub with wide upright branches.



Myoporum parvifolium

Width x height: 2m x 0.2m
Growing rate: FG
Density/Spacing: 1 per m²
Supply size: 140-250mm

Description: Extremely hardy weed-suppressing ground cover for embankments, verges, streetscapes and high traffic areas. Acts as a living mulch and weed suppressor.

Maximum width x maximum height e.g. 4m x 4m

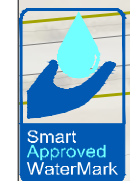
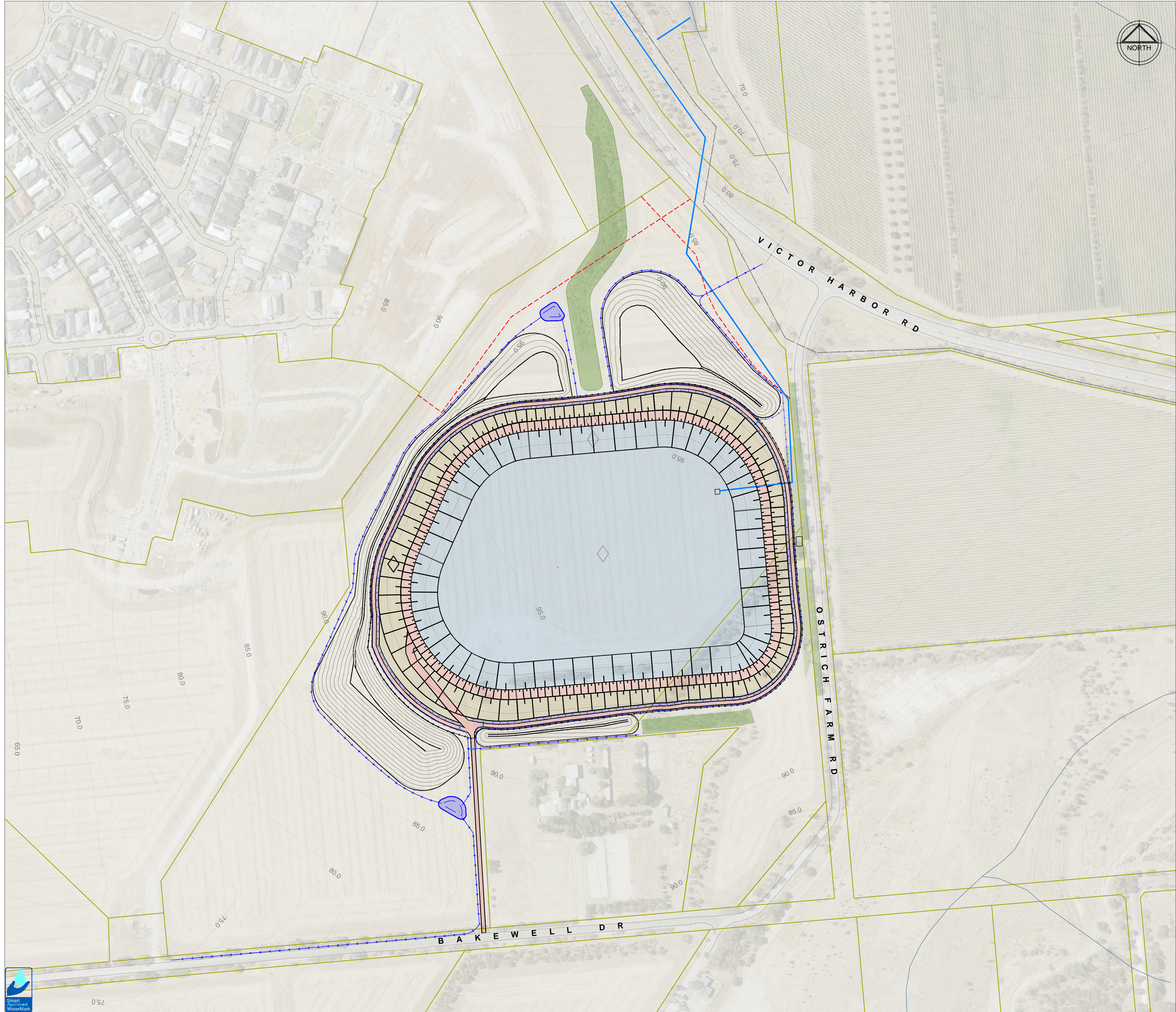
FG fast growing – 1-2 meters in first year

MG moderate growth – 1 meter in first year

SG slow growth – 50cm – 1 meter in first year

Appendix C

Appendix C: Concept Design prepared by Hydroplan



SITeworks Legend

- PROPERTY LINE
- PROPOSED PIPELINE
- PROPOSED SWALE
- EXISTING PIPELINE
- BUFFER LAND BOUNDARY LINE
- COORDINATES AS SHOWN ON DRAWING No. "1-3255" OF THE LAND MANAGEMENT AGREEMENT

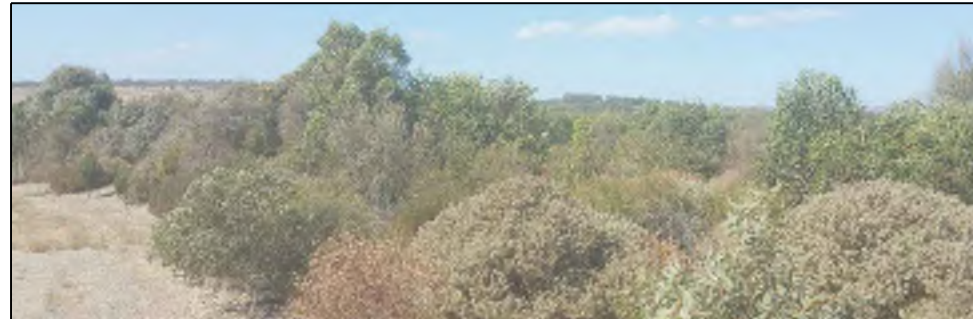
FINISHED SURFACE Legend

- RUBBLE AREA
- STORAGE AREA (PLASTIC LINED)
- OUTSIDE BATTER AREA

VEGETATION Legend

EXTENDED VEGETATION AREA: (FOR SCREENING - INDICATIVE ONLY)

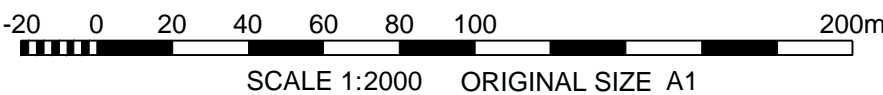
EXAMPLE:



NOTE: VEGETATION PLAN TO BE AGREED WITH BIODIVERSITY McLAREN VALE AND DEW. VEGETATION TO SCREEN A 1.8m HIGH SECURITY FENCE ON THE INTERNAL SIDE OF EXTENDED VEGETATION ALIGNMENT.

EXISTING VEGETATION AREA:

EXAMPLES:



REV	ISSUED	D.DWN	APRVD	REVISION DESCRIPTION	REV	ISSUED	D.DWN	APRVD	REVISION DESCRIPTION
1	08/10/2018	JT	JG/BH	FOR DISCUSSION					
0	20/09/2018	JT	JG/BH	FOR DISCUSSION	-				-



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PERTH ADELAIDE SYDNEY BRISBANE BEIJING

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The arrangement and general details as shown on this drawing are essentially diagrammatic and must be applied to the circumstances as found on site.

DES/DRAWN:	JT	CLIENT: WILLUNGA BASIN WATER					
CHECKED:	BH						
APPROVED:	JG	PROJECT: SRWRA STORAGE CONCEPT DESIGN PLAN WITH MOUNDS					
DATE:	29/03/2018						
DRAFT REF:	2-WBW-d4	DRAWING No.	14689-SK017	SHEET	1 OF 1	REVISION	1

Appendix D: Curriculum Vitae of Warwick Keates



WARWICK KEATES

DIRECTOR
LANDSCAPE ARCHITECTURE AND URBAN DESIGN



Warwick Keates is a landscape architect and urban designer with over twenty five years experience in private practice, academia and government. During this time, he has developed a diverse range of skills, working on awarded projects in the United Kingdom, Middle East and Australia. This experience has provided Warwick with a detailed understanding of the complex requirements associated with landscape and urban projects as well as the need for sensitive, high-quality design solutions.

Warwick is a Director of WAX Design and has worked in all aspects of the profession, including master plans for urban and civic spaces, placemaking programmes and open space strategies, as well as design for numerous parks and playspaces. His ability to actively listen and closely collaborate with clients, other professionals and the community, provides Warwick with a complete understanding of landscape and urban design, with respect to the creation of exceptional places that meet the needs of end users.

Qualification

Graduate Diploma in Landscape Architecture,
Leeds Polytechnic (United Kingdom) 1990
Bachelor of Arts (Hons) in Landscape Architecture, Leeds Polytechnic (UK) 1988

Professional Affiliations

Associate of the Australian Institute of Landscape Architects
Chartered Member of the Landscape Institute (UK) 1995

Specialist Expertise

Reserve and Play Space Design
Urban Design and Planning
Open Space Assessment and Planning
Large Scale Master Planning
Visual Impact Assessment
Global Information Systems (GIS)
Computer Aided Design and 3D Modelling
Consultation and Facilitation

Other Appointments

Member of the Community Participation and Sustainability Advisory Committee
Part Lecturer Adelaide University
Art for Public Places (panel member)

Relevant Experience

Victor Harbor Mainstreet Upgrade
Willunga Mainstreet Beautification Project
Rundle Street Arts Masterplan
Salisbury City Centre Urban Design Strategy
Gawler Town Centre Integrated Urban Design Precincts
Flinders University Landscape Masterplan
Inner West Precinct Place Making Strategy
Salisbury Oval Masterplan
Edwardstown Oval Redevelopment
Klemzig Recreation Ground Masterplan
Marion Sports Facility Masterplan
Bonython Park Playspace
Charles Sturt Open Space Strategy
Hazelwood Park Playspace
JB Ware Reserve Upgrade & Playspace
Kadina Mainstreet Masterplan
Nature's Playground, Adelaide Zoo
Suneden Special School Sensory
West Torrens Open Space and Urban Design Strategy

Appendix E

Appendix E: Visualisations and Landscape Masterplan

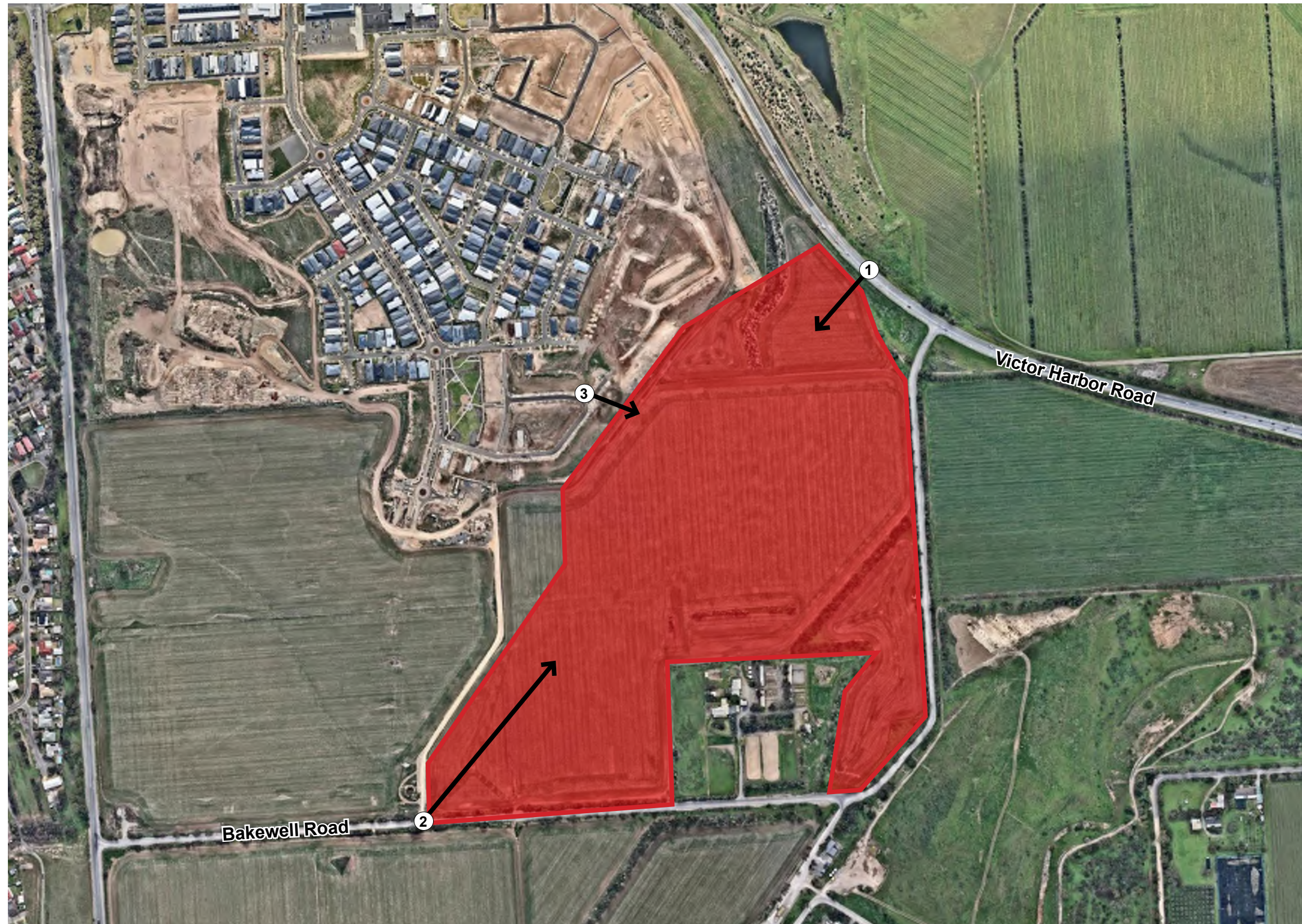
SEAFORD HEIGHTS DAM

VISUALISATIONS


17 OCTOBER 2018

SEAFORD HEIGHTS DAM


1.1 VIEWPOINT LOCATIONS



KEY

 Subject Site

 Viewpoints

 200m 

SEAFORD HEIGHTS DAM

WAX

1.2 VIEWPOINT 1- VICTOR HARBOR ROAD



Existing viewpoint



Artists impression of proposed development superimposed on to existing viewpoint.

SEAFORD HEIGHTS DAM

WAX

1.3 VIEWPOINT 1- VICTOR HARBOR ROAD



Existing viewpoint



Artists impression of proposed development superimposed on to existing viewpoint.

SEAFORD HEIGHTS DAM

1.4 VIEWPOINT 2- BAKEWELL ROAD

WAX



Existing

Existing viewpoint



Post-Construction

Artists impression of proposed development superimposed on to existing viewpoint.

SEAFORD HEIGHTS DAM

1.5 VIEWPOINT 2- BAKEWELL ROAD

WAX



Existing

Existing viewpoint



5 Years

Artists impression of proposed development superimposed on to existing viewpoint.

SEAFORD HEIGHTS DAM

WAX

1.6 VIEWPOINT 3- CORNER EDISON AND COTTERELL ROAD



Existing

Existing viewpoint



5 Years

Artists impression of proposed development superimposed on to existing viewpoint.

SEAFORD HEIGHTS DAM

WAX

1.7 VIEWPOINT 3- CORNER EDISON AND COTTERELL ROAD



Existing

Existing viewpoint

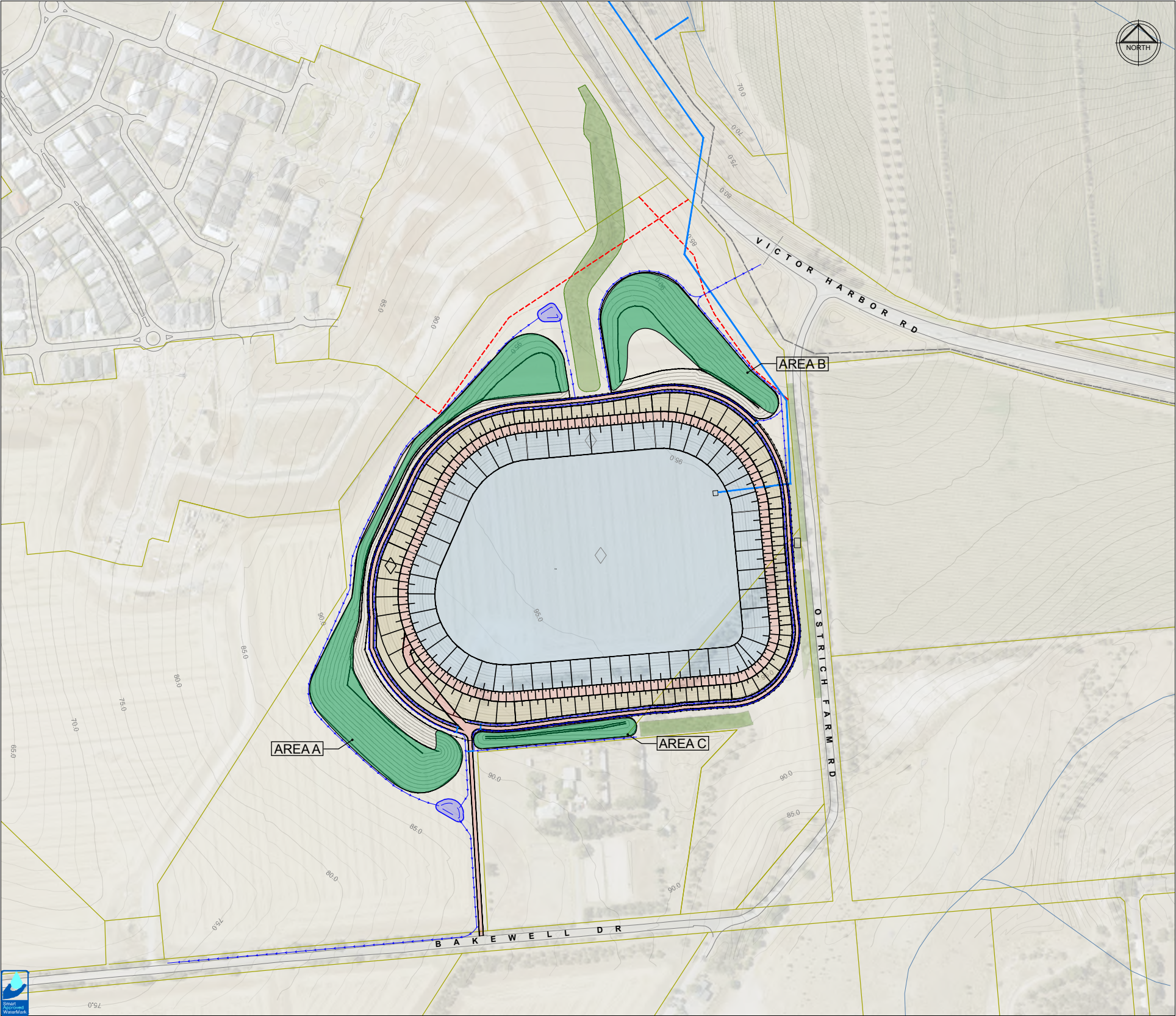


5 Years

Artists impression of proposed development superimposed on to existing viewpoint.

SEAFORD HEIGHTS DAM

LANDSCAPE MASTERPLAN



SITEWORKS LEGEND

- PROPERTY LINE
- PROPOSED PIPELINE
- PROPOSED SWALE
- EXISTING PIPELINE
- BUFFER LAND BOUNDARY LINE
- COORDINATES AS SHOWN ON DRAWING No. "1-3255" OF THE LAND MANAGEMENT AGREEMENT

FINISHED SURFACE LEGEND

- RUBBLE AREA
- STORAGE AREA (PLASTIC LINED)
- OUTSIDE BATTER AREA

VEGETATION LEGEND

EXTENDED VEGETATION AREA: (FOR SCREENING - INDICATIVE ONLY)

EXAMPLE:

NOTE: VEGETATION PLAN TO BE AGREED WITH BIODIVERSITY McLaren VALE AND DEW. VEGETATION TO SCREEN A 1.8m HIGH SECURITY FENCE ON THE INTERNAL SIDE OF EXTENDED VEGETATION ALIGNMENT.

EXISTING VEGETATION AREA:

EXAMPLES:

PLANT SPECIES

MASS MIX PLANTING ON MOUNDS USING TUBE STOCK OR SIMILAR, PLANTED ON GROUPS OF 5-7 OF THE SAME SPECIES @ 800MM CTRS

PLANT SPECIES MIX

TREE SPECIES MIX 1 (24%)

- ALLOCASUARINA VERTICILLATA 4%
- CALLITRIS GRACILIS 4%
- EUCALYPTUS MICROCARPA 4%
- EUCALYPTUS POROSA 4%
- PITTOSPORUM PHILLYREOIDES 4%
- MELALEUCA LANCEOLATE 4%

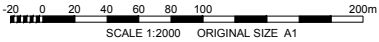
TREE SPECIES MIX 2 (36%)

- ACACIA PYCNANTHA 12%
- BURSARIA SPINOSE 12%
- DODONAEA VISCOSA 12%

UNDERSTOREY SPECIES MIX (40%)

- ACACIA ACINACEA 5%
- ADRIANA QUADRIpartite 5%
- ARIPLEX SEMIBACCATA 5%
- ENCHYLAENA TOMENTOSA 5%
- GOODENIA ALBIFLORA 5%
- OLEARIA RAMULOSA 5%
- RHAGODIA CANDOLLEANA 5%
- RHAGODIA PARABOLICA 5%

AREA A = 17,795.72m²
AREA B = 10,153.30m²
AREA C = 2,893.03m²



Appendix 14. Stormwater Management Plan (Tonkin)

Seaford Heights Water Storage

Stormwater Management Plan

Willunga Basin Water Company

December 2018

Ref No. 20181776R001B

Document History and Status

Rev	Description	Author	Reviewed	Approved	Date
A	Draft for client comment	MM	OO	OO	07 December 2018
A	Final – for use	MM	OO	OO	14 December 2018

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Appendix A	Hydroplan concept design
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1 Introduction

1.1 Background

Willunga Basin Water Company (WBWC) is proposing to construct a 600 ML water storage at Seaford Heights and is seeking a stormwater management plan (SMP) to support the development application for the project.

A concept plan for the proposed works has been developed by Hydroplan (Rev 2, Appendix A). The concept shows a preliminary drainage design for the site and incorporates three outfall locations for discharge of stormwater from the site. This concept has been used as the basis to develop the SMP.

1.2 Site description

The site of the proposed water storage is bounded by Victor Harbor Road to the north, Ostrich Farm Road to the east and Bakewell Drive to the south, as shown on the locality plan in Figure 1.1.

The proposed location of the storage is situated at the top of a high point, resulting in a 'turkey nest' configuration. Observations made during a site visit combined with review of the available topographic information (2 m contours) indicates that runoff currently discharges from this high point via overland flow paths to a number of outfall locations, including the locations described below:

- South-western corner of the site, adjacent to the intersection of Bakewell Drive and the new access road (Figure 1.2).
- South-eastern corner of the site, at the intersection of Bakewell Drive and Ostrich Farm Road.
- An existing storage pond located in the north-eastern corner, adjacent to Victor Harbor Road (Figure 1.3).

Review of the topography of the site shows longitudinal grades varying between 1% and 6%. The site is predominantly agricultural in nature, however is bordered by a new residential development to the north-west and a rural residential lot to the south.

1.3 This report

This report provides a recommendation for the management of stormwater discharged from the developed site. Consideration is given to the requirements of the City of Onkaparinga (Council) as well as other relevant authorities. Details of the analyses that have been undertaken are also included.





Figure 1.2 Looking east along Bakewell Drive from the low spot in the south-western corner



Figure 1.3 Existing storage pond in the north-eastern corner adjacent Victor Harbor Road

2 Relevant policies

The site of the proposed basin is located in an area over which several policies apply. The policies, and their potential impact on the operations of the storage, are discussed in the following sections. The recommendations outlined in this SMP consider the requirements of each of these policies.

2.1 Onkaparinga Council Development Plan

Council's development plan outlines the expectations for the management of stormwater from new developments. Review of the development plan identified the following criteria that are relevant to the preparation of this SMP:

- Development, including earthworks associated with development, should not do any of the following:
 - Impede the flow of floodwaters through the land or other surrounding land.
 - Increase the potential hazard risk to public safety of persons during a flood event.
 - Increase the risk of flooding of other land.
 - Obstruct a watercourse.
- Water discharged from a development site should:
 - Not exceed the rate of discharge from the site as it existed in pre-development conditions.
 - Be of a physical, chemical and biological condition equivalent to or better than its pre-developed state.
- Development should include stormwater management systems to mitigate peak flows and manage the rate and duration of stormwater discharges from the site to ensure the carrying capacities of downstream systems are not overloaded.

2.2 Western Mount Lofty Ranges Water Allocation Plan

The site of the development is within the Western Mount Lofty Ranges (WMLR) Prescribed Water Resources Area (PWRA). Specifically, the site is within Surface Water Management Zone (SWMZ) O_OM12 within the catchment of the Onkaparinga River. The development is therefore subject to the requirements of the WMLR water allocation plan (WAP). The WAP sets the amount of water that will be available, how that water may be allocated to users, and the types of activities that are permitted with that water.

The WAP sets out the maximum amount of surface water and watercourse water that can be taken within an SWMZ. The limit aims to ensure sufficient flows for environmental water provisions as well as for downstream users. Each SWMZ also has a diversion limit which is the "total volume of surface water that can be collected or diverted by all dams and/or intercepted by existing and new commercial forests."

The extraction and diversion limits for SWMZ O_OM12, as set out in the WAP are as follows:

- Surface water extraction – 63 ML/year
- Main watercourse (Onkaparinga River) extraction – 2205 ML/year
- Diversion limit – 125 ML/year.

The storage is located on a high point and will not capture surface runoff. Modelling of the proposed development using the MUSIC model (refer Section 4.3 for details) shows that the development will not result in a reduced runoff volume from the site. It is therefore unlikely that WBWC will need a licence for the facility under the WMLR WAP.

2.3 McLaren Vale Water Allocation Plan

The site is situated within the McLaren Vale Prescribed Wells Area, and hence is subject to the conditions of the McLaren Vale Water Allocation Plan. This WAP pertains to the taking and use of groundwater.

A licence would only be required if extraction from groundwater was proposed as part of the operations of the storage.

3 Hydrological modelling

Hydrological modelling was undertaken to provide estimates of pre- and post-development peak flows leaving the site. The hydrological assessment is based upon the recommendations and guidance provided within the 2016 edition of Australian Rainfall and Runoff (ARR2016) and is consistent with the specifications of Council's Stormwater Management Design Guide (SMDG).

The modelling was undertaken using the DRAINS software package (version 2018.09). The model was run for all durations from five minutes to 168 hours. As recommended in ARR2016, for each duration the model was run for an ensemble of ten rainfall patterns using the latest (2016) intensity-frequency-duration (IFD) data.

Consistent with Council's requirements the model was run for a minor (10% annual exceedance probability (AEP)) and major (1% AEP) rainfall event.

3.1 Hydrological modelling parameters

The sub-catchments within the study area have been modelled in DRAINS using an ILSAX-type hydrological model. The model parameters provided in Table 3.1 have been adopted and are consistent with the values recommended in the SMDG. No supplementary areas were used, in accordance with the SMDG.

Table 3.1 DRAINS model parameters

Parameter	Value
Paved area depression storage (equivalent to an impervious area initial loss)	1 mm
Grassed area depression storage (equivalent to a pervious area initial loss)	5 mm
Soil type	3
Antecedent moisture content	2.5

3.2 Catchment characteristics

3.2.1 Sub-catchment definition

In the absence of a digital elevation model of the site, sub-catchments were delineated using topographical data available from ESRI satellite.

The Hydroplan concept (Appendix A) shows three discharge points from the site. Review of the topography of the site combined with observations made during the site visit identified a low point at the south-eastern corner (the intersection of Ostrich Farm Road and Bakewell Drive). The concept plan does not show a discharge at this location, but there appears to be an existing natural flow path to this area of the site.

The concept drainage design would require a section of the swale on the southern side of the storage to be constructed against the natural grade to allow runoff to drain to the outfall location to the west. This would result in a deep swale. It is therefore recommended that the drainage design be revised to incorporate a fourth outfall location at the south-eastern low point. This would utilise the natural fall of the land and would keep the post-development flow regime as close as possible to the existing flow regime. The SMP detailed in this report assumes that, consistent with the existing flow paths, there will be four discharge points from the site.

The sub-catchments contributing to each of the proposed four discharge locations were defined for the pre-development (Figure 3.1) and post-development (Figure 3.2) scenarios. A summary of the catchment areas is provided in Table 3.2. The reduction in catchment size for the post-development scenario is due to the fact that the storage will capture and retain all water that falls onto its surface.



50 0 50 100 150 m



Willunga Basin Water Company

SEAFORD HEIGHTS WATER STORAGE SMP PRE-DEVELOPMENT SUB-CATCHMENT PLAN

Job Number: 20181776
 Filename: 20181776GQ001
 Revision: REV B
 Date: 2018-12-13
 Drawn: MM

Data Acknowledgement:
 Aerial imagery from MetroMap, 2017
 Roads layer from Data SA, 2018

Figure 3.1



Table 3.2 Sub-catchment areas

Sub-catchment	Pre-development (ha)	Post-development (ha)
North-east	5.26	3.62
North-west	1.76	1.19
Southern	12.68	11.52
South-east	11.73	6.56

3.2.2 Estimates of impervious area

The ILSAX hydrological model used in DRAINS requires users to estimate the proportion of impervious and pervious areas for each sub-catchment. Review of aerial imagery indicates that the current (pre-development) site is entirely pervious. This was confirmed during an inspection of the site.

Following development of the proposed storage basin, a compacted rubble track with an approximate width of 10 m will line the upper circumference of the basin. It is estimated that this represents approximately 5% of the total area. The track would normally be modelled in DRAINS as a supplementary area, however as the Council SMDG specifies that supplementary areas are not to be used, the compacted rubble portion of each catchment was modelled as a directly connected impervious area.

The modelling assumes a 0% impervious fraction for all catchments pre-development and 5% impervious for all catchments post-development.

3.2.3 Time of concentration

The times of concentration for each sub-catchment were estimated based on flow path lengths and slopes. The estimates assumed a Manning's roughness coefficient (n) of 0.035.

The estimated times of concentration are shown in Table 3.3. As is to be expected the steeper batter slopes and more formalised drainage paths (swales) result in lower times of concentration for the smaller sub-catchments in the post-development scenario.

Table 3.3 Times of concentration (minutes)

Sub-catchment	Pre-development	Post-development
North-east	18	12
North-west	19	15
Southern	26	26
South-east	25	16

3.3 Peak flows

The estimates of peak flows for each of the sub-catchments is summarised in Table 3.4.

Table 3.4 Modelled flowrates (L/s) for each sub-catchment

Sub-catchment	Pre-development 10% AEP	Post-development 10% AEP	Pre-development 1% AEP	Post-development 1% AEP
North-east	37	36	384	382
North-west	12	12	126	102
Southern	82	115	798	740
South-east	80	66	738	536

The results show that the post-development major and minor event flow rates for the north-east, north-west and south-east sub-catchments do not exceed the flowrates for the pre-development scenario. The slight increase in impervious area is off-set by the reduction in catchment size.

The modelling indicates that runoff from the southern catchment is higher for the post-development scenario. Measures to reduce the peak flows from this catchment will therefore be required.

4 Stormwater management plan

The DRAINS model described in the previous section was used to develop stormwater management measures required to meet Council's requirements. A summary of the recommended measures is provided in the following sections.

4.1 Detention basin

The modelling indicates that the development of the storage and associated works will result in an increase in the peak flow from the southern catchment in a 10% AEP event. A detention basin is therefore required.

The Council SMDG specifies that detention basins are to be designed with maximum side slopes of 1V:5H or flatter and a maximum water depth of 1.2 m in the 1% AEP event.

The DRAINS model was used to determine the following detention basin requirements:

- Basin volume: 60 m³
- Basin depth: 0.6 m
- Outlet pipe diameter: 375 mm

The modelling indicates that the basin configuration described above reduces the 10% AEP peak flows from the southern catchment to 74 L/s which is less than the pre-development peak flows (82 L/s).

The basin will overtop in high flow events and hence scour protection should be provided on the crest and outside of the downstream batters.

4.2 Swales

Drainage swales will be constructed around the circumference of the new storage to divert runoff to each outfall location. As part of this SMP, swale sizes to convey flows from the 1% AEP event have been determined using Manning's calculations. The calculations assume the swales will have a trapezoidal cross section with a base width of 0.3 m and 1V:3H side slopes. It is assumed that the swales will be grassed (Manning's roughness value of 0.035).

A summary of the minimum dimensions required for each swale are provided in Table 4.1

Table 4.1 Minimum swale dimension

Sub-catchment	1% AEP design flow (L/s)	Depth
North-east	382	0.3
North-west	102	0.2
Southern	740	0.4
South-east	536	0.4

4.3 Water quality measures

It is not considered that the operation of the storage on the site will impact the water quality of runoff from the site.

Further, the design of the storage incorporates a number of features that will reduce pollutant loads leaving the site. Specifically:

- The batters of the storage will be grassed which will act as buffer strips.
- The grassed swales used to convey flows to the discharge points will provide further treatment of the flow.

- The detention basin will provide additional water quality improvement for flows from the southern catchment.

A MUSIC (Model for Urban Stormwater Improvement Conceptualisation) model was developed to provide an understanding of the likely quality of stormwater runoff from the site.

4.3.1 Council requirements

Council's SMDG specifies the following pollutant reduction targets for development:

- Total suspended solids (TSS): 80%
- Total phosphorus (TP): 60%
- Total nitrogen (TN): 45%
- Gross pollutants (GP): 90%

4.3.2 Model set-up

The definition of catchment areas and characteristics was based on the catchments defined during the development of the DRAINS hydrological model. Rainfall and evaporation data were obtained from the Council meteorological template, which sources six-minute rainfall and daily evapotranspiration data from the Noarlunga weather station (station number 023885). The model incorporates the features of the development that will contribute to water quality improvement as described above. The layout of the model is shown in Figure 4.1.

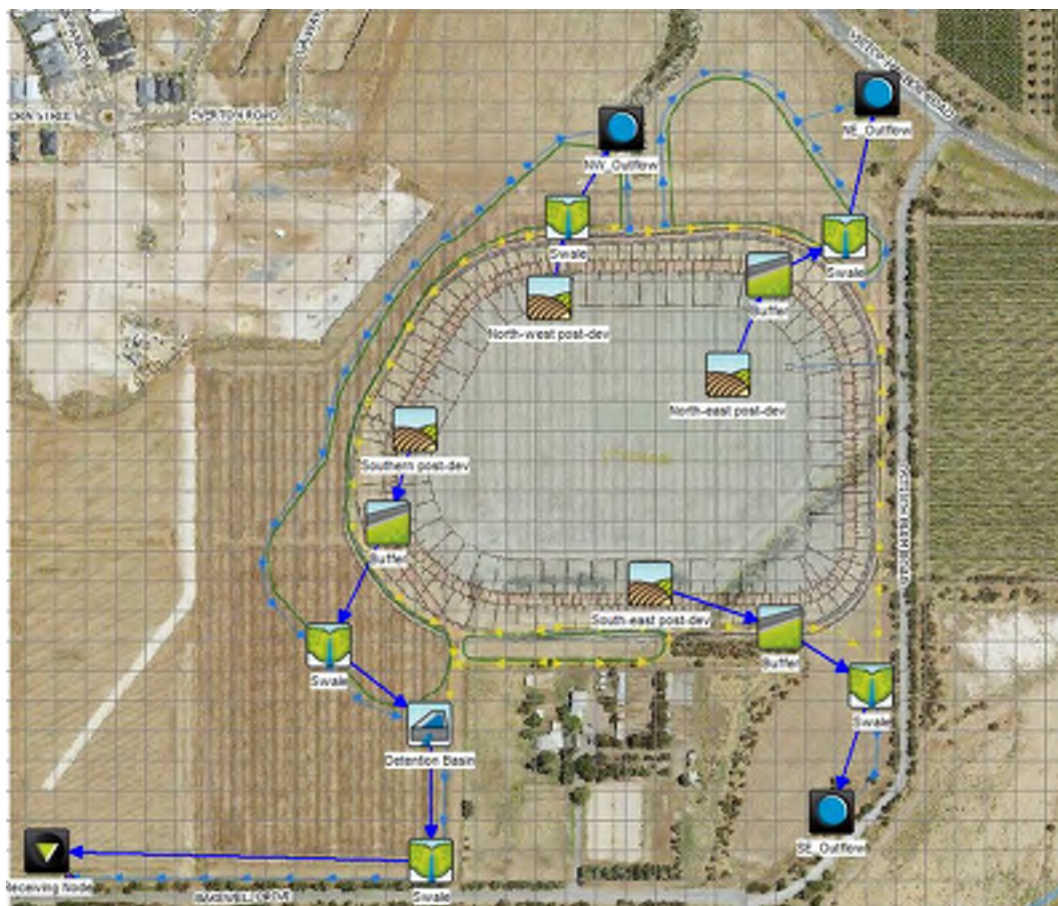


Figure 4.1 MUSIC model

A summary of the modelled pollutant reductions for each catchment is provided in Table 4.2. It can be seen that the features incorporated into the design provide a significant reduction in pollutant loads, with the whole of site reductions exceeding Council's guidelines.

Table 4.2 *Modelled pollutant reductions for the site*

Catchment	TSS	TP	TN	GP
North-east	99%	74%	57%	100%
North-west	92%	75%	55%	100%
Southern	93%	75%	60%	100%
South-east	90%	72%	33%	100%
Whole of site	92%	74%	51%	100%

Based on considerations of the nature of the development, and the results of the MUSIC modelling, it can be concluded that the development will not negatively impact the water quality of downstream receiving waters.

4.4 Stormwater management plan

A GIS-based plan detailing the recommended stormwater management measures to manage stormwater discharged from the site is shown in Figure 4.2.

The key features of the stormwater management strategy include:

- The use of grassed swales to convey flows to the discharge points.
- A detention basin to limit peak flow rates from the southern catchment.
- Vegetated batters.

The modelling undertaken as part of the development of this SMP confirms that the proposed measures comply with Council's requirements.



50 0 50 100 150 m



Job Number: 20181776
 Filename: 20181776GQ001
 Revision: REV B
 Date: 2018-12-13
 Drawn: MM

Data Acknowledgement:
 Aerial imagery from MetroMap, 2017
 Storage basin concept from Hydroplan, 2018
 Roads layer from Data SA, 2018

Willunga Basin Water Company

SEAFORD HEIGHTS WATER STORAGE BASIN STORMWATER MANAGEMENT PLAN

Figure 4.2

5 Construction – erosion and sediment control

During construction of the proposed storage, the water quality of site runoff should be managed to ensure that sediment is not transported into any downstream receiving waters. A soil erosion and drainage management plan (SEDMP) should be prepared by the contractor prior to the commencement of construction.

5.1 Preliminary erosion hazard assessment

A preliminary assessment of erosion hazard has been undertaken using the International Erosion Control Association Guidelines for Best Practice Erosion and Sediment Control (IECA, 2008).

A summary of the key parameters of the assessment is provided in Table 5.1.

Table 5.1 Erosion hazard assessment

Condition		Score ¹
Average slope of disturbance area	1-6%	2
Soil classification	Silty Clay	3
Emerson (Dispersion) class number	Not assessed	4
Duration of soil disturbance	4-6 months	4
Area of disturbance	13.4 ha	6
Waterway disturbance	No disturbance	0

¹ Score based on IECA (2008) Table F4

Based on the preliminary assessment the site is likely to be considered 'high risk' for erosion during construction and will require a detailed SEDMP. The area of the disturbance alone would trigger this requirement.

5.2 Likely requirements for erosion and sediment control

Development of a detailed SEDMP is beyond the scope of the SMP. The measures specified in the SEDMP will be required to address:

- Effective control of surface runoff entering and leaving the site.
- Erosion control works and measures to minimise the amount of site erosion.
- Sediment collection devices to prevent sediment leaving the site.
- Provision for stockpiles to be stored within the sediment barrier.
- Rehabilitation of all disturbed areas as soon as possible – temporary vegetation may be required.
- Maintenance of the erosion control and sediment collection devices.

Potential measures may include:

- Sedimentation basins.
- Sediment fences.
- Staging of construction.
- Sediment control at site entry and exit points.
- Management of stockpiles (covering).
- Temporary erosion protection during vegetation establishment.

The SEDMP will also need to specify maintenance requirements for the control measures. All sediment and erosion control measures should be inspected at least weekly and after any significant rain. Any necessary repairs (areas of erosion, torn sections of sediment fence etc.) should be addressed immediately.

6 References

City of Onkaparinga 2017, *Stormwater Management Design Guide*.

Commonwealth of Australia (Geoscience Australia) 2016, *Australian Rainfall and Runoff: A Guide to Flood Estimation*.

Environmental Protection Agency 2004, *Handbook for Pollution Avoidance on Commercial and Residential Building Sites 2nd ed.*, Government of South Australia.

International Erosion Control Association (IECA) Australasia 2008, *Best Practice Erosion & Sediment Control*, IECA, Australia.

Appendix A

Hydroplan concept design

REAL PROPERTY ACT, 1866



The Registrar-General certifies that this Title Register Search displays the records maintained in the Register Book and other notations at the time of searching.



Certificate of Title - Volume 6034 Folio 589

Parent Title(s) CT 5403/182

Creating Dealing(s) RTU 11136862

Title Issued 01/05/2009

Edition 3

Edition Issued

05/12/2017

Estate Type

FEE SIMPLE

Registered Proprietor

SOUTHERN REGION WASTE RESOURCE AUTHORITY
OF PO BOX 2414 MCLAREN VALE SA 5171

Description of Land

ALLOTMENT 108 DEPOSITED PLAN 80592
IN THE AREA NAMED SEAFORD HEIGHTS
HUNDRED OF WILLUNGA

Easements

NIL

Schedule of Dealings

Dealing Number	Description
12835643	AGREEMENT UNDER DEVELOPMENT ACT, 1993 PURSUANT TO SECTION 57(1)

Notations

Dealings Affecting Title NIL

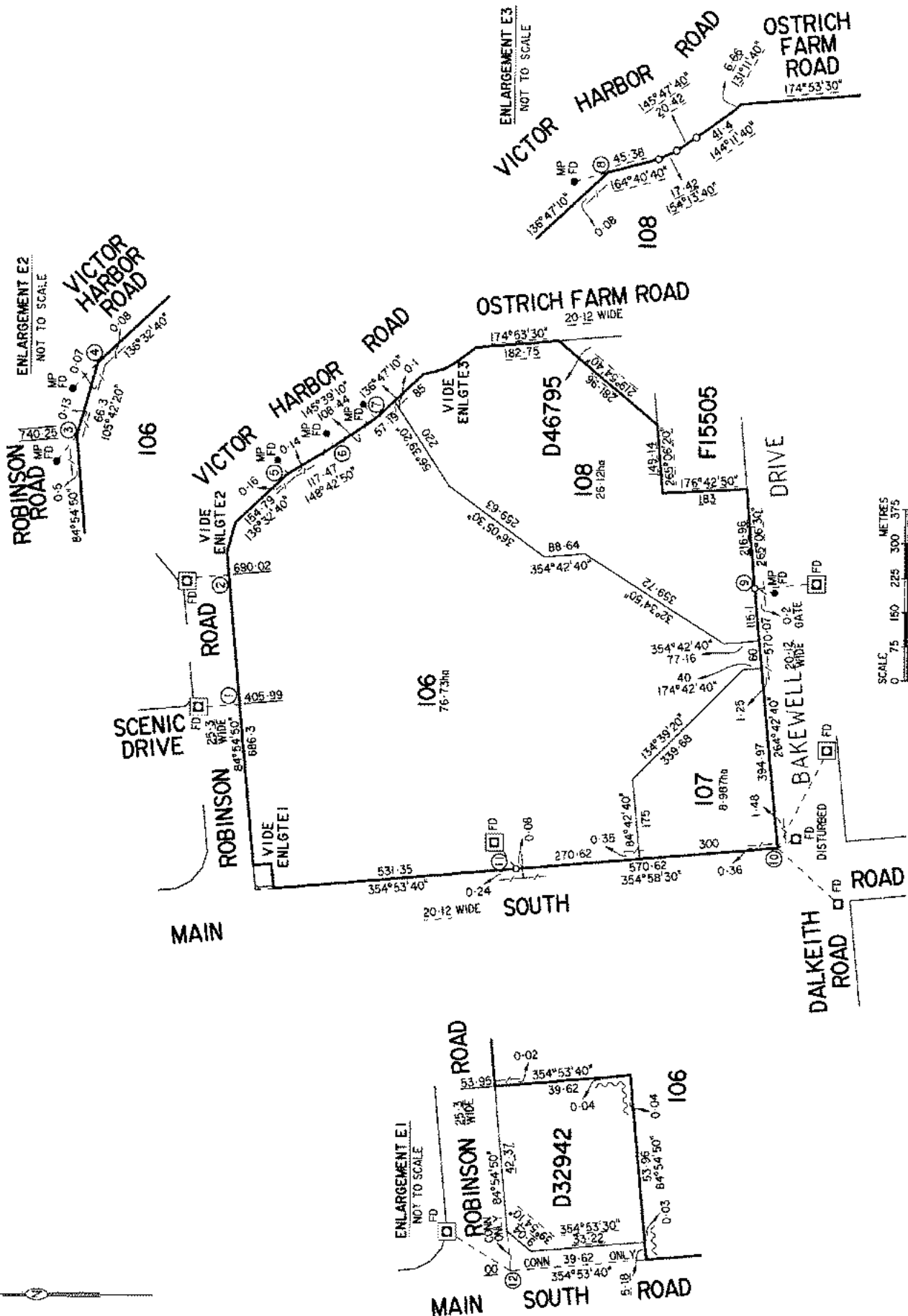
Priority Notices NIL

Notations on Plan NIL

Registrar-General's Notes

CONTROLLED ACCESS ROAD VIDE PLAN 10
APPROVED G21/2011
AMENDMENT TO DIAGRAM VIDE 47/2010

Administrative Interests NIL



REAL PROPERTY ACT, 1866



The Registrar-General certifies that this Title Register Search displays the records maintained in the Register Book and other notations at the time of searching.



Certificate of Title - Volume 5829 Folio 936

Parent Title(s) CT 5403/179

Creating Dealing(s) SC 8974989

Title Issued	14/12/2000	Edition	4	Edition Issued	24/07/2009
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Estate Type

FEE SIMPLE

Registered Proprietor

SOUTHERN REGION WASTE RESOURCE AUTHORITY
OF PO BOX 2414 MCLAREN VALE SA 5171

Description of Land

ALLOTMENT 102 DEPOSITED PLAN 46795
IN THE AREA NAMED SEAFORD HEIGHTS
HUNDRED OF WILLUNGA

Easements

NIL

Schedule of Dealings

Dealing Number	Description
12966519	LEASE TO TELSTRA CORPORATION LTD. (ACN: 051 775 556) COMMENCING ON 01/06/2018 AND EXPIRING ON 31/05/2028 OF PORTION (AREA A IN F 253623)

Notations

Dealings Affecting Title NIL

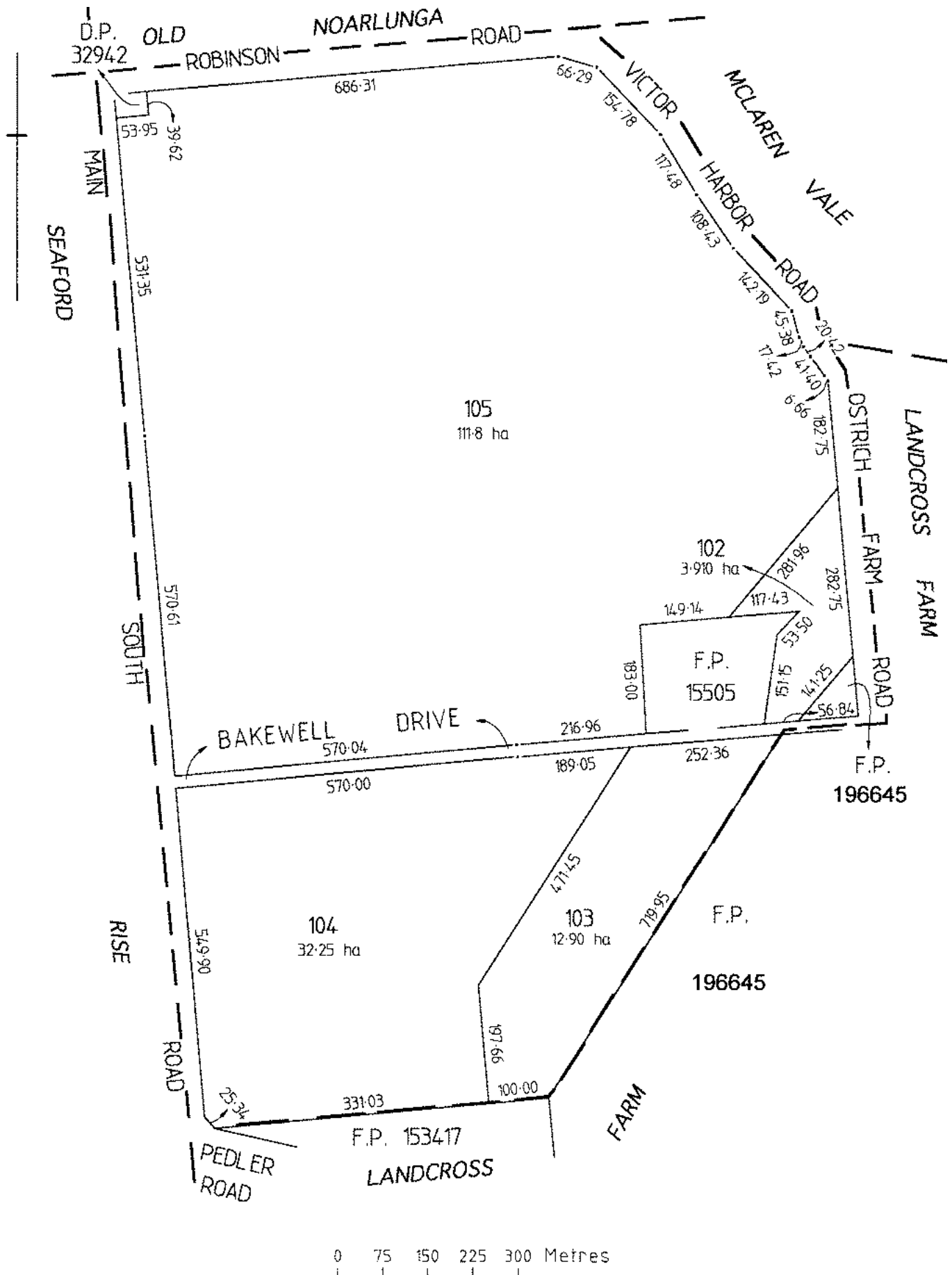
Priority Notices NIL

Notations on Plan NIL

Registrar-General's Notes

AMENDMENT TO DIAGRAM VIDE 47/2010
APPROVED FILED PLAN FOR LEASE PURPOSES FX253623

Administrative Interests NIL



COPY

#13088653



Government
of South Australia

The Hon Stephan Knoll MP
Member for Schubert

Mr Richard Dwyer
Managing Director
ekistics
Level 1/16 Vardon Avenue
ADELAIDE SA 5000

Dear Mr Dwyer

Thank you for your letter and supplementary information regarding the 600ML treated water dam at Seaford Heights and associated infrastructure proposed by your client Willunga Basin Water Company Pty Ltd (WBWC).

Given that the proposed works meet the definition of "public infrastructure" as outlined in Section 49(1)(a) of *Development Act 1993*, I am pleased to confirm support and specific endorsement pursuant to Section 49 (2)(c) of the *Development Act 1993* for the 600ML treated water dam including the 500mm inlet/outlet pipe and associated vegetation - as detailed in the attached Hydroplan concept plans dated 29/3/2018 drawings 14689 SK015 and SK013.

It is WBWC's responsibility to obtain all other statutory approvals, licences and permits from relevant authorities and to fund the project. The State of South Australia makes no commitment to provide any funding for the project or to purchase any product or service related to the project.

All costs of the development application, lodgement with the State Commission Assessment Panel (SCAP) and any subsequent action are the responsibility of WBWC. No representations or warranties are given in relation to the outcome of the development application or time that it takes to secure a planning outcome.

A development application must be lodged with SCAP on or prior to 30 September 2019. If this is not achieved by that time, my support under Section 49(2)(c) of the *Development Act 1993* will lapse. It is also a requirement that you contact Mr Brett Fundak, Senior Infrastructure Coordinator, prior to lodgement of the development application. Furthermore, if you have any queries in regard to this letter, please contact Mr Fundak on 8402 1845 or via e-mail at brett.fundak@sa.gov.au.

Yours sincerely


HON STEPHAN KNOLL MP
MINISTER FOR TRANSPORT, INFRASTRUCTURE AND LOCAL GOVERNMENT
MINISTER FOR PLANNING

17 January 2019

Attachments: Hydroplan concept plans – dated 29/3/2018 drawings 14689 SK015 and SK013.
Minister for Transport, Infrastructure and Local Government
Minister for Planning

Roma Mitchell House Adelaide SA 5000 | GPO Box 1533 Adelaide SA 5001 DX 171
Tel 08 7109 8430 | Email ministerknoll@sa.gov.au



Development Deed

South Australian Housing Trust

and

Urban Renewal Authority

and

Southern Region Waste Resource Authority

Table of Contents

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Date

7 November 2017

Parties

1. **South Australian Housing Trust** (ABN 17 545 435 789) a body corporate pursuant to the South Australian Housing Trust Act 1994 of Level 5 Riverside Centre, North Terrace, Adelaide SA 5000 (**SAHT**)
2. **Urban Renewal Authority** (ABN 86 832 349 553) of Level 9 (West) Riverside Centre, North Terrace, Adelaide SA 5000 (**URA**)
3. **Southern Region Waste Resource Authority** of 112 Bakewell Drive, Seaford Heights SA 5169 (**SRWRA**)

Recitals

- A SAHT and URA are the registered proprietors of the whole of the land which is comprised and described in Certificate of Title Volume 6175 Folio 501, Certificate of Title Volume 6034 Folio 589 and Certificate of Title Volume 5403 Folio 181 (**Land**).
- B SRWRA proposes to purchase the Land from SAHT and URA.
- C The Land is in proximity to land that is used for residential purposes and land that is proposed to be developed for residential purposes (**Residential Land**).
- D The Parties have agreed to enter into this Deed for the purposes of limiting the impact of the development of the Land on the amenity of the Residential Land.

It is agreed as follows.

1. Recitals

The Parties agree that the Recitals are true and correct and form part of this Deed.

2. Definitions and Interpretation

In the interpretation of this Deed, unless the contrary intention appears or the context otherwise requires:

- (a) **Business Day** means any day other than a Saturday, Sunday or public holiday;
- (b) **Government Agency** means any government department or any statutory, public, municipal, local or other authority charged with the responsibility for administering any relevant legislation, regulations, ordinances or by laws;

- (c) **Land** means the whole of the land which is comprised and described in Certificate of Title Volume 6175 Folio 501, Certificate of Title Volume 6034 Folio 589 and Certificate of Title Volume 5403 Folio 181;
- (d) **waste** means any discarded, rejected, abandoned, unwanted or surplus matter,
 - (i) whether or not intended for sale or for recycling, reprocessing, recovery or purification by a separate operation from that which produced the matter; and
 - (ii) whether of value or not,
 but for the avoidance of doubt does not include landscaping materials derived from green waste;
- (e) singular includes plural and vice versa and any gender includes every gender;
- (f) references to a person include a corporation, association, partnership, Government Agency or other legal entity;
- (g) references to statutes include statutes amending, consolidating or replacing the statutes referred to and all regulations, orders-in-council, rules, by laws and ordinances made under those statutes;
- (h) references to sections of statutes or terms defined in statutes refer to corresponding sections or defined terms in amended, consolidated or replacement statutes;
- (i) headings and the table of contents are used for convenience only and are to be disregarded;
- (j) where any word or phrase is given a defined meaning, any other grammatical form of that word or phrase has a corresponding meaning;
- (k) a reference to two (2) or more persons means those persons jointly and severally;
- (l) a reference to a Party includes:
 - (i) the successors and permitted assigns of that Party;
 - (ii) that Party acting in a trustee or other representative capacity;
- (m) a reference to including is not and must not be treated as a word of limitation;
- (n) a provision of this Deed must not be construed to the disadvantage of a Party because that Party (or its advisers) was responsible for the preparation of the Deed (or a portion of the Deed);
- (o) if any term of this Deed is legally unenforceable or made inapplicable, it will be severed or read down, but so as to maintain (as far as possible) all other terms of this Deed (unless to do so would change the underlying principal commercial purposes of this Deed).

3. Development of Land

SRWRA must not cause, suffer or permit the receipt, handling, storage or disposal of waste on the Land.

4. Default

- (a) If either party (**Defaulting Party**), is in Default the other party (**Non-Defaulting Party**) may give the Defaulting Party a written notice (**Default Notice**) specifying:
 - (i) the nature and extent of the Default that has occurred; and
 - (ii) the act, matter or thing that the Defaulting Party must do or refrain from doing in order to rectify the Default.
- (b) Upon receipt of a Default Notice, the Defaulting Party has such reasonable time as may be specified in the Notice in which to rectify the Default in the manner specified in the Default notice.
- (c) The period specified in a Default Notice for the rectification of a Default must not be less than 10 Business Days, unless the Defaulting Party can comply with the Default Notice by refraining from engaging in a specified act or activity.
- (d) The Defaulting Party must diligently pursue the rectification of a Default during the period specified in a Default Notice given to the Defaulting Party under this clause in respect of the Default. If the Defaulting Party does not diligently pursue the rectification of the Default at any time during that period, the Non-Defaulting Party may forthwith exercise its rights under clause (e).
- (e) If the Defaulting Party does not rectify the Default in the manner specified in the Default notice within the period specified in the Default Notice, the Non-Defaulting Party may undertake or cause to be undertaken such actions as are reasonably required to rectify the Default and recover the costs of doing so as a debt from the Defaulting Party.
- (f) The rights of the Non-Defaulting Party to take other action (including instituting legal proceedings) to restrain the Default or to require the Defaulting Party to specifically perform the Defaulting Party's obligations under this Deed are not affected by reason that the Non-Defaulting Party has given the Defaulting Party a Default notice in relation to the Default.
- (g) This clause does not affect any right either party may have to terminate this Deed.
- (h) The Non-Defaulting Party may, without prejudice to any of its other rights under this clause, if the Defaulting Party does not comply with a Default notice, commence legal proceedings for damages against the Defaulting Party and the Defaulting Party must indemnify the party not in default in respect of any costs incurred by the Council arising from the commencement of those proceedings.

5. Waiver

The failure of a Party at any time to insist on performance of any obligation under this Deed of another Party is not a waiver of its right:

- (a) to insist on performance of, or claim damages for breach of, that obligation unless that Party acknowledges in writing that the failure is a waiver; and

- (b) at any other time to insist on performance of that or any other obligation of that other Party under this Deed.

6. Termination

- (a) The parties may terminate this Deed at any time by mutual agreement entered into in writing.
- (b) Subject to clause (c) below and any other provisions of this Deed which are expressed to survive termination, this Deed continues until terminated in accordance with this Deed.
- (c) If this Deed is taken to be terminated each of the parties is discharged from any obligation or liability under this Deed other than any liability for a breach of or failure to comply with any obligation under this Deed by the party before its termination.

7. Notice

- (a) Each Party notifying or giving notice under this Deed must do so:
 - (i) in writing;
 - (ii) addressed to the address of the recipient as specified in this Deed, as altered from time to time by notice given in accordance with this clause:
and
 - (iii) hand delivered or sent by prepaid post to that address or sent by facsimile transmission.
- (b) A notice given in accordance with clause (a) is received:
 - (i) if hand delivered, on the date of delivery;
 - (ii) if sent by prepaid post, five (5) days after the date of posting; and
 - (iii) if sent by facsimile transmission, on the day the transmission is sent (but only if the sender has a confirmation report specifying a facsimile number of the recipient, the number of pages sent and the date of transmission).

8. Transfer

SRWRA must not transfer the Land to any person (*Transferee*) unless the Transferee enters into a deed with SAHT and URA under which the Transferee covenants to be bound by the terms of this Deed and SRWRA will remain liable for any obligation it has under this Deed until the Transferee covenants to be bound by this Deed.

9. Amendment

All additions, amendments or modifications to this Deed (including any Appendix of this Deed) may be made in writing and signed by a duly authorised

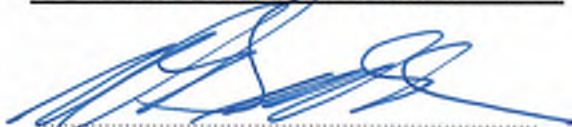
representative of the Parties. All such additions, amendments or modifications must be dated, numbered, and attached to or appended to this Deed.

10. Miscellaneous

- (a) This Deed is governed by the law applicable in South Australia.
- (b) This Deed (including all its Appendices) constitutes the entire agreement between the Parties as to its subject matter and supersedes all prior representations and agreements in connection with that subject matter.
- (c) Each Party must:
 - (i) do or cause to be done all things necessary or desirable to give effect to the performance of this Deed (including signing all such documents as may be required by this Deed); and
 - (ii) refrain from doing anything that could hinder performance of this Deed.

Executed as a Deed

Sealed under the authority of
SOUTH AUSTRALIAN HOUSING TRUST



Authorised Signatory

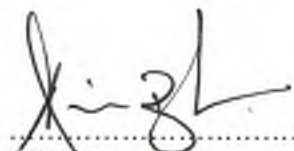
NORM SWANSSON - Manager Conveyancing
Print Name:



Authorised Signatory

Julie Waters - Manager
Sales & Acquisitions
Print Name:

2/2015
SIGNED for and on behalf of the
**URBAN RENEWAL AUTHORITY trading
as Renewal SA** by its duly constituted
Attorney pursuant to Power of Attorney
[INSERT], who has not received a notice of
the revocation of that Power of Attorney in
the presence of:



7 November
2017

Attorney

Michael Buchan

Full Name of Attorney

Address:

C/- Urban Renewal Authority
Level 9 Riverside Centre
North Terrace Adelaide SA 5000
Tel.8207 1300



Witness

Courtney Amelia Tyler

Full Name of Witness

Address:

C/- Urban Renewal Authority
Level 9 Riverside Centre
North Terrace Adelaide SA 5000
Tel.8207 1300

EXECUTED BY THE PURCHASER on

15TH

day of ~~September~~ 2017

THE COMMON SEAL of
**SOUTHERN REGION WASTE
RESOURCE AUTHORITY**
was affixed in the presence of:

.....
Chairperson

.....
Board Member



July 5, 2018

CARRINGTON CHAMBERS

BARRISTERS

48 Carrington Street
Adelaide SA 5000

(T) 08 8212 4511
(F) 08 8231 6080

O'Loughlins
Lawyers
Level 2, 99 Frome Street
Adelaide SA 5000

Attention: James Frearson-Lea

Dear James

Willunga Basin Water Co Pty Ltd

You have asked for my opinion on certain issues arising from a proposal by your client Willunga Basin Water Co. Pty Ltd (**WBW**) to construct and use a dam on land at Seaford Heights for the storage of recycled water.

Current operations

WBW is in the business of distributing recycled water principally to customers engaged in primary production within the Willunga Basin.

WBW presently sources its recycled water from the Christies Beach Wastewater Treatment Plant (**Christies Beach WWTP**) operated by SA Water.

SA Water receives sewage at the Christies Beach WWTP, and then subjects that sewage to sequential treatment including primary sedimentation/settling; activated sludge secondary treatment; secondary sedimentation/settling and chlorination.

Following treatment by SA Water, the treated water is either discharged to the sea at Christies Beach, or it is diverted by pipe to a storage dam on adjacent land operated by WBW.

WBW pays a commercial rate to SA Water for the purchase of the recycled water which is diverted to its Christies Beach dam.

The recycled water purchased from SA Water is pumped several kilometres from WBW's Christies Beach dam to WBW's site at Quarry Road Seaford Heights via a trunk main. The Quarry Road site includes a 13ML storage dam and a pump station. From the Quarry Road site, WBW distributes the recycled water to customers in the Willunga Basin via an existing network of pipes. The customers generally use the recycled water for the irrigation of crops.

SA Health has granted to SA Water a licence under the *Public and Environmental Health (Waste Control) Regulations* for the supply of recycled water from the Christies Beach WWTP, subject to conditions directed to achieving water quality requirements.

Proposal for additional storage dam

WBW proposes to construct a 700ML dam at Lot 108 in Deposited Plan 80592 at Seaford Heights (**Lot 108**). Lot 108 is conveniently located near the Quarry Road dam and pump station. Recycled water received at Quarry Road will be pumped to the proposed dam at Lot 108 for storage, and pumped back to the Quarry Road site when it is needed for sale to customers.

Lot 108 is presently owned by Southern Region Waste Resources Authority (**SRWRA**). WBW and SRWRA propose to enter into a lease whereby WBW will take possession of Lot 108, construct the dam and use the dam for the purposes of its recycled water distribution business.

The purpose of the dam on Lot 108 will be to take and store recycled water purchased from SA Water at the Christies Beach WWTP at times when there is low demand for irrigation water from WBW's customers, and then distribute that recycled water to customers in times of high demand. It is expected that the dam would be filled over the winter months when demand for irrigation water is low, and will progressively be emptied over the summer months when demand for irrigation water is high.

The dam on Lot 108 will be filled and emptied using the existing pumping infrastructure at the existing WBW site at Quarry Road.

In terms of composition and quality, there will be no difference between the water held in the dam on Lot 108 and the water currently being distributed by WBW using its existing infrastructure and systems. The purpose of the dam is simply to provide additional storage capacity within the distribution system to augment WBW's ability to provide irrigation water in summer.

The legal issue

SRWRA bought Lot 108 from the South Australian Housing Trust and the Urban Renewal Authority in about 2017. At about the time of the sale, the vendors and SRWRA executed a 'Development Deed' dated 7 November 2017. The Deed recites that its purpose is to limit the impact of the development of the land to which it relates on the amenity of nearby land that is used for residential purposes or that is proposed to be developed for residential purposes.

From my reading of the Development Deed clause 3 is its only operative clause. Clause 3 reads as follows:

3 *SRWRA must not cause, suffer or permit the receipt, handling, storage or disposal of waste on the Land.*

In the Development Deed, 'Land' is defined to include Lot 108.

Further the Deed contains the following definition of 'waste':

waste means any discarded, rejected, abandoned, unwanted, or surplus matter,

- (i) whether or not intended for sale or for recycling, reprocessing, recovery or purification by a separate operation from that which produced the matter; and
- (ii) whether of value or not,

but for the avoidance of doubt does not include landscaping materials derived from green waste.

A question has arisen whether the storage of recycled water sourced from the Christies Beach WWTP in a dam to be constructed on Lot 108 would be contrary to clause 3 of the Development Deed. This issue comes down to whether or not the recycled water is 'waste' as defined in the Development Deed.

Discussion

Clause 3 of the Development Deed would only be contravened if the recycled water held in the dam proposed on Lot 108 met the definition of 'waste' set out in the Development Deed.

That definition is in all material respects the same as the definition of 'waste' as it was found in section 3(1) of the *Environment Protection Act 1993* (SA) (the **EP Act**) at the time the Development Deed was executed and before an amendment to the definition in the EP Act in November 2017.¹

The definition of waste in the EP Act was the subject of an appeal heard by the Full Court of the Supreme Court of South Australia in the matter of *Wood v Adelaide Resource Recovery Pty Ltd* in 2017.² That appeal was concerned with a licenced waste depot at which construction and demolition waste was 'processed' into a form of alternative fuel suitable for use in some

¹The definition in the EP Act allowed for the definition to be enlarged by the inclusion of additional forms of waste by way of regulation or environment protection policy. This aspect of the EP Act definition is absent from the definition in the Development Deed. The EP Act definition also makes no reference to landscaping materials derived from green waste. Neither of these aspects of the definition are relevant for present purposes.

²[2017] SASCF 13. This decision was published on 20 February 2017.

industrial activities. The question was whether the construction and demolition waste had ceased to be waste for the purposes of the definition on account of it having been 'processed' into a product.

The Court ultimately held that on the facts of the case there had not been sufficient processing of the waste to convert it into a product. However, as the nature of the materials bore no resemblance to the irrigation water with which we are concerned here, the importance of the Full Court case lies in the principles discussed by the Court in determining whether materials are waste for the purposes of the definition, or alternatively whether they are a product.

The Court said:

[44] *In ordinary parlance, waste is a purposive concept. It is a relative and not absolute concept. It is not an inherent characteristic of material that it comprises waste: it must be assessed from the perspective of a person whose purpose is to be considered at the relevant time. Waste is the antithesis of a product in ordinary parlance.*

[45] *This dichotomy between waste and a product is reflected in the first limb of the definition of "waste" in the Act. If material that was waste has been used to make or has otherwise become a product, by a combination of what it says and does not say the definition treats the material as no longer being waste. Thus, the definition explicitly provides that the mere fact that the material is intended for sale, recycling, reprocessing, recovery or purification does not prevent it being waste if it falls within the first part of the limb. Conversely, the definition implicitly provides that if the material has actually been sold, recycled, reprocessed, recovered or purified such that it is now a product, it is no longer waste.*

[46] *The conversion of unwanted waste into a product of value may be a complex process over an extended time period. In many cases, it will be a question of fact and degree to determine the point at which waste has changed its character and become a product. However, the mere fact that there may be questions of judgment involved in determining the precise point at which this occurs does not detract from the dichotomy evident in the definition between waste and a product. The definition makes plain that mere intention to convert waste into a product will not suffice: the enquiry is into objective fact.*

Because the definition of waste in the Development Deed is relevantly in the same terms as the definition of waste in the EP Act, in my view the Full Court's statements of principle in paragraphs [44] - [46] quoted above have application to the definition in the Development Deed, and are therefore likely to be decisive in determining the question whether the recycled water in the proposed dam will be 'waste'.

Paragraph [44] of the Full Court's decision requires the identification of the person whose purpose will determine the status of the material. In this case, in my view, that person will be WBW as the occupier of Lot 108 and the operator of the dam to be built there. It will not be

SRWRA, who will merely hold ownership of the land and will not be involved in any handling of the water. It will plainly not be SA Water, whose involvement with the water ceases when it is sold to WBW and piped from the Christies Beach WWTP into WBW's holding dam at Christies Beach.

Further, in the hands of WBW at Lot 108, the recycled water is neither discarded, rejected, abandoned, unwanted nor surplus. On the contrary, the water is a valuable resource for which WBW has paid a commercial rate to acquire title, and for the purpose of re-selling at a profit. Clearly, in the hands of WBW the recycled water is not waste within the definition.

Paragraph [45] recognises that material that was formally waste may be turned into a product, and once this occurs it is no longer waste. In the circumstances of this case, the sewage received by SA Water at Christies Beach is undoubtedly waste. However that sewage is processed by SA Water at the Christies Beach WWTP, and reusable water emerges from those processes. The principles discussed by the Full Court in paragraph [45] suggest that in the hands of SA Water the recycled water may still be waste, despite the fact that it is intended to be sold to WBW, because mere intention to sell is not sufficient to convert something from waste into a non-waste. However the last sentence of paragraph [45] makes it clear that upon actual sale of the processed material to a customer, then that material ‘...is now a product, it is no longer waste.’

Thus it is clear that upon delivery from SA Water to WBW, the recycled water becomes a product, and is no longer waste.

It can further be seen that in accordance with the principles identified by the Full Court, the mere transportation of the recycled water from WBW's Christies Beach storage to the proposed dam at Lot 108 will not change the status of the water, and will certainly not convert the water into waste.

Paragraph [46] refers to the possibility of conversion of waste into a product over time and by a complex process. In my view, the relevant time frame and processes occur at SA Water's Christies Beach WWTP, and the point at which the water changes its character from waste to product occurs when the recycled water is diverted into WBW's storage dam at Christies Beach. At that point there is something more than mere intention on the part of SA Water. The water is sold for value, and a change in ownership takes place.

Summary

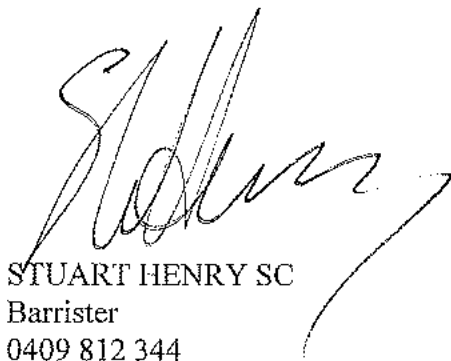
The definition of ‘waste’ in the Development Deed is framed in terms relevantly identical to the old definition of ‘waste’ in the EP Act. As such, the Full Court's decision in *Woods v Adelaide Resource Recovery* sets out the relevant principles for determining whether the recycled water to be held in the proposed dam on Lot 108 will be ‘waste’ for the purposes of the Deed.

It is plain from the Full Court's decision that material may be transformed from waste into a product through the application of industrial processes, and that if such a product is sold to a customer who wishes to put the product to some use, then the product is not waste.

In my view, this is exactly the situation involving WBW and the proposed dam at Lot 108. WBW buys the recycled water from SA Water. WBW values the recycled water because WBW is able to sell the recycled water to its customer at a profit.

The recycled water is not, in my view, a form of 'waste' for the purposes of the Development Deed.

Yours sincerely

A handwritten signature in black ink, appearing to read 'Stuart Henry', with a long, sweeping horizontal stroke extending to the right.

STUART HENRY SC

Barrister

0409 812 344

s.henry@carringtonchambers.com.au

DATED

23rd

DAY OF

OCTOBER

2017

LAND MANAGEMENT AGREEMENT

BETWEEN

MINISTER FOR PLANNING ("MINISTER")

-AND-

SOUTHERN REGION WASTE RESOURCE AUTHORITY (ABN 37 443 976 085)
("OWNER")



Government
of South Australia

CROWN SOLICITOR
Level 9, 45, Pirie Street, Adelaide SA 5000

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LAND MANAGEMENT AGREEMENT dated ~~day of~~ *23rd October*

2017

PARTIES:

MINISTER FOR PLANNING of a body corporate pursuant to the *Administrative Arrangements Act 1994 (SA)* of 9th Floor Terrace Towers, 176 North Terrace, Adelaide 5000 in the State of South Australia ("**MINISTER**")

AND

SOUTHERN REGION WASTE RESOURCE AUTHORITY of PO Box 2414 McLaren Vale SA 5171 ("**OWNER**")

RECITALS:

- A. The Owner is the registered proprietor of the whole of the land which is comprised and described in Certificate of Title Volume 6034 Folio 589 ("**Land**").
- B. The Minister for Planning and the Owner have agreed to enter into this Agreement pursuant to section 57(1) of the *Development Act 1993 (SA)* ("**the Act**") in relation to the development, management, preservation and conservation of the Land subject to the terms and conditions as expressed in this agreement.
- C. This Land Management Agreement is executed as a Deed and applies to the whole of the Land.

IT IS AGREED:

1. RECITALS

That the matters recited above are true and accurate and shall form part of this agreement.

2. DEFINITIONS

In this agreement, unless otherwise provided:

- 2.1 "Act" has the meaning given in Recitals paragraph B above;
- 2.2 "Buffer Land" means the area delineated as A on the plan attached to this agreement as Annexure C
- 2.3 "Buffer Zone Landscaping" means the landscaping and vegetation that has been established on the Buffer Zone Landscaping Area in accordance with the attached landscape drawings which form Annexure A to screen urban development and to interrupt sight lines from Victor Harbor Road and reference to Buffer Zone Landscaping includes reference to any portion of it;
- 2.4 "Buffer Zone Landscaping Area" means the landscaped and vegetated area where the Buffer Zone Landscaping exists and which is bounded in blue on the plan attached to this agreement as Annexure B
- 2.5 "Land" has the meaning given in Recitals paragraph A above;
- 2.6 "Laws" shall mean and include all present and future legislation (both State and Federal) and all amendments to them and re-enactments of them and all regulations, by-laws and orders made pursuant to them;
- 2.7 "LTO" means the Land Titles Office of South Australia;
- 2.8 "Minister" means the Minister to whom the Act is committed from time to time and includes his or her authorised agents or delegates;
- 2.9 "Owner" means the person and/or company registered or entitled to be registered as the proprietor of an estate in fee simple to the Land or to each and every one of all separate allotments into which the Land may be divided after the date of this Agreement (subject however to such encumbrances, liens and interests as are registered and notified by memoranda endorsed on the Certificate of Title thereof) and where the Owner consists of more than one person means each and every one or more of such persons jointly and each of them severally;

3. INTERPRETATION

3.1 In this agreement, unless a contrary intention is evident:

- 3.1.1 a reference to any legislation or to any provision of any legislation includes:
 - (a) all legislation, regulations, proclamations, ordinances, by-laws and instruments issued under that legislation or provision; and
 - (b) any modification, consolidation, amendment, re-enactment or substitution of that legislation or provision;

-
- 3.2 a reference to a party includes that party's administrators, successors, heirs and permitted assigns;
 - 3.3 a reference to two or more persons is a reference to those persons jointly and severally;
 - 3.4 a reference to a clause or schedule is a reference to a clause of, or a schedule to, this agreement;
 - 3.5 a reference to a clause number is a reference to all of its sub-clauses; and
 - 3.6 the clause headings are for convenient reference only and they do not form part of this agreement.

4. TERM

This agreement commences from the moment it is duly registered at the LTO pursuant to Section 57(5) of the Act and continues until terminated in accordance with this agreement.

5. MANAGEMENT OF LAND

- 5.1 The Owner must:
 - 5.1.1 not cause, suffer or permit interference with, damage to or removal or destruction of the Buffer Zone Landscaping;
 - 5.1.2 re-plant, re-establish or re-construct any part of the Buffer Zone Landscaping in the event that there is any damage to, or destruction of the Buffer Zone Landscaping on the Buffer Zone Landscaping Area or the removal of any vegetation or soil from the Buffer Zone Landscaping Area; and
 - 5.1.3 not permit the doing or omission of any act, matter or thing on the Buffer Zone Landscaping Area which has the potential to cause such act, matter or thing in 5.1.1 or 5.1.2;as it relates to the Land and without the prior written approval of the Minister.
- 5.2 The Owner must:
 - 5.2.1 ensure that the Buffer Land is maintained as primarily a passive vegetated area to screen development and interrupt site lines from Victor Harbor Road; and
 - 5.2.2 obtain the consent of the Developer for any change in the use of the Buffer Land as described in 5.2.1.
- 5.3 In this clause 5, "Developer" means Fairmont Land Holdings Pty Ltd (ACN 098 486 429), LandSA Pty Ltd (ABN 47 079 317 623) and MSP Property Holdings Pty Ltd (ACN 110 753 707) and each of their successors and permitted assigns in respect of the deed entitled Development Deed – Seaford Heights 2008 dated 29 May 2009 and as subsequently varied.

6. RESTRICTIONS ON LEASING AND OTHER DEALINGS

The Owner must not grant, or agree to grant, any lease, licence, easement (including a right of way) or other right of any nature whatsoever which may give any person the right to possession or control of or entry on to the Land which right would enable such person to breach any of the obligations imposed on the Owner by this agreement unless such grant:

- 6.1 is in writing; and
- 6.2 contains as an essential term a covenant by the grantee not to do, or omit to do (or suffer or permit any other person to do or omit to do) any act, matter or thing which would constitute a breach by the Owner of the Owner's obligations under this agreement if the Owner itself performed (or omitted to perform) the act.

7. SEVERANCE

- 7.1 Each word, phrase, sentence, paragraph and clause of this agreement is severable.
- 7.2 If a court determines that a part of this agreement is unenforceable, invalid, illegal or void that court may sever that part.
- 7.3 Severance of a part of this agreement will not affect any other part of this agreement.

8. ENTIRE AGREEMENT

- 8.1 This agreement contains the entire agreement between the parties with respect to its subject matter.
- 8.2 This agreement supersedes any prior agreement, understanding or representation of the parties on the subject matter.

9. MODIFICATION

- 9.1 Any modification of this agreement must be in writing and signed by each party.
- 9.2 Modifications must be enacted in accordance with the provisions of the Act which apply to changes or alterations of Land Management Agreements.

10. WAIVER

- 10.1 A waiver of any provision of this Agreement must both be in writing and be signed by the parties or by a person duly authorised to sign such a document on a party's behalf.
- 10.2 No waiver by a party of a breach of a term or condition contained in this agreement shall operate as a waiver of any breach of the same or any other term or condition contained in this agreement.
- 10.3 No forbearance, delay or indulgence by any party in enforcing the provisions of this agreement shall prejudice or restrict the rights of that party.

EXECUTED AS A DEED BY

THE COMMON SEAL of
SOUTHERN REGION WASTE
RESOURCE AUTHORITY
was affixed in the presence of:



.....
Chairperson

.....
Board Member

THE COMMON SEAL of MINISTER
FOR PLANNING
was hereto affixed in the presence of:

.....
Witness

[Print Name: CHELSEA KATE LUCAS]



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ANNEXURE A
Buffer Zone Landscaping

DRAWING	LOCATION MAP
SHEET 500	PLANT LAYOUT 1
SHEET 501	PLANT LAYOUT 2
SHEET 502	PLANT LAYOUT 3
SHEET 503	MOUND LAYOUT 1
SHEET 504	MOUND LAYOUT 2
SHEET 505	

[illegible]

[illegible]

PROPOSED
FAIRMONT
GROUP
DEVELOPMENT



4760
VICTOR-HARBOR-ROAD
SEAFORD-HEIGHTS
LANDSCAPE-CONSTRUCTION
PLANT-LAYOUT-1

[illegible]

1994 SPECIAL ADVERTISING SECTION

1994 SPECIAL ADVERTISING SECTION

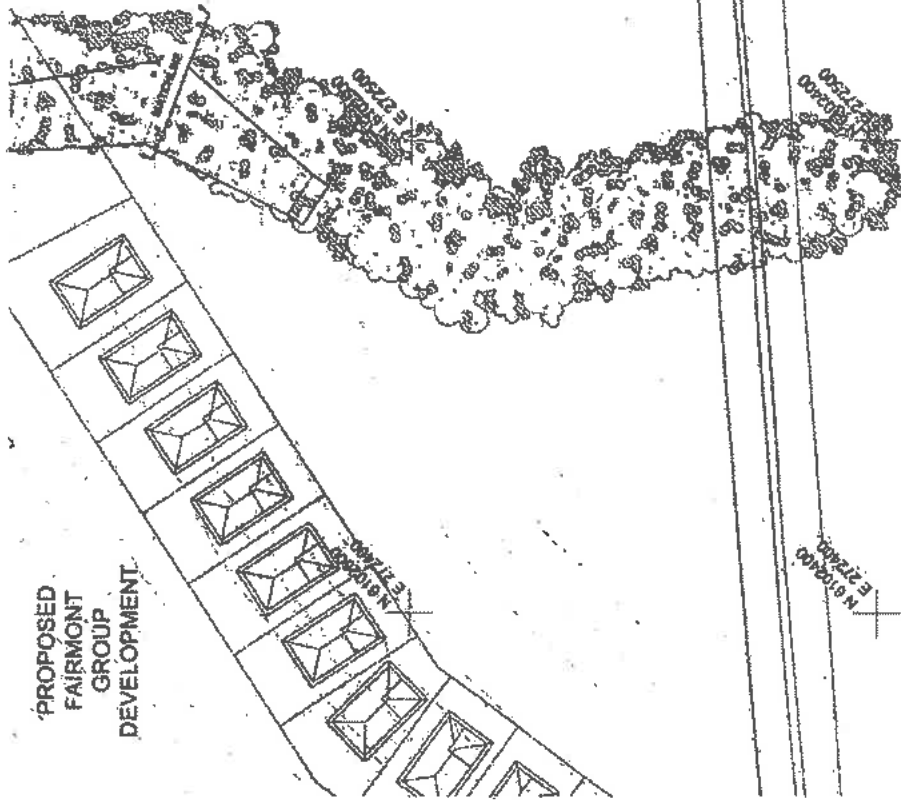
PROTEIN DEVELOPMENT MIX 2

AS00112630407

THE JOURNAL OF THE

Wavelengths

**PROPOSED
FAIRMONT
GROUP
DEVELOPMENT**

[illegible]

Department of South Australia
Department of Housing,
Transport and Infrastructure

THE ASSAULT ON 9/11	THE BOMBING OF MEMPHIS
------------------------	---------------------------

4760
VICTOR-HARBOR-ROAD
SEAFORD-HEIGHTS
LANDSCAPE-CONSTRUCTION
PLANT-LAYOUT-3

[illegible]

TYPE OF DOCUMENT

APPLICATION TO NOTE LAND MANAGEMENT AGREEMENT

PRIVACY COLLECTION STATEMENT: The information in this form is collected under statutory authority and is used for maintaining publicly searchable registers and indexes. It may also be used for authorised purposes in accordance with Government legislation and policy requirements.

(Pursuant to s 57(5) of the Development Act 1993)

To the Registrar-General:

1. The MINISTER FOR PLANNING a body corporate constituted by a proclamation made pursuant to s 7(1) of the *Administrative Arrangements Act 1994* ("the Minister") of 11th Floor 45 Pirie Street Adelaide South Australia 5000 has entered into the attached Land Management Agreement dated the 23rd day of October 2017 ("the Agreement") with SOUTHERN WASTE RESOURCE AUTHORITY (ABN 37 443 975 085) of Post Office Box 2414 McLaren Vale 5171 pursuant to Section 57(1) of the *Development Act 1993* ("the Act").
2. The Agreement relates to the whole of the land comprised in Certificate of Title Volume 6034 Folio 589 ("the Land").

NOW THEREFORE the Minister applies pursuant to s 57(5) of the Act to note the Agreement against the Land.

Dated 21st day of November 2017

THE COMMON SEAL of MINISTER
FOR PLANNING was hereto affixed
in the presence of:

Signature of Witness

CHELSEA KATE LULAS
Full Name of Witness

45 PIRIE STREET
ADELAIDE SA 5000
8204 1495



FORM 100 (1/1/17)
 AG 12835643

 11:39 28-Nov-2017
 4 of 4

LANDS TITLES REGISTRATION OFFICE
 SOUTH AUSTRALIA

FORM APPROVED BY THE REGISTRAR-GENERAL

PRIORITY NOTICE ID	
--------------------	--

BELOW THIS LINE FOR OFFICE &
 STAMP DUTY PURPOSES ONLY

SERIES NO	PREFX
4	AG

AGENT CODE

LODGED BY:



MCDL

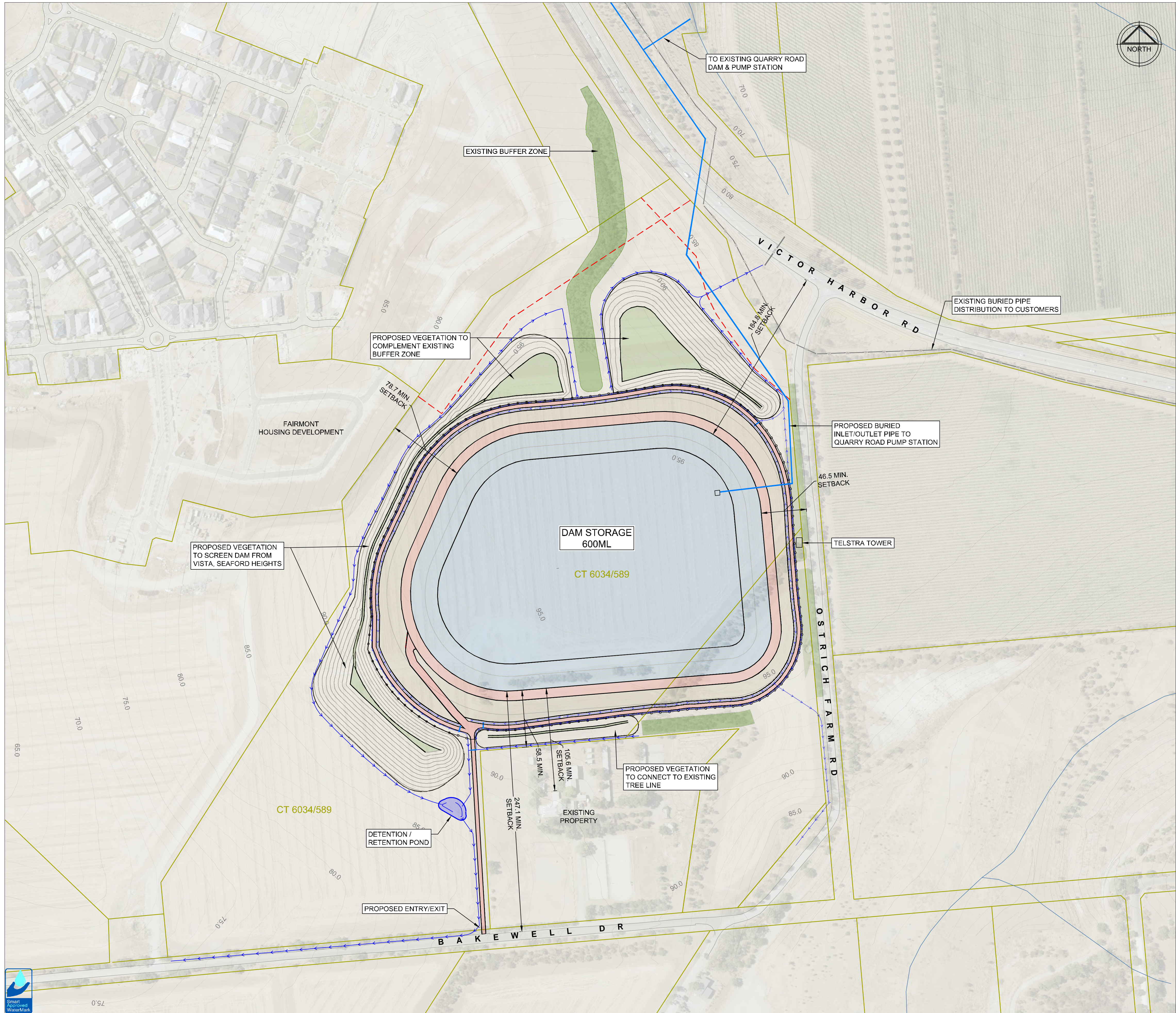
CORRECTION TO:

SOUTH AUSTRALIAN HOUSING TRUST SAHT

SUPPORTING DOCUMENTATION LODGED WITH INSTRUMENT
(COPIES ONLY)

- 1
- 2
- 3
- 4
- 5

CORRECTION	PASSED
REGISTERED	 
5 - DEC 2017	



SITeworks LEGEND

- PROPERTY LINE
- PROPOSED PIPELINE
- PROPOSED SWALE
- EXISTING PIPELINE
- BUFFER LAND BOUNDARY LINE

FINISHED SURFACE LEGEND

- RUBBLE AREA
- STORAGE AREA (PLASTIC LINED)
- OUTSIDE BATTER AREA

VEGETATION LEGEND

EXTENDED VEGETATION AREA:
(FOR SCREENING - INDICATIVE ONLY)

EXAMPLE:



NOTE: VEGETATION PLAN TO BE AGREED WITH BIODIVERSITY McLaren VALE AND DEW. VEGETATION TO SCREEN A 1.8m HIGH SECURITY FENCE ON THE INTERNAL SIDE OF EXTENDED VEGETATION ALIGNMENT.

EXISTING VEGETATION AREA:

EXAMPLES:



SCALE 1:2000 ORIGINAL SIZE A1

Drawing file: Z:\WBW\14689 SRWA Dam Drawings\SK017-d7 (57MM x Mounds) dwg - 19/12/2018 5:14 PM Original Size: ISO Full Bleed A1 (841.00 X 594.00 MM)

4	19/12/2018	JT	BH	FOR DISCUSSION					
3	16/11/2018	JT	JG/BH	FOR DISCUSSION					
2	22/10/2018	JT	JG/BH	FOR DISCUSSION					
1	03/10/2018	JT	JG/BH	FOR DISCUSSION					
0	20/09/2018	JT	JG/BH	FOR DISCUSSION					
REV	ISSUED	D.DWN	APRVD	REVISION DESCRIPTION	REV	ISSUED	D.DWN	APRVD	REVISION DESCRIPTION



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PERTH ADELAIDE SYDNEY BRISBANE BEIJING

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commissioned and in accordance with the terms of
engagement for the commission.

The arrangement and general details as shown on
this drawing are essentially diagrammatic and must
be applied to the circumstances as found on site.

DES/DRAWN:	JT	CLIENT: WILLUNGA BASIN WATER							
CHECKED:	BH								
APPROVED:	JG	PROJECT: SRWRA STORAGE CONCEPT DESIGN PLAN WITH MOUNDS							
DATE:	29/03/2018								
DRAFT REF:	2-WBW-d7	DRAWING No.	14689-SK017	SHEET	1	OF	1	REVISION	4



DRAFT GEOTECHNICAL INVESTIGATION REPORT

SRWRA Storage Seaford

Reference No. 3005628
Prepared for Hydroplan
18 June 2018

Document Control

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Rev A	14 June 2018	Simon Pointon	Mark Drechsler	Mark Drechsler

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The information within this document is and shall remain the property of Hydroplan.

Important Notice

This report is confidential and is provided solely for the purposes of assessing the ground conditions at the SRWRA Storage Seaford. This report is provided pursuant to a Consultancy Agreement between SMEC Australia Pty Limited ("SMEC") and Hydroplan, under which SMEC undertook to perform a specific and limited task for Hydroplan. This report is strictly limited to the matters stated in it and subject to the various assumptions, qualifications and limitations in it and does not apply by implication to other matters. SMEC makes no representation that the scope, assumptions, qualifications and exclusions set out in this report will be suitable or sufficient for other purposes nor that the content of the report covers all matters which you may regard as material for your purposes.

This report must be read as a whole. The executive summary is not a substitute for this. Any subsequent report must be read in conjunction with this report.

The report supersedes all previous draft or interim reports, whether written or presented orally, before the date of this report. This report has not and will not be updated for events or transactions occurring after the date of the report or any other matters which might have a material effect on its contents or which come to light after the date of the report. SMEC is not obliged to inform you of any such event, transaction or matter nor to update the report for anything that occurs, or of which SMEC becomes aware, after the date of this report.

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1 Introduction

A geotechnical investigation has been undertaken by SMEC Australia at the location of the proposed Willunga Basin Water storage project at Seaford Heights, South Australia. The project locality is shown on Figure 1.

The objective of the investigation was to provide Hydroplan with a broad understanding of the foundation, excavation and earthworks conditions for a proposed 700 ML water storage to be located on Ostrich Farm Road.

SMEC understands that Hydroplan is looking for a site for a Willunga Basin Water storage for the Southern Region Waste Resource Authority (SRWRA) with the capacity of 700ML. The concept design is for a site at Seaford Heights on Ostrich Farm Road at the top of a hill, which is located above a new subdivision, the Victor Harbor Road and neighbouring properties. Excavations within the subdivision infer a weathered profile of siltstones and sandstone at depth, which are inferred to extend under the water storage facility.

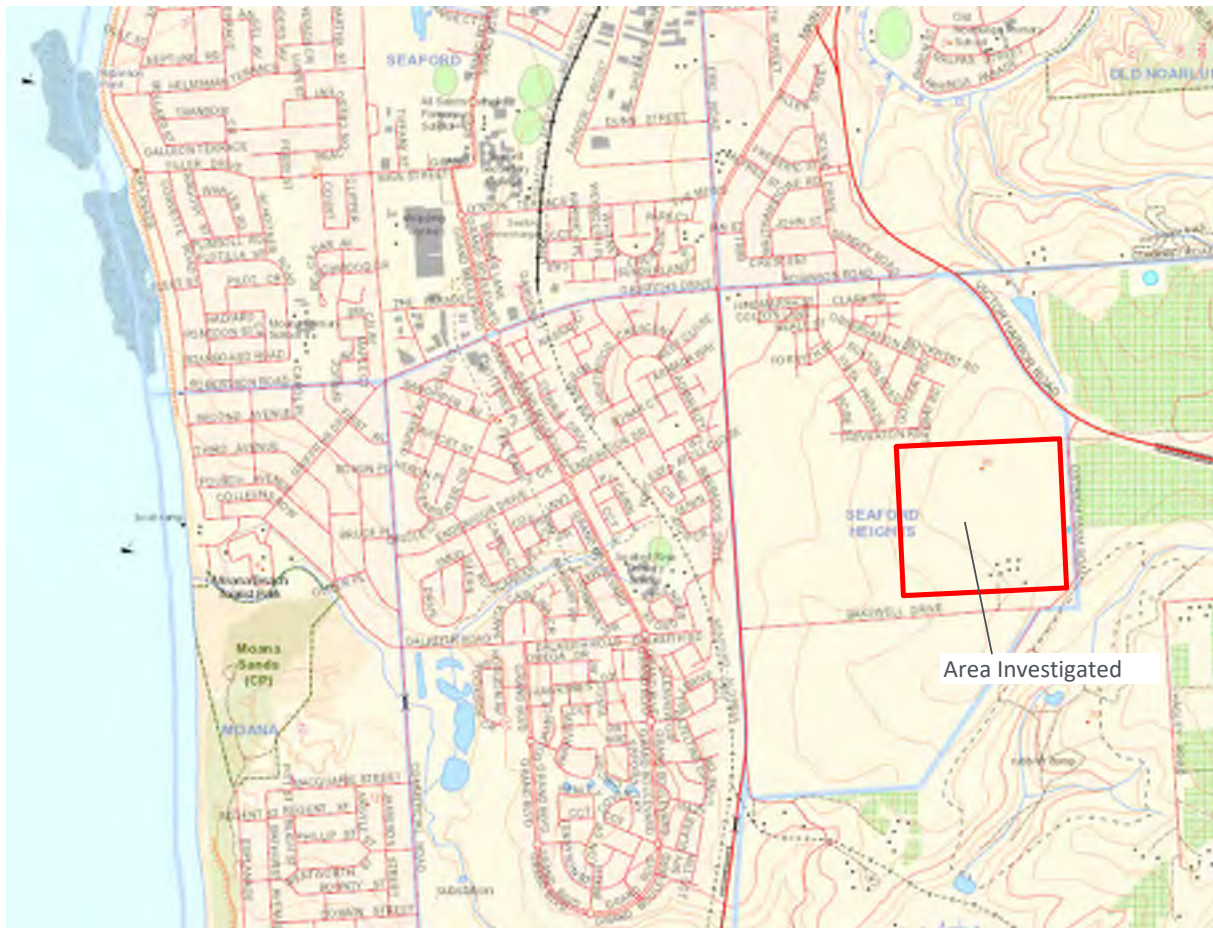


Figure 1: Project Location

[Image Source: Department of State Development, the Government of South Australia, SARIG (South Australian Resources Information Gateway) <https://map.sarig.sa.gov.au/> accessed May 2018]

2 OUTLINE OF THE SITE INVESTIGATION

2.1 Field Investigation

The field investigation was carried out on 21 May and 22 May 2018 and comprised drilling four boreholes (denoted BH1 to BH4) to a target depth of 8 m. The boreholes were drilled by subcontractor Drilling Solutions using a truck mounted drilling rig and the HQ diamond coring technique.

The boreholes were positioned to provide a broad coverage of the proposed storage area. The field investigation was completed in general accordance with AS1726:2017 Geotechnical Site Investigations, and was supervised by an experienced Geotechnical Engineer from SMEC. The boreholes were backfilled with spoil following completion of the site investigation.

A plan of the boreholes is included in Appendix A. Representative site photographs are presented in Appendix B. Engineering logs of the boreholes are contained in Appendix C. The position of the boreholes was recorded on site using a hand-held GPS unit and has been reported on the logs.

2.2 Laboratory Testing

Samples were collected for laboratory testing and were submitted for testing at the NATA registered Golder laboratory in Adelaide. The purpose of the testing was to assess the physical and dispersive properties of the soil.

The following scope of testing was completed:

- 3 x Particle Size Distribution
- 3 x Atterberg Limits
- 3 x Emerson Class

3 SITE CONDITIONS

3.1 Site Description

The project site is located at Seaford Heights, approximately 31 km south of the Adelaide CBD. The site is bound to the east by Ostrich Farm Road, to the south by Bakewell Road, to the west by undeveloped farmland and to the north-west by a residential sub-division.

The topography of the local area consists of a series of undulating hills. The proposed water storage basin is located at the top of a hill and the terrain gently slopes away from a high point at the centre of the site (near BH1). At the time of investigation, the land was being used for agricultural purposes and the surface vegetation consisted of a low stubble, with rows of trees surrounding the perimeter of the field. Photographs of the site are included in Appendix B.

3.2 Regional Geology

The regional geology map (1:50,000 Noarlunga Sheet) shows undifferentiated Quaternary deposits at the surface including Hindmarsh Clay, Ngalinga Clay and a lower sand unit equivalent to the Carisbrook Sand, Ochre Cove Formation and Seaford Formation. The Hindmarsh/Ngalinga Formations comprise brown, red and olive clays and sandy clays with sand and gravel lenses.

The geology map indicates the upper clay soils are underlain by Proterozoic bedrock including:

- SEACLIFF SANDSTONE: Pale grey and red sandstone, quartzite and red siltstone
- BRACHINA FORMATION: Red and green siltstone and fine-grained sandstone
- REYNELLA SILTSTONE MEMBER: Mostly massive siltstone with small rock fragments
- WILMINGTON FORMATION: Massive, green-grey, fine-grained sandstone

It is understood that bedrock consistent with the above units has been intercepted at shallow depth during construction of the subdivision.

3.3 Subsurface Conditions

The subsurface conditions encountered in the boreholes were broadly consistent with the expected regional geology. The sub-surface soils can be broadly categorized into the following units listed in Table 1. The depth of the various units is summarised in Table 2.

Table 1: Summary of Encountered Soil Units

UNIT	DESCRIPTION
Topsoil (A Horizon):	Silty CLAY, dark brown with roots and other organics, trace to some sand.
Upper Clays (B Horizon)	Silty and Sandy CLAY, medium plasticity, pale brown mottle, with some sand and gravel
Hindmarsh / Ngalinga Clays	CLAY, high plasticity, grey mottled orange-brown and red-brown
Residual Soils	CLAY and CLAYEY SAND and with extremely to highly weathered fragments of the parent rock
Siltstone	Siltstone, red brown, orange brown and pale grey, indistinct fabric. Highly weathered and low strength at the top of the stratum, becoming moderately to slightly weathered and medium strength with depth. Encountered BH2 only.
Sandstone	Sandstone, orange brown, very low strength, highly to extremely weathered. Encountered BH4 only.

Table 2: Summary of sub-surface lithology

UNIT	BH1	BH2	BH3	BH4
Top Soil	0.0 m to ≈0.2 m	0.0 m to ≈0.2 m	0.0 m to ≈0.2 m	0.0 m to ≈0.2 m
Upper Clay	≈0.2 m - ≈2.5 m	≈0.2 m - 1.3 m	≈0.2 m - ≈2.5 m	≈0.2 m - ≈3.6 m
Hindmarsh / Ngalinga Clay	≈2.5 m - 7.5 m	Not Encountered	≈2.5 m - 7.8 m	Not Encountered
Clayey Sand	7.5 m – 8.0 m (EOH)	Not Encountered	7.8 - 8.06 m (EOH)	Not Encountered
Residual Soil		1.3 m – 1.6 m		3.6 m - 4.9 m
Siltstone / Sandstone		1.6 m – 8.1 m (EOH)		4.9 m - 8.0 m (EOH)

No groundwater was encountered within the depth investigated.

3.4 Dispersion Testing

Emerson Class laboratory testing was completed on three samples of the clays soils. The Emerson test divides soils up into eight classes based on their coherence in water (dispersion and slaking) and the presence of carbonate or gypsum.

The results of the testing were as follows:

- BH01 - 1.7 m to 2.0 m – **CLASS 4**, The remoulded soil does not disperse in water. Calcium carbonate (calcite) is present.
- BH01 - 2.7 m to 3.0 m and BH01 - 4.7 m to 5.0 m – **CLASS 2**, Air-dried crumbs of soil show a moderate to slight reaction. A moderate reaction consists of an easily recognizable cloud of colloids in suspension, usually spreading in thin streaks on the bottom of the beaker. A slight reaction consists of the bare hint of cloud in water at the surface of the crumbs.

The testing indicates that the soils below 2 m depth may be dispersive.

3.5 Soil Classification Testing

The results of soil classification testing are summarized in Table 3. The testing indicates the following soil properties:

- Clay soils with fines content (clays and silts) greater than 76%;
- High to very high plasticity, increasing with depth;
- Soils are highly reactive with respect to change in moisture content (linear shrinkage > 15%)

Table 3 : Summary of laboratory testing

TEST INTERVAL	SOIL DESCRIPTION	MOISTURE CONTENT %	PARTICLE SIZE DISTRIBUTION			ATTERBERG LIMITS		
			% Gravel	% Sand	% Silt and Clay	Liquid Limit (%)	Plasticity Index (%)	Linear Shrinkage (%)
BH01 1.7 m to 2.0 m	Clay, CH	21.7	1	19	80	56	36	15
BH01 2.7 m to 3.0 m	Clay, CH	31.0	0	24	76	69	49	16
BH01 4.7 m to 5.0 m	Clay, CH	32.3	0	20	80	81	58	16

3.6 Infiltration Rate

One in-hole infiltration test was completed at a depth of 5.5 m in a separate hole drilled adjacent to BH1. To conduct the test a solid casing was placed flush with the base of the hole. The casing was slightly pushed into the clay so the water didn't leak out horizontally. The PVC casing was then filled with water to the top of the hole and the rate of infiltration was measured over a period of two hours.

For this test an infiltration rate of $2.2 \times 10^{-5} \text{ m/sec}$ was calculated.

The above value represents an upper bound of the likely in-situ permeability. The value is indicative only as it is unclear if the soils surrounding the test holes reached full saturation. The true saturated in-situ permeability may be several magnitudes of order lower. The typical range of permeability for relatively homogeneous clays below the zone of weathering / effects of vegetation is $1 \times 10^{-12} \text{ m/sec}$ to 10^{-8} m/sec (Carter and Bentley (1991)). Further testing is recommended.

It is noted that the bedrock encountered at BH2 includes numerous defects and seams spaced at 20 to 60 mm. As a result, the rock is likely to be relatively permeable.

3.7 Excavations and Earthworks

The natural clay soils encountered in the boreholes are expected to be generally excavatable using conventional machinery such as excavators and dozers. Slower production rates would be expected in the residual soils and the very low strength weathered rocks. Use of specialist rock breaking equipment will likely be required for excavation of the medium strength siltstone encountered in BH2 below 3 m depth.

Temporary batter slopes or benches in the clay soils shall be cut at no steeper than 1H to 1V. For permanent works a 3H to 1V batter is considered suitable, provided the clays are protected from erosion caused by concentrated flows.

The natural clay soils at this site have high plasticity, with plasticity increasing with depth. Such soils are reactive in response to seasonal moisture changes (high shrink-swell potential) which may cause large surface movements and development of shrinkage cracks following desiccation. Pipe connections and shallow foundations will need to be designed with appropriate articulation to allow for surface movements.

4 Statement of Limitations

4.1 Geotechnical Reports

The following notes have been provided to outline the methodology and limitations inherent in geotechnical reporting. The issues discussed are not relevant to all reports and further advice should be sought if there are any queries regarding any advice or report.

Geotechnical reports are prepared by qualified personnel on the information supplied or obtained and are based on current engineering standards of interpretation and analysis.

Information may be gained from limited subsurface testing, surface observations, previous work, and is supplemented by knowledge of the local geology and experience of the range of properties that may be exhibited by the materials present. For this reason geotechnical reports should be regarded as interpretative rather than factual documents, limited to some extent by the scope of information on which they rely.

Where the report has been prepared for a specific purpose (e.g. design of a three storey building), the information and interpretation may not be appropriate if the design is changed (e.g. a twenty-storey building). In such cases, the report and the sufficiency of the existing work should be reviewed by SMEC in the light of the new proposal.

Every care is taken with the report content, however, it is not always possible to anticipate or assume responsibility for the following conditions:

- Unexpected variations in ground conditions. The potential for this depends on the amount of investigative work undertaken.
- Changes in policy or interpretation by statutory authorities
- The actions of contractors responding to commercial pressures

If these occur, SMEC would be pleased to resolve the matter through further investigation, analysis or advice.

4.2 Unforeseen Conditions

Should conditions encountered on site differ markedly from those anticipated from the information contained in the report, SMEC should be notified immediately. Early identification of site anomalies generally results in any problems being more readily resolved and allows re-interpretation and assessment of the implications for future work.

4.3 Subsurface Information

Logs of a borehole, recovered core, test pit, excavated face, or cone penetration test are an engineering and/or geological interpretation of the subsurface conditions. The reliability of the logged information depends on the drilling/testing method, sampling/observation spacing's and the ground conditions. It is not always possible or economic to obtain continuous high-quality data. It should also be recognised that the volume of material observed or tested is only a fraction of the total subsurface profile.

Interpretation of subsurface information and application to design and construction must take into consideration the spacing of the test locations, the frequency of observations and testing, and the possibility that geological boundaries may vary between observation points.

Groundwater observations and measurements outside of specially designed and constructed piezometers should be treated with care for the following reasons:

- In low permeability soils groundwater may not seep into an excavation or bore in the short time it is left open.
- A localized perched water table may not represent the true water table.
- Groundwater levels vary according to rainfall events or season.
- Some drilling and testing procedures mask or prevent groundwater inflow.
- The installation of piezometers and long-term monitoring of groundwater levels may be required to adequately identify groundwater conditions.

DRAFT GEOTECHNICAL INVESTIGATION REPORT
SRWRA Storage Seaford
Prepared for Hydroplan

Appendix B Site Photographs



Photograph 1: Site looking downhill towards Victor Harbor Road



Photograph 2: Looking east towards Ostrich Farm Road



Photograph 3: Looking south towards BH 1 (location of truck in background)



Photograph 4: BH4 looking North



Photograph 5: BH4 looking North-East



Photograph 6: BH4 looking East



Photograph 7: BH4 looking South



Photograph 8: BH4 looking uphill towards BH1



Photograph 9: BH4 looking West



Photograph 10: BH3 looking North



Photograph 11: BH3 looking West



Photograph 12: BH3 looking South



Photograph 13: BH3 looking East



Photograph 14: South Western Corner of Site, Looking West



Photograph 15: South Western Corner of Site, Looking South



Photograph 16: South Western Corner of Site, Looking North



Photograph 17: BH2 Looking East



Photograph 18: BH2 Looking North



Photograph 19: BH2 Looking West



Photograph 20: BH2 Looking South

Date & Time: Tue May 22 16:39:47 ACST 2018
Position: 34 S 270220 3702222
Altitude: 50m
Battery: 70%
Azimuth Bearing: 65° NNE 000m/s (True)
Elevation Angle: -0.1°
Horizon Angle: -0.05°
Zoom: 1X
BH2 north adjacent subdivision



Photograph 21: BH2 Looking North Adjacent Subdivision.

Appendix C Borehole Logs

CORED DRILL HOLE - ENGINEERING LOG

HOLE NO : BH1
PROJECT NUMBER : 3005628
SHEET : 1 OF 2
FINAL DEPTH : 8 m

CLIENT : Hydroplan
LOCATION : Centre of site










PROJECT : Willunga Basin SRWRA Storage

POSITION : E: 272459.0, N: 6102245.0 (MGA94 Zone 54) SURFACE ELEVATION : INCLINATION° / ORIENTATION° : 90° / N/A

RIG TYPE : MKV2 MOUNTING : Truck CONTRACTOR : Drilling Solutions HOLE DIA :

DATE STARTED : 22/05/2018 DATE COMPLETED : 22/05/2018 DATE LOGGED : 22/05/2018 LOGGED BY : SK CHECKED BY : SP

CASING DIAMETER : BARREL (Length) : BIT : BIT CONDITION :

DRILLING							MATERIAL							FRACTURES												
PROGRESS		TCR% DRILL DEPTH	ROD% DRILL DEPTH	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	ELEVATION	DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION ROCK NAME : grain size, colour, texture and fabric, features, inclusion and minor components	Weathering / Alteration	ESTIMATED STRENGTH Is(50)										DEFECT SPACING (mm)				VISUAL	ADDITIONAL DATA (joints, partings, seams, zones, etc) Description, orientation, infilling or coating, shape, roughness, thickness, other
DRILLING & CASING	DRILLING FLUID										VL	L	M	H	VH	EH	20	60	200	600	2000					
HQ3							0.0		START CORING AT 0.00m		EL -0.03															
							0.10m		Silty CLAY (Cl): medium plasticity, dark brown, with fine to medium grained sand, (topsoil)		VL -0.1															
												L -0.3														
												M -1														
												H -3														
												VH -10														
												EH														
									1.5																	
									1.60m		Silty CLAY (CH): high plasticity, mottled pale brown and off-white, trace fine grained sand															
							1.70m 1		2.00m																	
					2.00m		2.0		CORE LOSS 0.70m (2.00-2.70)																	
							2.5																			
							2.70m		Silty CLAY (CH): high plasticity, grey brown, trace fine grained sand																	
					2.70m 2		3.00m																			
					3.00m		3.0		CORE LOSS 0.40m (3.00-3.40)																	
							3.5		Silty CLAY (CH): high plasticity, mottled grey brown and orange brown; moist greater than plastic limit, very stiff - hard																	
							4.0																			
							4.00m		CORE LOSS 0.20m (4.00-4.20)																	
							4.20m		Silty CLAY (CH): high plasticity, grey brown mottled orange brown and red brown; moist greater than plastic limit, very stiff to hard																	
							4.5																			
					4.70m 3		5.0																			
					5.00m		5.00m																			

DRILLING CC Concrete core WB Wash bore DB Wash bore with drag bit NQ Wireline core barrel 42mm NQ3 Wireline core barrel 45mm HQ Wireline core barrel 64mm HQ3 Wireline core barrel 62mm PQ Wireline core barrel 85mm NMLC Diamond core 52mm diameter HMLC Diamond core 62mm diameter VC Vibro-core drilling PT Continuous push tube	WATER dd/mm/yy Water Level on Date shown Drilling water level water inflow water outflow WEATHERING FR Fresh SW Slightly Weathered MW Moderately Weathered HW Highly Weathered DW Distinctly Weathered XW Extremely Weathered RS Residual Soil	STRENGTH EH Extremely High VH Very High H High M Medium L Low VL Very Low ROUGHNESS Po Polished SI Slickensided Sm Smooth Ro Rough VR Very Rough	DEFECT TYPE Bg Bedding C Cleavage Pt Parting CZ Crushed Zone SZ Shear Zone IS Infilled Seam Jt Joint Se Seam SS Shear Seam Ve Vein VO Void Cn Contact Bd Boundary DB Drilling Break HB Handling Break	COATING CN Clean CT Coating (>= 1.0mm) FLD Filled SN Stained VNR Veneer (< 1.0mm) PLANARITY Cu Curved DIS Discontinuous Ir Irregular Pl Planar St Stepped Un Undulose Vu Vuggy Wv Wavy	INFILL Ca Calcite Cl Clay Fe Iron Oxide Fe Cl Iron Oxide Clay Ch Chlorite Um Unidentified Mineral Qz Quartz X Carbonaceous Py Pyrite Mn Manganese Cr Crushed Rock Co Coal Gp Gypsum Fp Feldspar
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See Explanatory Notes for details of abbreviations & basis of descriptions.

SMEC AUSTRALIA



CORED DRILL HOLE - ENGINEERING LOG

HOLE NO : BH1
PROJECT NUMBER : 3005628
SHEET : 2 OF 2
FINAL DEPTH : 8 m

CLIENT : Hydroplan
LOCATION : Centre of site



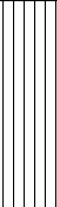







PROJECT : Willunga Basin SRWRA Storage

POSITION : E: 272459.0, N: 6102245.0 (MGA94 Zone 54) SURFACE ELEVATION : INCLINATION° / ORIENTATION° : 90° / N/A

RIG TYPE : MKV2 MOUNTING : Truck CONTRACTOR : Drilling Solutions HOLE DIA :

DATE STARTED : 22/05/2018 DATE COMPLETED : 22/05/2018 DATE LOGGED : 22/05/2018 LOGGED BY : SK CHECKED BY : SP

CASING DIAMETER : BARREL (Length) : BIT : BIT CONDITION :

DRILLING						MATERIAL						FRACTURES					
PROGRESS		TCR% DRILL DEPTH	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	ELEVATION	DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION ROCK NAME : grain size, colour, texture and fabric, features, inclusion and minor components	Weathering / Alteration	ESTIMATED STRENGTH Is(50) ● - Axial ○ - Diametral	DEFECT SPACING (mm)	VISUAL	ADDITIONAL DATA (joints, partings, seams, zones, etc) Description, orientation, infilling or coating, shape, roughness, thickness, other				
DRILLING & CASING	DRILLING FLUID																
HO3 ↓						5.0		CORE LOSS 0.20m (5.00-5.20)		EL -0.03 VL -0.1 L -0.3 M -1 H -3 VH 10 EH	20 60 200 600 2000		— 5.50: PP In-situ =370 - 420 kPa				
						5.20m		Silty CLAY (CH): high plasticity, grey brown mottled red brown; moist greater than plastic limit, very stiff to hard									
						6.0		CORE LOSS 0.50m (6.00-6.50)									
						6.50m		Silty CLAY (CH): high plasticity, grey brown mottled red brown; moist greater than plastic limit, very stiff to hard									
						7.0											
						7.20m		Sandy CLAY (CI-CH): medium to high plasticity, red brown and grey brown, fine to coarse grained sand; moist greater than plastic limit, very stiff to hard									
						7.50m		Clayey SAND (SC): fine to medium grained, red brown and grey brown; moist									
						8.00m											
						8.0		Hole Terminated at 8.00 m Target Depth									
						8.5											
						9.0											
						9.5											
						10.0											

DRILLING	WATER	STRENGTH	DEFECT TYPE	COATING	INFILL
CC Concrete core WB Wash bore DB Wash bore with drag bit NQ Wireline core barrel 42mm NQ3 Wireline core barrel 45mm HQ Wireline core barrel 64mm HQ3 Wireline core barrel 62mm HQ3 Wireline core barrel 85mm NMLC Diamond core 52mm diameter HMLC Diamond core 62mm diameter VC Vibro-core drilling PT Continuous push tube	dd/mm/yy Water Level on Date shown Drilling water level water inflow water outflow WEATHERING FR Fresh SW Slightly Weathered MW Moderately Weathered HW Highly Weathered DW Distinctly Weathered XW Extremely Weathered RS Residual Soil	EH Extremely High VH Very High H High M Medium L Low VL Very Low ROUGHNESS Po Polished SI Slickensided Sm Smooth Ro Rough VR Very Rough	Bg Bedding C Cleavage Pt Parting CZ Crushed Zone SZ Shear Zone IS Infilled Seam Jt Joint Se Seam SS Shear Seam Ve Vein VO Void Cn Contact Bd Boundary DB Drilling Break HB Handling Break	CN Clean CT Coating (>= 1.0mm) FLD Filled SN Stained VNR Veneer (< 1.0mm) PLANARITY Cu Curved DIS Discontinuous Ir Irregular PI Planar St Stepped Un Undulose Vu Vuggy Wv Wavy	Ca Calcite Cl Clay Fe Iron Oxide Fe Cl Iron Oxide Clay Ch Chlorite Um Unidentified Mineral Qz Quartz X Carbonaceous Py Pyrite Mn Manganese Cr Crushed Rock Co Coal Gp Gypsum Fp Feldspar

See Explanatory Notes for details of abbreviations & basis of descriptions.

SMEC AUSTRALIA





PointID : BH1 Depth Range: 0.00 - 5.00 m



PointID : BH1 Depth Range: 5.00 - 8.00 m



TITLE Hydroplan SMEC Ostrich Farm Rd Seaford Willunga Basin SRWRA Storage Core Photo - BH1	DRAWN	DATE 27/05/2018
	CHECKED	DATE 27/05/2018
	SCALE Not To Scale	A4
	PROJECT No 3005628	FIGURE No 1/1

CORED DRILL HOLE - ENGINEERING LOG

HOLE NO : BH2
PROJECT NUMBER : 3005628
SHEET : 1 OF 2
FINAL DEPTH : 8.1 m

CLIENT : Hydroplan
LOCATION : Adjacent Sub-division

PROJECT : Willunga Basin SRWRA Storage

POSITION : E: 272312.0, N: 6102316.0 (MGA94 Zone 54) SURFACE ELEVATION : INCLINATION° / ORIENTATION° : 90° / N/A

RIG TYPE : MKV2 MOUNTING : Truck CONTRACTOR : Drilling Solutions HOLE DIA :

DATE STARTED : 22/05/2018 DATE COMPLETED : 22/05/2018 DATE LOGGED : 22/05/2018 LOGGED BY : SK CHECKED BY : SP

CASING DIAMETER : BARREL (Length) : BIT : BIT CONDITION :

DRILLING						MATERIAL						FRACTURES											
PROGRESS		TCR% DRILL DEPTH	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	ELEVATION	DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION ROCK NAME : grain size, colour, texture and fabric, features, inclusion and minor components START CORING AT 0.00m	Weathering / Alteration	ESTIMATED STRENGTH Is(50)								DEFECT SPACING (mm)				VISUAL	ADDITIONAL DATA (joints, partings, seams, zones, etc) Description, orientation, infilling or coating, shape, roughness, thickness, other
DRILLING & CASING	DRILLING FLUID									VI	L	M	H	VH	EH	20	60	200	600	2000			
						0.0		0.10m Silty CLAY (CL): low plasticity, dark brown, with fine to medium grained sand, with roots CORE LOSS 0.90m (0.10-1.00)		El -0.03 L -0.1 M -1 H -3 VH 10 EH													
						0.5																	
						1.0		1.00m Silty CLAY (CL): low plasticity, pale orange brown, brown and pale brown, trace roots															
						1.30m		CLAY (CL-CI): low to medium plasticity, pale brown and white, (EW SILTSTONE)															
						1.5																	
						1.60m		SILTSTONE: fine grained, pale brown with orange brown and brown staining From 1.8 m: pale grey with orange brown staining	HW										1.65: Note coring commenced from surface, start of rock core section of borehole log 1.60 Fractured Zone, 150 mm 1.80 Jt, 70 - 90°, CI VNR, Ir				
						2.0		2.00m CORE LOSS 0.05m (2.00-2.05) SILTSTONE: fine grained, indistinct fabric, red brown, orange brown and pale grey	HW										2.20 Fractured Zone, 35 mm 2.26 CS, clayey gravel, 50 mm 2.33 Fractured Zone, 130 mm 2.51 CS, clayey gravel, 30 mm 2.63 Fractured Zone, 70 mm				
						2.5																	
						2.80m		CORE LOSS 0.20m (2.80-3.00)															
						3.0		3.00m SILTSTONE: fine grained, indistinct fabric, red brown, orange brown and pale grey	HW										3.09 Jt, 50°, Fe SN, PI, Ro 3.16 CS, 10°, gravely clay, 20 mm 3.22 Jt, 60°, Fe SN, PI, Ro 3.28 Jt, 40°, Fe SN, PI, Ro, x2 3.46 Jt, 50°, Fe SN, Un, Ro 3.50 CS, 20°, 10 mm 3.54 Jt, 40 - 70°, Fe SN, Un, Ro 3.64 CS, 30°, 40 mm 3.68 Fractured Zone, 80 mm 3.80 Jt, 70 - 90°, CI FLD, Ir, 5 mm thick 4.03 CS, 40°, gravely clay, 60 mm 4.05 Jt, 50°, CI FLD, PI, 5-10 mm thick 4.16 Jt, 60°, CI FLD, PI, 2 mm thick, x2 at 10 mm spacing 4.40 Jt, 20°, CI FLD, PI, 5 mm thick 4.52 Jt, 20°, CI FLD, PI, 5 mm thick 4.63 Jt, 60°, Fe SN, PI, CI CT, x2 cross-jointed 4.70 CS, 40°, gravely clay, 50 mm 4.80 Jt, 20°, Fe SN, PI				
						3.5			HW - MW														
						4.0		From 4.0 m: orange brown and pale grey															
						4.5																	
						5.0																	

DRILLING		WATER		STRENGTH		DEFECT TYPE		COATING		INFILL	
CC	Concrete core	dd/mm/yy Water		EH	Extremely High	Bg	Bedding	CN	Clean	Ca	Calcite
WB	Wash bore	Level on Date shown		VH	Very High	C	Cleavage	CT	Coating (>= 1.0mm)	Cl	Clay
DB	Wash bore with drag bit	Drilling water level		H	High	Pt	Parting	FLD	Filled	Fe	Iron Oxide
NQ	Wireline core barrel 42mm	water inflow		M	Medium	CZ	Crushed Zone	SN	Stained	Fe Cl	Iron Oxide Clay
NQ3	Wireline core barrel 45mm	water outflow		L	Low	SZ	Shear Zone	VNR	Veneer (< 1.0mm)	Ch	Chlorite
HQ	Wireline core barrel 64mm			VL	Very Low	IS	Infilled Seam			Un	Unidentified Mineral
HQ3	Wireline core barrel 62mm					Jt	Joint			Qz	Quartz
PQ	Wireline core barrel 85mm					Se	Seam			X	Carbonaceous
NMLC	Diamond core 52mm diameter					SS	Shear Seam			Py	Pyrite
HMLC	Diamond core 62mm diameter					Ve	Vein			Mn	Manganese
VC	Vibro-core drilling					VO	Void			Cr	Crushed Rock
PT	Continuous push tube					Cn	Contact			Co	Coal
						Bd	Boundary			Gp	Gypsum
						DB	Drilling Break			Fp	Feldspar
						HB	Handling Break				

See Explanatory Notes for details of abbreviations & basis of descriptions.

SMEC AUSTRALIA



CORED DRILL HOLE - ENGINEERING LOG

HOLE NO : BH2
PROJECT NUMBER : 3005628
SHEET : 2 OF 2
FINAL DEPTH : 8.1 m

CLIENT : Hydroplan
LOCATION : Adjacent Sub-division

PROJECT : Willunga Basin SRWRA Storage

POSITION : E: 272312.0, N: 6102316.0 (MGA94 Zone 54) SURFACE ELEVATION : INCLINATION° / ORIENTATION° : 90° / N/A

RIG TYPE : MKV2 MOUNTING : Truck CONTRACTOR : Drilling Solutions HOLE DIA :

DATE STARTED : 22/05/2018 DATE COMPLETED : 22/05/2018 DATE LOGGED : 22/05/2018 LOGGED BY : SK CHECKED BY : SP

CASING DIAMETER : BARREL (Length) : BIT : BIT CONDITION :

DRILLING					MATERIAL					FRACTURES				
PROGRESS	DRILLING & CASING	DRILLING FLUID	TCR% DRILL ROD% DRILL DEPTH	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	ELEVATION	DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION ROCK NAME : grain size, colour, texture and fabric, features, inclusion and minor components	Weathering / Alteration EL -0.03 VL -0.1 L -0.3 M -1 H -3 VH -10 EH	ESTIMATED STRENGTH Is(50) ● - Axial ○ - Diametral	DEFECT SPACING (mm)	VISUAL	ADDITIONAL DATA (joints, partings, seams, zones, etc) Description, orientation, infilling or coating, shape, roughness, thickness, other
	HQ3						5.0		SILTSTONE: fine grained, indistinct fabric, red brown, orange brown and pale grey (<i>continued</i>) From 5.25 m: red brown and orange brown	HW MW				4.92 Jt, 50°, CI FLD, PI, 6 mm thick 5.03 Jt, 70°, CI VNR, PI 5.10 Jt, 20°, CI VNR, PI 5.26 Jt, 70°, CI FLD, PI, 2-5 mm thick
							5.5							5.64 Jt, 10°, Fe SN, PI 5.66 Jt, 10°, CI CT, PI 5.73 Jt, 40°, CI FLD, PI, 2 mm thick 5.85 Jt, 30°, Fe SN, PI 5.87 Jt, 60 - 80°, CI CT, Un, Um SN
							6.0		From 6.0 m: orange brown					
							6.5			MW SW				6.50 CS, 10°, gravelly clay, 20 mm 6.54 Jt, 30°, Um SN, PI 6.65 Jt, 70°, CI FLD, Un
							7.0							6.92 Jt, 20°, Um SN, PI 7.00 Jt, 40°, CI FLD, PI 7.02 Jt, 70 - 80°, CI FLD
							7.5							7.23 Jt, 40°, CI FLD, PI, x2 7.33 Jt, 50°, CI FLD, PI 7.35 Jt, 80 - 90°, Um SN, Un
							8.0							7.61 Jt, 30°, CI VNR, PI 7.70 Jt, 40°, Um SN, St 7.79 Jt, 20°, CI VNR, PI
			8.10				8.10		Hole Terminated at 8.10 m Target Depth					7.95 Jt, 20°, Um SN, PI 7.97 Jt, 50°, CI FLD, PI, Um SN
							8.5							
							9.0							
							9.5							
							10.0							

DRILLING		WATER		STRENGTH		DEFECT TYPE		COATING		INFILL	
CC	Concrete core	dd/mm/yy Water	Level on Date shown	EH	Extremely High	Bg	Bedding	CN	Clean	Ca	Calcite
WB	Wash bore	Drilling water level		VH	Very High	C	Cleavage	CT	Coating (>= 1.0mm)	Cl	Clay
DB	Wash bore with drag bit	water inflow		H	High	Pt	Parting	FLD	Filled	Fe	Iron Oxide
NQ	Wireline core barrel 42mm	water outflow		M	Medium	CZ	Crushed Zone	SN	Stained	Fe Cl	Iron Oxide Clay
NQ3	Wireline core barrel 45mm			L	Low	SZ	Shear Zone	VNR	Veneer (< 1.0mm)	Ch	Chlorite
HQ	Wireline core barrel 64mm			VL	Very Low	IS	Infilled Seam			Um	Unidentified Mineral
HQ3	Wireline core barrel 62mm					Jt	Joint			Qz	Quartz
PQ	Wireline core barrel 85mm					Se	Seam			X	Carbonaceous
NMLC	Diamond core 52mm diameter					SS	Shear Seam			Py	Pyrite
HMLC	Diamond core 62mm diameter					Ve	Vein			Mn	Manganese
VC	Vibro-core drilling					VO	Void			Cr	Crushed Rock
PT	Continuous push tube					Cn	Contact			Co	Coal
						Bd	Boundary			Gp	Gypsum
						DB	Drilling Break			Fp	Feldspar
						HB	Handling Break				

See Explanatory Notes for details of abbreviations & basis of descriptions.

SMEC AUSTRALIA





PointID : BH2 Depth Range: 0.00 - 5.00 m



PointID : BH2 Depth Range: 5.00 - 8.10 m



TITLE Hydroplan SMEC Ostrich Farm Rd Seaford Willunga Basin SRWRA Storage Core Photo - BH2	DRAWN	DATE 27/05/2018
	CHECKED	DATE 27/05/2018
	SCALE Not To Scale	A4
	PROJECT No 3005628	FIGURE No 1/1

CORED DRILL HOLE - ENGINEERING LOG

HOLE NO : BH3
PROJECT NUMBER : 3005628
SHEET : 1 OF 2
FINAL DEPTH : 8.06 m

CLIENT : Hydroplan
LOCATION : Southern Boundary Adjacent Farm House
PROJECT : Willunga Basin SRWRA Storage

POSITION : E: 272462.0, N: 6102076.0 (MGA94 Zone 54) SURFACE ELEVATION : INCLINATION° / ORIENTATION° : 90° / N/A

RIG TYPE : MKV2 MOUNTING : Truck CONTRACTOR : Drilling Solutions HOLE DIA :

DATE STARTED : 22/05/2018 DATE COMPLETED : 22/05/2018 DATE LOGGED : 22/05/2018 LOGGED BY : SK CHECKED BY : SP

CASING DIAMETER : BARREL (Length) : BIT : BIT CONDITION :

DRILLING					MATERIAL										FRACTURES						
PROGRESS		TCR% DRILL DEPTH	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	ELEVATION DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION ROCK NAME : grain size, colour, texture and fabric, features, inclusion and minor components START CORING AT 0.00m CORE LOSS 1.20m (0.00-1.20)	Weathering / Alteration	ESTIMATED STRENGTH Is(50) <div><div>● Axial</div><div>○ Diametral</div></div>										DEFECT SPACING (mm)	VISUAL	ADDITIONAL DATA (joints, partings, seams, zones, etc) Description, orientation, infilling or coating, shape, roughness, thickness, other
DRILLING & CASING	DRILLING FLUID								EL -0.03	VL -0.1	L -0.3	M -1	H -3	VH -10	EH	20	60	200			
↑																	0.00: Topsoil: Silty CLAY; medium plasticity, dark brown, with fine to medium grained sand				

DRILLING		WATER		STRENGTH		DEFECT TYPE		COATING		INFILL	
CC	Concrete core	dd/mm/yy	Water	EH	Extremely High	Bg	Bedding	CN	Clean	Ca	Calcite
WB	Wash bore	Level on Date shown		VH	Very High	C	Cleavage	CT	Coating (>= 1.0mm)	Cl	Clay
DB	Wash bore with drag bit	Drilling water level		H	High	Pt	Parting	FLD	Filled	Fe	Iron Oxide
NQ	Wireline core barrel 42mm	water inflow		M	Medium	CZ	Crushed Zone	SN	Stained	Fe Cl	Iron Oxide Clay
NQ3	Wireline core barrel 45mm	water outflow		L	Low	SZ	Shear Zone	VNR	Veneer (< 1.0mm)	Ch	Chlorite
HQ	Wireline core barrel 64mm			VL	Very Low	IS	Infilled Seam			Um	Unidentified Mineral
HQ3	Wireline core barrel 62mm					Jt	Joint			Qz	Quartz
PQ	Wireline core barrel 85mm					Se	Seam			X	Carbonaceous
NMLC	Diamond core 52mm diameter					SS	Shear Seam			Py	Pyrite
HMLC	Diamond core 62mm diameter					Ve	Vein			Mn	Manganese
VC	Vibro-core drilling					VO	Void			Cr	Crushed Rock
PT	Continuous push tube					Cn	Contact			Co	Coal
						Bd	Boundary			Gp	Gypsum
						DB	Drilling Break			Fp	Feldspar
						HB	Handling Break				

See Explanatory Notes for
details of abbreviations
& basis of descriptions.

SMEC AUSTRALIA



CORED DRILL HOLE - ENGINEERING LOG

HOLE NO : BH3
PROJECT NUMBER : 3005628
SHEET : 2 OF 2
FINAL DEPTH : 8.06 m




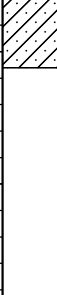






CLIENT : Hydroplan
LOCATION : Southern Boundary Adjacent Farm House
PROJECT : Willunga Basin SRWRA Storage

POSITION : E: 272462.0, N: 6102076.0 (MGA94 Zone 54) SURFACE ELEVATION : INCLINATION° / ORIENTATION° : 90° / N/A

RIG TYPE : MKV2 MOUNTING : Truck CONTRACTOR : Drilling Solutions HOLE DIA :

DATE STARTED : 22/05/2018 DATE COMPLETED : 22/05/2018 DATE LOGGED : 22/05/2018 LOGGED BY : SK CHECKED BY : SP

CASING DIAMETER : BARREL (Length) : BIT : BIT CONDITION :

DRILLING						MATERIAL						FRACTURES														
PROGRESS		TCR% DRILL DEPTH	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	ELEVATION	DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION ROCK NAME : grain size, colour, texture and fabric, features, inclusion and minor components	Weathering / Alteration	ESTIMATED STRENGTH Is(50)										DEFECT SPACING (mm)				VISUAL	ADDITIONAL DATA (joints, partings, seams, zones, etc) Description, orientation, infilling or coating, shape, roughness, thickness, other	
DRILLING & CASING	DRILLING FLUID									VL	L	M	H	VH	EH	20	60	200	600	2000						
						5.0		5.10m CORE LOSS 0.10m (5.00-5.10)		EL -0.03	VL -0.1	L -0.3	M -1	H -3	VH 10	EH										
						5.5		Sandy CLAY (CH): as above, increased sand content; very stiff																		
						6.0		6.00m CORE LOSS 0.09m (6.00-6.09)																		
						6.5		Sandy CLAY (CH): high plasticity, mottled orange brown, red brown and grey brown, fine to medium grained sand, trace fine grained gravel; hard																		
						7.5		7.80m Clayey SAND (SC): fine to coarse grained, pale brown and red brown, medium to high plasticity clay; moist, hard																		
		8.06				8.0		8.06m Hole Terminated at 8.06 m Target Depth																		
						8.5																				
						9.0																				
						9.5																				
						10.0																				

DRILLING CC Concrete core WB Wash bore DB Wash bore with drag bit NQ Wireline core barrel 42mm NQ3 Wireline core barrel 45mm HQ Wireline core barrel 64mm HQ3 Wireline core barrel 62mm PQ Wireline core barrel 85mm NMLC Diamond core 52mm diameter HMLC Diamond core 62mm diameter VC Vibro-core drilling PT Continuous push tube	WATER dd/mm/yy Water Level on Date shown Drilling water level water inflow water outflow WEATHERING FR Fresh SW Slightly Weathered MW Moderately Weathered HW Highly Weathered DW Distinctly Weathered XW Extremely Weathered RS Residual Soil	STRENGTH EH Extremely High VH Very High H High M Medium L Low VL Very Low ROUGHNESS Po Polished SI Slickensided Sm Smooth Ro Rough VR Very Rough	DEFECT TYPE Bg Bedding C Cleavage Pt Parting CZ Crushed Zone SZ Shear Zone IS Infilled Seam Jt Joint Se Seam SS Shear Seam Ve Vein VO Void Cn Contact Bd Boundary DB Drilling Break HB Handling Break	COATING CN Clean CT Coating (>= 1.0mm) FLD Filled SN Stained VNR Veneer (< 1.0mm) PLANARITY Cu Curved DIS Discontinuous Ir Irregular PI Planar St Stepped Un Undulose Vu Vuggy Wv Wavy	INFILL Ca Calcite Cl Clay Fe Iron Oxide Fe Cl Iron Oxide Clay Ch Chlorite Um Unidentified Mineral Qz Quartz X Carbonaceous Py Pyrite Mn Manganese Cr Crushed Rock Co Coal Gp Gypsum Fp Feldspar
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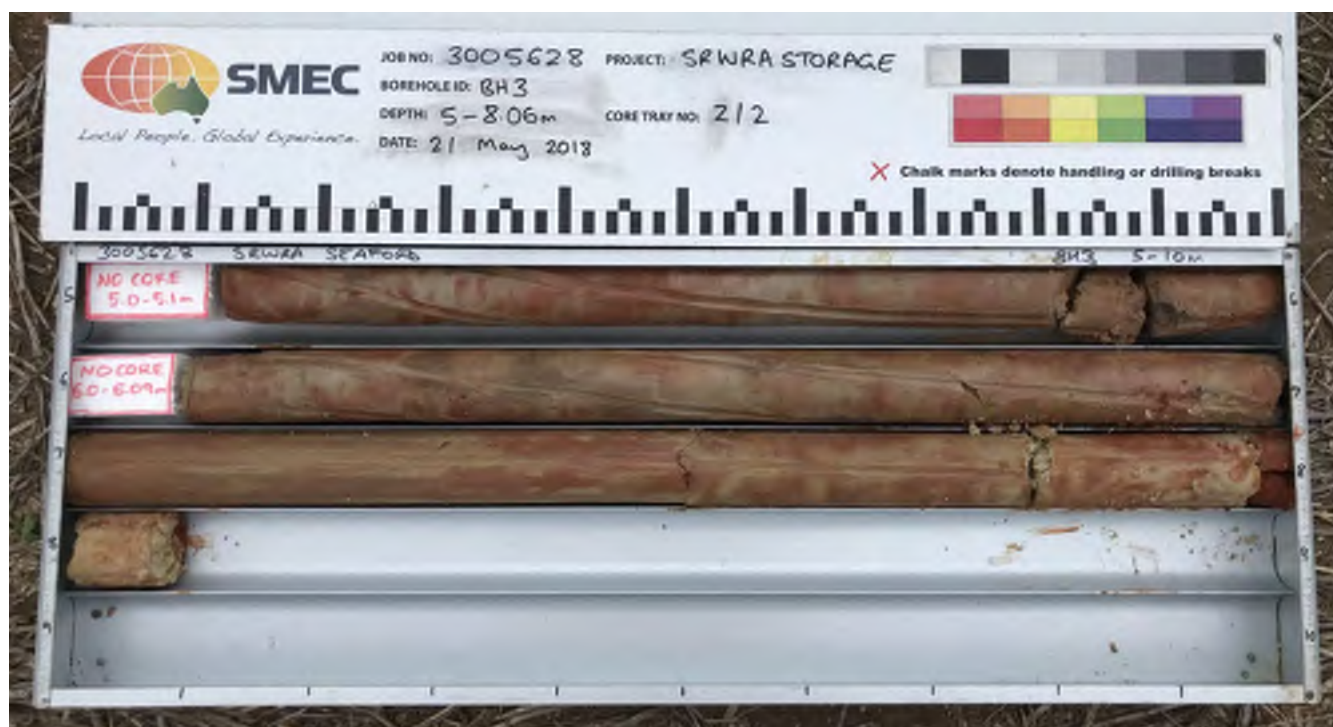
See Explanatory Notes for details of abbreviations & basis of descriptions.

SMEC AUSTRALIA





PointID : BH3 Depth Range: 0.00 - 5.00 m



PointID : BH3 Depth Range: 5.00 - 8.06 m



TITLE

Hydroplan
SMEC
Ostrich Farm Rd Seaford
Willunga Basin SRWRA Storage
Core Photo - BH3

DRAWN

DATE

27/05/2018

CHECKED

DATE

27/05/2018

SCALE

Not To Scale

A4

PROJECT No

3005628

FIGURE No

1/1

CORED DRILL HOLE - ENGINEERING LOG

HOLE NO : BH4
PROJECT NUMBER : 3005628
SHEET : 1 OF 2
FINAL DEPTH : 8 m

CLIENT : Hydroplan
PROJECT : Willunga Basin SRWRA Storage
LOCATION : Intersection Victor Harbour Rd/Ostrich Farm Rd

POSITION : E: 272634.0, N: 6102385.0 (MGA94 Zone 54) SURFACE ELEVATION : INCLINATION° / ORIENTATION° : 90° / N/A

RIG TYPE : MKV2 MOUNTING : Truck CONTRACTOR : Drilling Solutions HOLE DIA :

DATE STARTED : 22/05/2018 DATE COMPLETED : 22/05/2018 DATE LOGGED : 22/05/2018 LOGGED BY : SK CHECKED BY : SP

CASING DIAMETER : BARREL (Length) : BIT : BIT CONDITION :

DRILLING					MATERIAL					FRACTURES				
PROGRESS	DRILLING & CASING	DRILLING FLUID	TCR% DRILL DEPTH	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	ELEVATION	DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION ROCK NAME : grain size, colour, texture and fabric, features, inclusion and minor components START CORING AT 0.00m CORE LOSS 1.60m (0.00-1.60)	Weathering / Alteration	ESTIMATED STRENGTH Is(50) ● - Axial ○ - Diametral	DEFECT SPACING (mm)	VISUAL	ADDITIONAL DATA (joints, partings, seams, zones, etc) Description, orientation, infilling or coating, shape, roughness, thickness, other
							0.0							0.00: Topsoil: Silty CLAY; medium plasticity, dark brown, with fine to medium grained sand
							0.5							
							1.0							
							1.5							
							1.60m							
							1.85m		Silty CLAY (Cl): medium plasticity, pale brown with some brown mottled, with fine to medium grained sand, trace medium grained rounded gravel					
							2.00m		Sandy CLAY (Cl): medium plasticity, pale brown and brown, fine to coarse grained sand, trace fine to medium grained sub-rounded to rounded gravel					
							2.00m		CORE LOSS 1.10m (2.00-3.10)					
							2.5							
							3.0							
							3.10m							
							3.5		Sandy Gravelly CLAY (Cl): medium plasticity, grey brown and pale brown, medium grained sub-rounded to rounded gravel, fine to coarse grained sand					
							3.60m							
							4.0		CLAY (Cl): low plasticity, orange brown, red brown and yellow brown, with highly weathered sandstone fragments to 30 mm					
							4.90m		From 3.7 m: becoming orange brown and pale grey					
							5.0							

DRILLING	WATER	STRENGTH	DEFECT TYPE	COATING	INFILL
CC Concrete core WB Wash bore DB Wash bore with drag bit NQ Wireline core barrel 42mm NQ3 Wireline core barrel 45mm HQ Wireline core barrel 64mm HQ3 Wireline core barrel 62mm FQ Wireline core barrel 85mm NMLC Diamond core 52mm diameter HMLC Diamond core 62mm diameter VC Vibro-core drilling PT Continuous push tube	dd/mm/yy Water Level on Date shown Drilling water level water inflow water outflow WEATHERING FR Fresh SW Slightly Weathered MW Moderately Weathered HW Highly Weathered DW Distinctly Weathered XW Extremely Weathered RS Residual Soil	EH Extremely High VH Very High H High M Medium L Low VL Very Low ROUGHNESS Po Polished SI Slickensided Sm Smooth Ro Rough VR Very Rough	Bg Bedding C Cleavage Pt Parting CZ Crushed Zone SZ Shear Zone IS Infilled Seam Jt Joint Se Seam SS Shear Seam Ve Vein VO Void Cn Contact Bd Boundary DB Drilling Break HB Handling Break	CN Clean CT Coating (>= 1.0mm) FLD Filled SN Stained VNR Veneer (< 1.0mm) PLANARITY Cu Curved DIS Discontinuous Ir Irregular PI Planar St Stepped Un Undulose Vu Vuggy Wv Wavy	Ca Calcite Cl Clay Fe Iron Oxide Fe Cl Iron Oxide Clay Ch Chlorite Um Unidentified Mineral Qz Quartz X Carbonaceous Py Pyrite Mn Manganese Cr Crushed Rock Co Coal Gp Gypsum Fp Feldspar

See Explanatory Notes for details of abbreviations & basis of descriptions.

SMEC AUSTRALIA



CORED DRILL HOLE - ENGINEERING LOG

HOLE NO : BH4
PROJECT NUMBER : 3005628
SHEET : 2 OF 2
FINAL DEPTH : 8 m

CLIENT : Hydroplan
PROJECT : Willunga Basin SRWRA Storage
LOCATION : Intersection Victor Harbour Rd/Ostrich Farm Rd

POSITION : E: 272634.0, N: 6102385.0 (MGA94 Zone 54) SURFACE ELEVATION : INCLINATION° / ORIENTATION° : 90° / N/A

RIG TYPE : MKV2 MOUNTING : Truck CONTRACTOR : Drilling Solutions HOLE DIA :

DATE STARTED : 22/05/2018 DATE COMPLETED : 22/05/2018 DATE LOGGED : 22/05/2018 LOGGED BY : SK CHECKED BY : SP

CASING DIAMETER : BARREL (Length) : BIT : BIT CONDITION :

DRILLING					MATERIAL					FRACTURES				
PROGRESS	DRILLING & CASING	DRILLING FLUID	TCR% DRILL ROD% DEPTH	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	ELEVATION	DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION ROCK NAME : grain size, colour, texture and fabric, features, inclusion and minor components	Weathering / Alteration	ESTIMATED STRENGTH Is(50) ● - Axial ○ - Diametral	DEFECT SPACING (mm)	VISUAL	ADDITIONAL DATA (joints, partings, seams, zones, etc) Description, orientation, infilling or coating, shape, roughness, thickness, other
							5.0		SANDSTONE: extremely to highly weathered, very low strength, fine grained, orange (<i>continued</i>)					
							5.5							
							6.0							
							6.5		From 6.2 m to 6.5 m: becoming orange and pale grey					
							6.50m		Sandy Silty CLAY: low plasticity, orange, fine grained sand, (extremely weathered SANDSTONE)					
							7.0							
							7.5							
							7.50m		CORE LOSS 0.50m (7.50-8.00)					
							8.0		Hole Terminated at 8.00 m Target Depth					
							8.00m							
							8.5							
							9.0							
							9.5							
							10.0							

DRILLING CC Concrete core WB Wash bore DB Wash bore with drag bit NQ Wireline core barrel 42mm NQ3 Wireline core barrel 45mm HQ Wireline core barrel 64mm HQ3 Wireline core barrel 62mm PQ Wireline core barrel 85mm NMLC Diamond core 52mm diameter HMLC Diamond core 62mm diameter VC Vibro-core drilling PT Continuous push tube	WATER dd/mm/yy Water Level on Date shown Drilling water level water inflow water outflow WEATHERING FR Fresh SW Slightly Weathered MW Moderately Weathered HW Highly Weathered DW Distinctly Weathered XW Extremely Weathered RS Residual Soil	STRENGTH EH Extremely High VH Very High H High M Medium L Low VL Very Low ROUGHNESS Po Polished SI Slickensided Sm Smooth Ro Rough VR Very Rough	DEFECT TYPE Bg Bedding C Cleavage Pt Parting CZ Crushed Zone SZ Shear Zone IS Infilled Seam Jt Joint Se Seam SS Shear Seam Ve Vein VO Void Cn Contact Bd Boundary DB Drilling Break HB Handling Break	COATING CN Clean CT Coating (>= 1.0mm) FLD Filled SN Stained VNR Veneer (< 1.0mm) PLANARITY Cu Curved DIS Discontinuous Ir Irregular Pl Planar St Stepped Un Undulose Vu Vuggy Wv Wavy	INFILL Ca Calcite Cl Clay Fe Iron Oxide Fe Cl Iron Oxide Clay Ch Chlorite Um Unidentified Mineral Qz Quartz X Carbonaceous Py Pyrite Mn Manganese Cr Crushed Rock Co Coal Gp Gypsum Fp Feldspar
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See Explanatory Notes for details of abbreviations & basis of descriptions.

SMEC AUSTRALIA





PointID : BH4 Depth Range: 0.00 - 5.00 m



PointID : BH4 Depth Range: 5.00 - 8.00 m



TITLE

Hydroplan
SMEC
Ostrich Farm Rd Seaford
Willunga Basin SRWRA Storage
Core Photo - BH4

DRAWN

DATE

27/05/2018

CHECKED

DATE

27/05/2018

SCALE

Not To Scale

A4

PROJECT No

3005628

FIGURE No

1/1

Appendix D Results of Laboratory Testing

Soils testing - Particle size distribution & consistency limits test report

Standard method (by sieving)

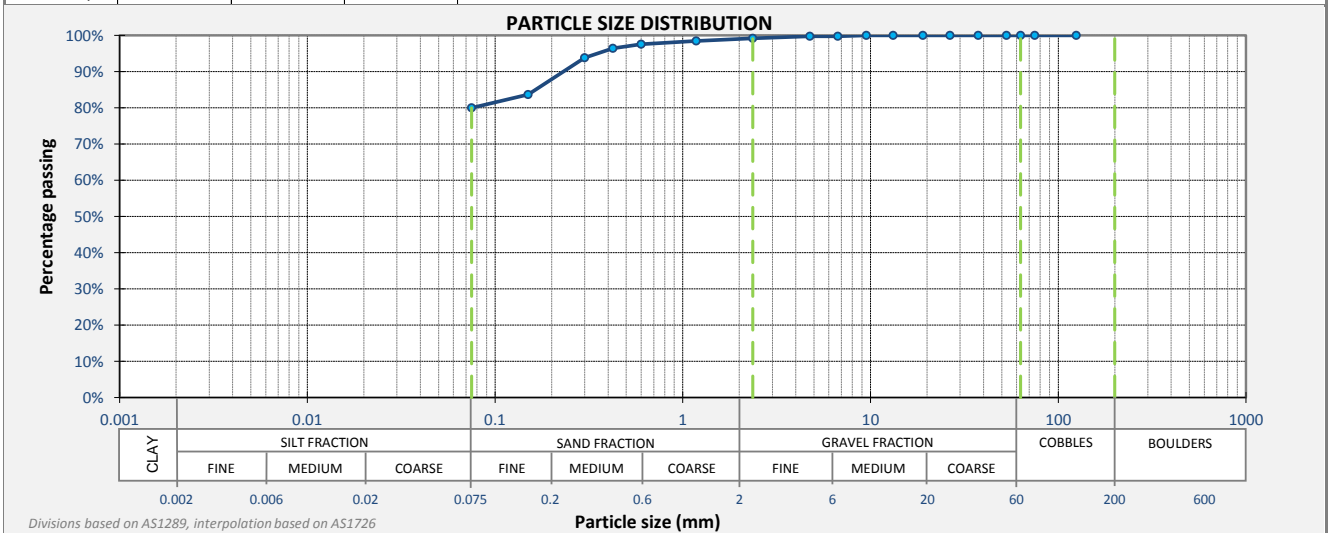
AS1289.3.6.1, 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1 & AS 1726:2017 Section 6.1



Test request #:	TRA18-0129	Lab sample ID:	LADL201805289	Golder Associates Pty Ltd ADELAIDE GEOTECHNICAL LABORATORY 118 Franklin Street, Adelaide, South Australia 5000
Client:	SMEC			
Client address:	Level 4, 19 Grenfell Street, Adelaide, SA, 5000			
Project ID:	1896865-002	Lab report ref.:	LADL_18016377	
Project name:	Storage Basin	Exploratory Hole	BH01 (22/5/18)	Sample depth (m): 1.70 - 2.00 Client sample ref:
Location:	Seaford	Project reference:	3005628	

Specimen description: (AS 1726:2017 Section 6.1)				(CH) CLAY, high plasticity, pale grey brown, with fine to coarse grained sand, trace fine gravel				Sampling co-ordinates		Reduced Level	
PARTICLE SIZE DISTRIBUTION AS 1289.3.6.1				Easting (m)		Northing (m)					
Sieve Size	Passing	LB S	UB S	Method:	AS 1289.2.1.1	AS 1289.3.1.2	AS 1289.3.2.1	AS 1289.3.3.1	AS 1289.3.4.1		
125 mm	100%			Moisture content	1 point Liquid limit	Plastic limit	Plasticity index	Linear shrinkage	Curling/ Crumbling/ Cracking		
75 mm	100%										
63 mm	100%										
53 mm	100%										
37.5 mm	100%										
26.5 mm	100%										
19 mm	100%										
13.2 mm	100%										
9.5 mm	100%										
6.7 mm	100%										
4.75 mm	100%										
2.36 mm	99%										
1.18 mm	98%										
600 µm	98%										
425 µm	96%										
300 µm	94%										
150 µm	84%										
75 µm	80%										
Result:					21.7% As Rcvd.	56%	20%	36%	15.0%	Cracking / Curling	
LB S:										-	
UB S:										-	
Att. preparation method:					Dry sieved		LSM length (mm):		250		
Specimen history/notes:				Preparation of specimen and testing performed on sample supplied to the laboratory							
Definitions:					LB S = Lower bound specification		N/A = Not applicable				
					LSM = Linear shrinkage mould		ND = Not determined; SIB = Slip in bowl				
					UB S = Upper bound specification		NO = Not obtainable; NP = Non plastic				
GRADING SUMMARY											
Fines				Sand*			Gravel*		Cobbles*		
(<75 µm)				(>75 µm - <2.36 mm)			(>2.36 mm - <63 mm)		(>63mm - <200 mm)		
80.0%				19.2%			0.8%		0.0%		
Proportions based on guidance in AS1726-2017 Section 6.1.4.2											

Proportions based on guidance in AS1726-2017 Section 6.1.4.2



Testing performed by:		RD	Results reviewed by:		DBergen	Date reported:		8/06/2018
Cert. ref.:	1896865-002_BH01 (22-5-18)_TRA18-0129_PSD_1805289_Rep18016377					Approved signatory:		
	NATA accreditation number: 1961 - Site:1954 - Adelaide Accredited for compliance with ISO/IEC 17025 - Testing							
	THIS DOCUMENT SHALL ONLY BE REPRODUCED IN FULL							
Phone: +61 (08) 8213 2100		Fax: +61 (08) 8213 2101		E-mail: adlgeolab@golder.com.au		Web: www.golder.com.au		

These tests were carried out in accordance with the Australian standards identified in this certificate.

Rep AS1289.3.6.1 - RL32

Soils testing - Particle size distribution & consistency limits test report

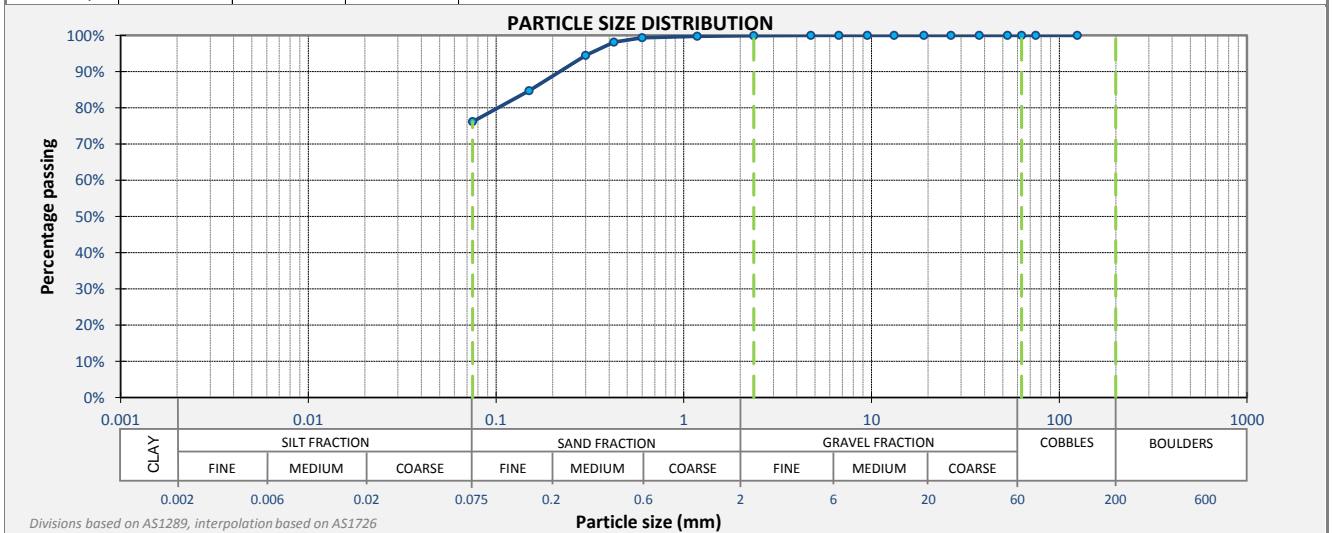
Standard method (by sieving)

AS1289.3.6.1, 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1 & AS 1726:2017 Section 6.1



Test request #:	TRA18-0129	Lab sample ID:	LADL2018052810	Golder Associates Pty Ltd ADELAIDE GEOTECHNICAL LABORATORY 118 Franklin Street, Adelaide, South Australia 5000
Client:	SMEC			
Client address:	Level 4, 19 Grenfell Street, Adelaide, SA, 5000			
Project ID:	1896865-002	Lab report ref.:	LADL_18016378	
Project name:	Storage Basin	Exploratory Hole	BH01 (22/5/18)	Sample depth (m): 2.70 - 3.00 Client sample ref: 3005628
Location:	Seaford	Project reference:	3005628	

Specimen description: (AS 1726:2017 Section 6.1)				(CH) CLAY, high plasticity, grey, with fine to coarse grained sand				Sampling co-ordinates		Reduced Level
								Easting (m)		
PARTICLE SIZE DISTRIBUTION				AS 1289.3.6.1						
Sieve Size	Passing	LB S	UB S	Method:	AS 1289.2.1.1	AS 1289.3.1.2	AS 1289.3.2.1	AS 1289.3.3.1	AS 1289.3.4.1	
125 mm	100%				Moisture content		1 point Liquid limit	Plastic limit	Plasticity index	Linear shrinkage
75 mm	100%			Result:	31.0% As Rcvd.	69%	20%	49%	16.0%	Cracking / Curling
63 mm	100%				LB S: UB S:					
53 mm	100%			Att. preparation method:		Dry sieved		LSM length (mm):		250
37.5 mm	100%			Specimen history/notes:	Preparation of specimen and testing performed on sample supplied to the laboratory					
26.5 mm	100%			Definitions:	LB S = Lower bound specification		N/A = Not applicable			
19 mm	100%				LSM = Linear shrinkage mould		ND = Not determined; SIB = Slip in bowl			
13.2 mm	100%				UB S = Upper bound specification		NO = Not obtainable; NP = Non plastic			
9.5 mm	100%			GRADING SUMMARY						
6.7 mm	100%			Fines	Sand*		Gravel*		Cobbles*	
4.75 mm	100%			(<75 µm)	(>75 µm - <2.36 mm)		(>2.36 mm - <63 mm)		(>63mm - <200 mm)	
2.36 mm	100%			76.2%	23.7%		0.1%		0.0%	
1.18 mm	100%			Proportions based on guidance in AS1726-2017 Section 6.1.4.2						
600 µm	99%									
425 µm	98%									
300 µm	94%									
150 µm	85%									
75 µm	76%									



Testing performed by:		RD	Results reviewed by:		DBergen	Date reported:		8/06/2018
Cert. ref.:	1896865-002_BH01 (22-5-18)_TRA18-0129_PSD_18052810_Rep18016378					Approved signatory:		
	NATA accreditation number: 1961 - Site:1954 - Adelaide Accredited for compliance with ISO/IEC 17025 - Testing							
	THIS DOCUMENT SHALL ONLY BE REPRODUCED IN FULL							
Phone: +61 (08) 8213 2100		Fax: +61 (08) 8213 2101		E-mail: adlgeolab@golder.com.au		Web: www.golder.com.au		

Soils testing - Particle size distribution & consistency limits test report

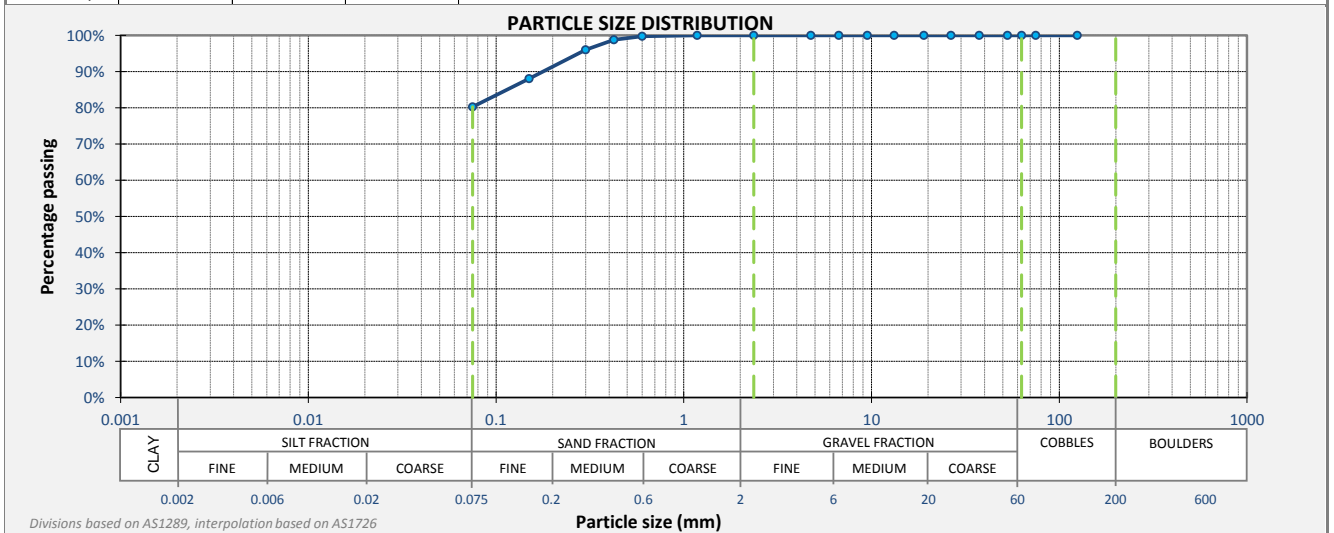
Standard method (by sieving)

AS1289.3.6.1, 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1 & AS 1726:2017 Section 6.1



Test request #:	TRA18-0129	Lab sample ID:	LADL2018052811	Golder Associates Pty Ltd ADELAIDE GEOTECHNICAL LABORATORY 118 Franklin Street, Adelaide, South Australia 5000
Client:	SMEC			
Client address:	Level 4, 19 Grenfell Street, Adelaide, SA, 5000			
Project ID:	1896865-002	Lab report ref.:	LADL_18016379	
Project name:	Storage Basin	Exploratory Hole	BH01 (22/5/18)	Sample depth (m): 4.70 - 5.00 Client sample ref: 3005628
Location:	Seaford	Project reference:	3005628	

Specimen description: (AS 1726:2017 Section 6.1)				(CH) CLAY, high plasticity, mottled red green grey, with fine to coarse grained sand				Sampling co-ordinates		Reduced Level		
PARTICLE SIZE DISTRIBUTION AS 1289.3.6.1								Easting (m)			Northing (m)	
Sieve Size	Passing	LB S	UB S	Method:	AS 1289.2.1.1	AS 1289.3.1.2	AS 1289.3.2.1	AS 1289.3.3.1	AS 1289.3.4.1			
125 mm	100%				Moisture content		1 point Liquid limit	Plastic limit	Plasticity index	Linear shrinkage	Curling/ Crumbling/ Cracking	
75 mm	100%			Result:	32.3% As Rcvd.	81%	23%	58%	16.0%	Crumbling		
63 mm	100%			LB S: UB S:							-	
53 mm	100%										-	
37.5 mm	100%			Att. preparation method:		Dry sieved		LSM length (mm):		250		
26.5 mm	100%			Specimen history/notes:	Preparation of specimen and testing performed on sample supplied to the laboratory							
19 mm	100%				Definitions:				LB S = Lower bound specification N/A = Not applicable LSM = Linear shrinkage mould ND = Not determined; SIB = Slip in bowl UB S = Upper bound specification NO = Not obtainable; NP = Non plastic			
13.2 mm	100%			GRADING SUMMARY								
9.5 mm	100%			Fines		Sand*		Gravel*		Cobbles*		
6.7 mm	100%			(<75 µm)		(>75 µm - <2.36 mm)		(>2.36 mm - <63 mm)		(>63mm - <200 mm)		
4.75 mm	100%			80.3%		19.7%		0.0%		0.0%		
2.36 mm	100%			Proportions based on guidance in AS1726-2017 Section 6.1.4.2								
1.18 mm	100%											
600 µm	100%											
425 µm	99%											
300 µm	96%											
150 µm	88%											
75 µm	80%											



Testing performed by:	RD	Results reviewed by:	DBergen	Date reported:	8/06/2018
Cert. ref.:	1896865-002_BH01 (22-5-18)_TRA18-0129_PSD_18052811_Rep18016379			Approved signatory:	
	NATA accreditation number: 1961 - Site:1954 - Adelaide Accredited for compliance with ISO/IEC 17025 - Testing				
	THIS DOCUMENT SHALL ONLY BE REPRODUCED IN FULL			Daniel Bergen - Laboratory Technician	
Phone:	+61 (08) 8213 2100	Fax:	+61 (08) 8213 2101	E-mail:	adlgeolab@golder.com.au
				Web:	www.golder.com.au

Soils testing - Report of Emerson class number


Soil classification

AS 1289.3.8.1-2017





Test request ID: TRA18-0129	Lab sample ID: LADL201805289	Golder Associates Pty Ltd	
Client: SMEC		ADELAIDE GEOTECHNICAL LABORATORY	
Client address: Level 4, 19 Grenfell Street, Adelaide, SA, 5000		118 Franklin Street, Adelaide, South Australia 5000	
Project ID: 1896865-002	Lab report ref.: LADL_18016380		
Project name: Storage Basin	Exploratory Hole BH01 (22/5/18)	Sample depth (m): 1.70 - 2.00	Client sample ref:
Location: Seaford	Project reference: 3005628		
Specimen description (Based on visual and tactile assessment)	(CH) CLAY, high plasticity, pale grey brown, with fine to coarse grained sand, trace fine gravel	Sampling co-ordinates	
		Easting (m)	Reduced Level
		Northing (m)	

TEST REPORT - SUMMARY OF ANALYSIS

Visual reference 	Date sampled:	
	Date tested:	06/06/18
	Temperature (°C):	21.0°
	Type of water used:	Distilled
Observations / Notes		
<i>Reaction to hydrochloric acid- Calcite</i>		
<div style="border: 1px solid black; padding: 5px; text-align: center;"> Emerson class number Class 4 </div>		

Emerson Class:	Definition / Notes
Class 1	Air-dried crumbs of soil show a strong dispersing reaction, i.e., a colloidal cloud covers nearly the whole of the bottom of the beaker, usually in a very thin layer. The reaction should be evident within 10 minutes. In extreme cases all the water in the beaker becomes cloudy, leaving only a coarse residue in a cloud of clay.
Class 2	Air-dried crumbs of soil show a moderate to slight reaction. A moderate reaction consists of an easily recognizable cloud of colloids in suspension, usually spreading in thin streaks on the bottom of the beaker. A slight reaction consists of the bare hint of cloud in water at the surface of the crumbs.
Class 3	The soil remoulded at the plastic limit disperses in water.
Class 4	The remoulded soil does not disperse in water. Calcium carbonate (calcite) or calcium sulfate (gypsum) is present.
Class 5	The remoulded soil does not disperse in water and the 1:5 soil/water suspension remains dispersed after 10 minutes.
Class 6	The remoulded soil does not disperse in water and the 1:5 soil/water suspension begins to flocculate within 10 minutes.
Class 7	The air-dried crumbs of soil remain coherent in water and swell.
Class 8	The air-dried crumbs of soil remain coherent in water and do not swell.

Definitions: ND = Not determined Result reviewed by: **DBergen** Test performed by: **RD** Date reported: **08/06/2018**

Cert. ref.: 1896865-002__TRA18-0129_Emerson_LADL201805289_R016380	Approved signatory:
 NATA accreditation number: 1961 - Site:1954 - Adelaide Accredited for compliance with ISO/IEC 17025 - Testing THIS DOCUMENT SHALL ONLY BE REPRODUCED IN FULL	 Daniel Bergen - Laboratory Technician

Soils testing - Report of Emerson class number


Soil classification

AS 1289.3.8.1-2017



Test request ID: TRA18-0129	Lab sample ID: LADL2018052810	Golder Associates Pty Ltd ADELAIDE GEOTECHNICAL LABORATORY 118 Franklin Street, Adelaide, South Australia 5000	
Client: SMEC			
Client address: Level 4, 19 Grenfell Street, Adelaide, SA, 5000			
Project ID: 1896865-002	Lab report ref.: LADL_18016381		
Project name: Storage Basin	Exploratory Hole BH01 (22/5/18)	Sample depth (m): 2.70 - 3.00	Client sample ref:
Location: Seaford	Project reference: 3005628		
Specimen description (Based on visual and tactile assessment)	(CH) CLAY, high plasticity, grey, with fine to coarse grained sand	Sampling co-ordinates	
		Easting (m)	Reduced Level

TEST REPORT - SUMMARY OF ANALYSIS

Visual reference		Date sampled:	
		Date tested:	06/06/18
		Temperature (°C):	21.0°
		Type of water used:	Distilled
		Observations / Notes	
		Emerson class number	
		Class 2	

Emerson Class:	Definition / Notes
Class 1	Air-dried crumbs of soil show a strong dispersing reaction, i.e., a colloidal cloud covers nearly the whole of the bottom of the beaker, usually in a very thin layer. The reaction should be evident within 10 minutes. In extreme cases all the water in the beaker becomes cloudy, leaving only a coarse residue in a cloud of clay.
Class 2	Air-dried crumbs of soil show a moderate to slight reaction. A moderate reaction consists of an easily recognizable cloud of colloids in suspension, usually spreading in thin streaks on the bottom of the beaker. A slight reaction consists of the bare hint of cloud in water at the surface of the crumbs.
Class 3	The soil remoulded at the plastic limit disperses in water.
Class 4	The remoulded soil does not disperse in water. Calcium carbonate (calcite) or calcium sulfate (gypsum) is present.
Class 5	The remoulded soil does not disperse in water and the 1:5 soil/water suspension remains dispersed after 10 minutes.
Class 6	The remoulded soil does not disperse in water and the 1:5 soil/water suspension begins to flocculate within 10 minutes.
Class 7	The air-dried crumbs of soil remain coherent in water and swell.
Class 8	The air-dried crumbs of soil remain coherent in water and do not swell.



Definitions:

ND = Not determined

Result reviewed by: **DBergen**

Test performed by: **RD**

Date reported: **08/06/2018**

Cert. ref.: 1896865-002__TRA18-0129_Emerson_LADL2018052810_R016381	Approved signatory:	
	NATA accreditation number: 1961 - Site:1954 - Adelaide	
	Accredited for compliance with ISO/IEC 17025 - Testing	
	THIS DOCUMENT SHALL ONLY BE REPRODUCED IN FULL	
	 Daniel Bergen - Laboratory Technician	

Soils testing - Report of Emerson class number


Soil classification

AS 1289.3.8.1-2017



Test request ID: TRA18-0129	Lab sample ID: LADL2018052811	Golder Associates Pty Ltd ADELAIDE GEOTECHNICAL LABORATORY 118 Franklin Street, Adelaide, South Australia 5000	
Client: SMEC			
Client address: Level 4, 19 Grenfell Street, Adelaide, SA, 5000			
Project ID: 1896865-002	Lab report ref.: LADL_18016382		
Project name: Storage Basin	Exploratory Hole BH01 (22/5/18)	Sample depth (m): 4.70 - 5.00	Client sample ref:
Location: Seaford	Project reference: 3005628		
Specimen description (Based on visual and tactile assessment)	CLAY, Reddish green grey	Sampling co-ordinates	
		Easting (m)	Reduced Level

TEST REPORT - SUMMARY OF ANALYSIS

Visual reference 	Date sampled:	
	Date tested:	06/06/18
	Temperature (°C):	21.0°
	Type of water used:	Distilled
Observations / Notes		
<div>Emerson class number</div> <div>Class 2</div>		

Emerson Class:	Definition / Notes
Class 1	Air-dried crumbs of soil show a strong dispersing reaction, i.e., a colloidal cloud covers nearly the whole of the bottom of the beaker, usually in a very thin layer. The reaction should be evident within 10 minutes. In extreme cases all the water in the beaker becomes cloudy, leaving only a coarse residue in a cloud of clay.
Class 2	Air-dried crumbs of soil show a moderate to slight reaction. A moderate reaction consists of an easily recognizable cloud of colloids in suspension, usually spreading in thin streaks on the bottom of the beaker. A slight reaction consists of the bare hint of cloud in water at the surface of the crumbs.
Class 3	The soil remoulded at the plastic limit disperses in water.
Class 4	The remoulded soil does not disperse in water. Calcium carbonate (calcite) or calcium sulfate (gypsum) is present.
Class 5	The remoulded soil does not disperse in water and the 1:5 soil/water suspension remains dispersed after 10 minutes.
Class 6	The remoulded soil does not disperse in water and the 1:5 soil/water suspension begins to flocculate within 10 minutes.
Class 7	The air-dried crumbs of soil remain coherent in water and swell.
Class 8	The air-dried crumbs of soil remain coherent in water and do not swell.



Definitions:

ND = Not determined

Result reviewed by: **DBergen**

Test performed by: **RD**

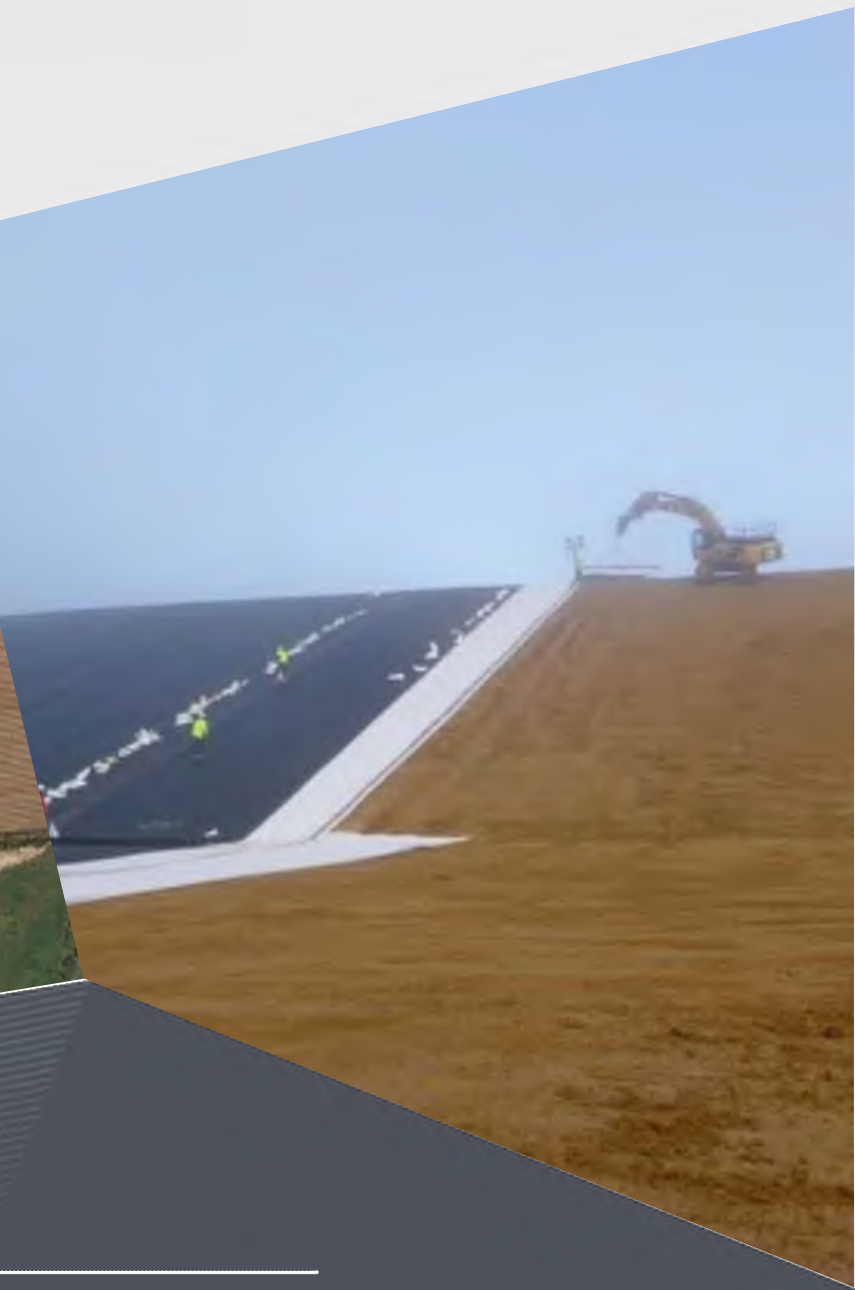
Date reported: **08/06/2018**

Cert. ref.:	1896865-002__TRA18-0129_Emerson_LADL2018052811_R016382		Approved signatory:
	NATA accreditation number: 1961 - Site:1954 - Adelaide		
	Accredited for compliance with ISO/IEC 17025 - Testing		
	THIS DOCUMENT SHALL ONLY BE REPRODUCED IN FULL		Daniel Bergen - Laboratory Technician

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www.smec.com



Construction Report

SRWRA Storage Seaford

Reference No. WBWC PO-0073
Prepared for Water Utilities Australia
31 October 2018

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1 Introduction

SMEC has been engaged by Water Utilities Australia (WUA) to prepare a construction excavation method Report for a new 600ML storage at Seaford Heights. The Willunga Basin Water storage for the Southern Region Waste Resource Authority (SRWRA) is currently in the Concept Design Phase with the work being completed by HydroPlan.

As the storage is located upstream of a residential population it is recognised that construction of the storage has potential implications for the surrounding residents. As such a Construction method assessment was undertaken based on the outcomes of a geotechnical investigation report:

- Geotechnical Investigations Report Draft (SMEC, June 2018)

Details of outcomes of the Construction Method Assessment are presented below.

2 Construction Activities

The Works associated with construction of the Seaford Storage are envisaged to comprise the following:

- Stripping of topsoil and unsuitable materials from embankment and reservoir footprint
- Excavation and preparation of foundation
- Embankment construction
- Inlet/Outlet works construction
- Overflow (spillway) construction
- Clearing of vegetation and stripping of topsoil along the spillway outfall chute
- Prepare surface for membrane
- Placement, welding and testing of geomembrane liner
- Landscaping

3 Construction Method

The results of the Draft Geotechnical Report identified the following sub-surface lithology

Table 2: Summary of sub-surface lithology

UNIT	BH1	BH2	BH3	BH4
Top Soil	0.0 m to ≈0.2 m	0.0 m to ≈0.2 m	0.0 m to ≈0.2 m	0.0 m to ≈0.2 m
Upper Clay	≈0.2 m - ≈2.5 m	≈0.2 m - 1.3 m	≈0.2 m - ≈2.5 m	≈0.2 m - ≈3.6 m
Hindmarsh / Ngalinga Clay	≈2.5 m - 7.5 m	Not Encountered	≈2.5 m - 7.8 m	Not Encountered
Clayey Sand	7.5 m – 8.0 m (EOH)	Not Encountered	7.8 - 8.06 m (EOH)	Not Encountered
Residual Soil		1.3 m – 1.6 m		3.6 m - 4.9 m
Siltstone / Sandstone		1.6 m – 8.1 m (EOH)		4.9 m - 8.0 m (EOH)

No groundwater was encountered within the depth investigated.

As noted in the Draft Geotechnical Investigations Report the natural clay soils encountered in the boreholes are expected to be generally excavatable using conventional machinery such as excavators and dozers. Slower production rates would be expected in the residual soils and the very low strength weathered rock. Should the medium strength siltstone unit be encountered the use of specialist rock breaking equipment may be required. The need for the use of drill and blast techniques for excavation of this unit is not considered likely.

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Craig Heidenreich
General Manager
Water Utilities Australia
Willunga Basin Water Company
CHeidenreich@wua.com.au

28 November 2018

Dear Craig

Re: Odour Assessment – SRWRA Treated Water Storage Dam

This letter report provides an odour assessment of a proposed 600 ML treated water storage dam at Seaford. The assessment is based on field odour intensity observations at four treated water storage dams in the area of Noarlunga, Willunga and Aldinga on 16 August 2018.

This letter report has been updated based on client comments and an updated dam layout plan.

If you require any clarification or further information, then please let me know.

Sincerely

A handwritten signature in blue ink, appearing to be 'Johan Meline', with a stylized flourish extending to the right.

Johan Meline CAQP, MIEAust
Principal Consultant

SRWRA Treated Water Storage Dam Odour Assessment

Background and Introduction

Willunga Basin Water Company is planning for a new treated water storage dam at Seaford Heights near the existing Quarry Road storage dam. The location is south of Victor Harbor Road, west of Ostrich Farm Road, north of the SRWRA landfill and southeast of a new residential development, as shown in Figure 1 and Figure 2. Plans of the facility concept design are included as an attachment.

The capacity of the proposed dam is 600 ML and the purpose of the development is to provide Willunga Basin Water with additional winter storage capacity of water for irrigation purposes, to service nearby vineyards. The dam will contain treated water from Christies Beach wastewater treatment plant. Treated water from the Christies Beach treatment plant is currently stored and distributed for irrigation across the region by Willunga Basin Water. One storage facility is the Quarry Road dam to the north of the proposed location.

To address potential concerns regarding odour from the treated water storage dam, Willunga Basin Water Company engaged ERM to perform an odour assessment. As there is no South Australian recommended evaluation (buffer/separation) distance, site specific assessment is recommended. The odour assessment was based on field odour observations at current treated water storage facilities in the area of the proposed dam location. Dispersion modelling was not performed for the assessment since it is difficult to characterise emissions from low level non offensive odour sources¹.

The nearest existing sensitive receptor location is a residence to the south of the dam at a distance of 105 m from the water edge of the proposed dam maximum fill height.

The closest sensitive future receptors to the dam will be residents at the new residential development to the northwest at a distance of approximately 78 m from the water edge of the proposed dam maximum fill height.

The land proposed for the dam is in the Primary Production and Deferred Urban Zone.

¹ Odour impacts from low level non offensive odour sources, such as treated water storage lagoons, typically produce over predictions in separation distance requirements in dispersion modelling.

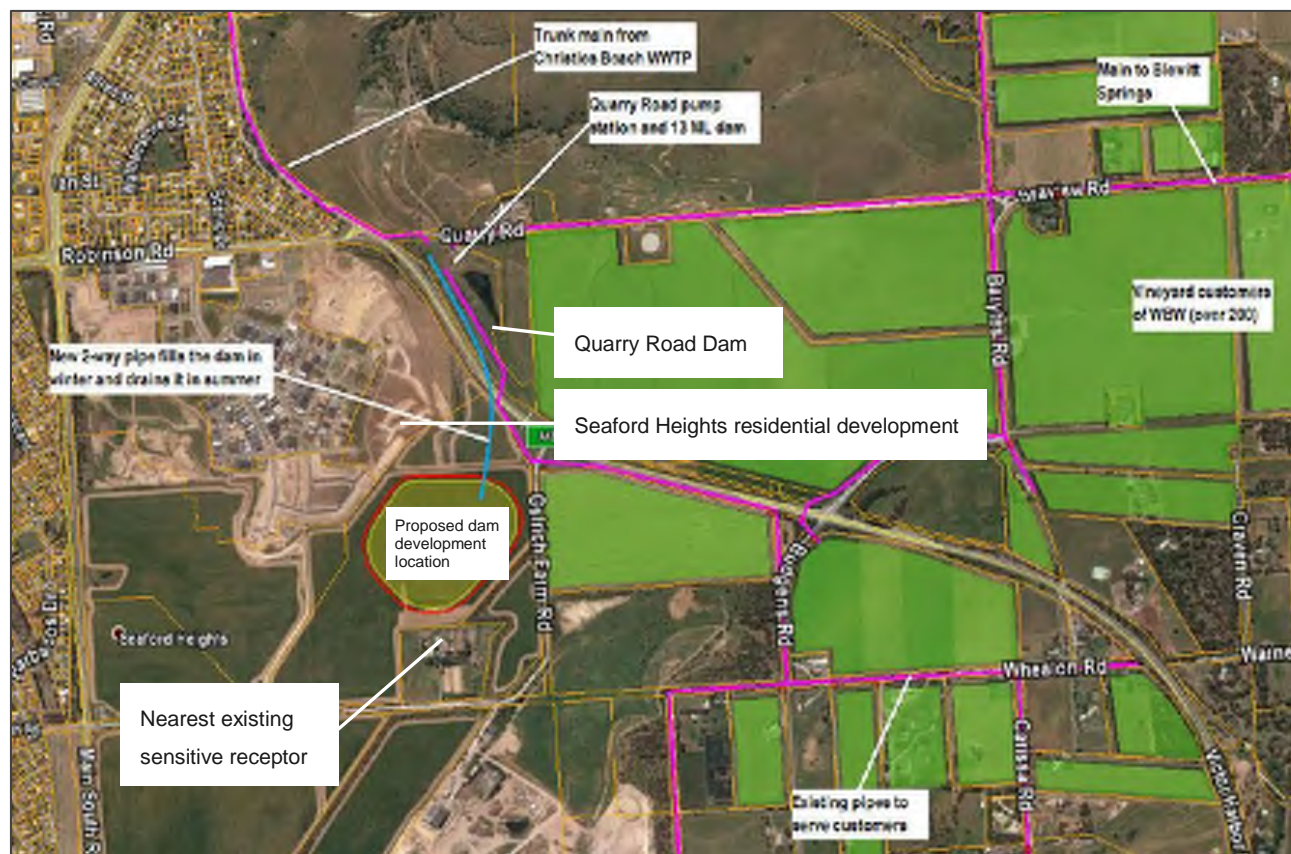


Figure 1: *SRWRA treated water storage dam site location*

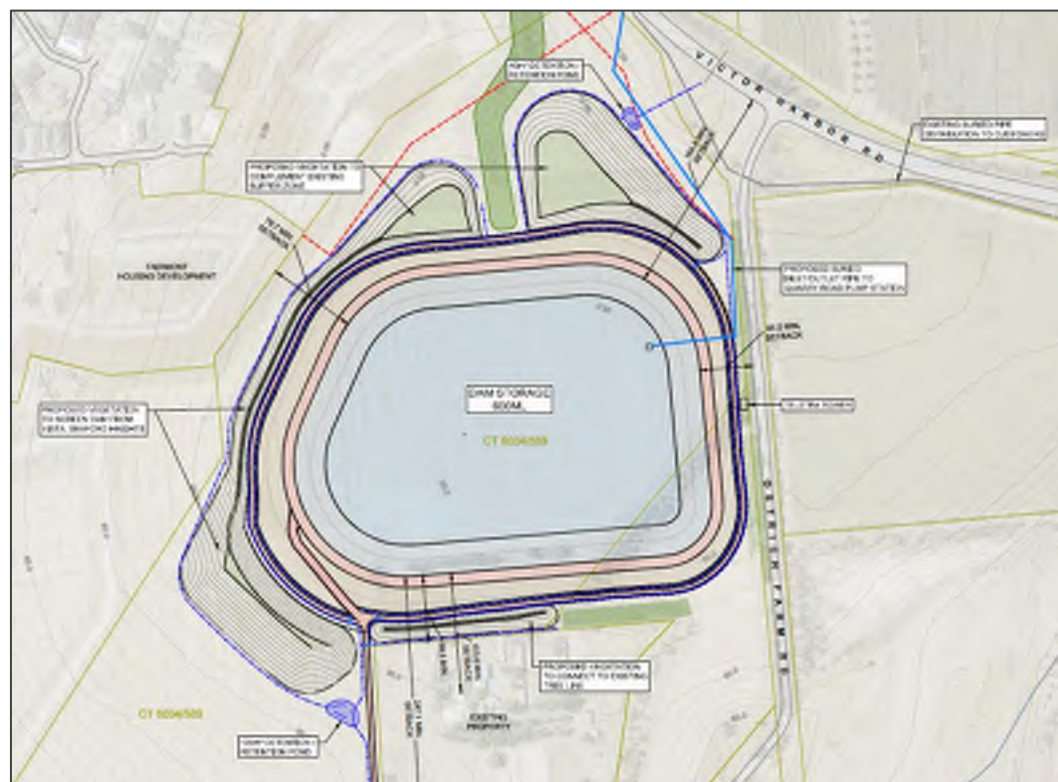


Figure 2: SRWRA treated water storage dam site layout (see attachment for full plan)

Odour Assessment Methodology

The odour assessment was based on field odour observations of existing nearby treated water storage dams. The results from the observations was evaluated against the separation distance to the nearest sensitive receptors, general settings of the area and wind data.

Field Odour Observations Assessment Methodology

The field odour observations methodology applied for the assessment was a modified version of the German Standard VDI 3490 (1993) method for odour surveys. The method standardises the odour logging approach by the adoption of a standard scale for describing odour intensity, as detailed in the German Standard VDI 3882, which relates to odour measurement. This method was selected as it enables the evaluation of odour over time rather than single point in time with discrete observations.

The German standard describes a procedure for logging odour in the field which involves noting the odour intensity based on a scale of 0 to 6 (see Table 1) every 10 seconds over a 10 minute period for a number of locations. In addition to making intensity observations, the observer also notes the character of the odour/odours observed, if that can be determined.

Table 1: *Odour intensity scale with interpretation*

Perceived Odour Strength	Intensity Rating	Interpretation Source: VDI 3490 (1993) and modified interpretations from Pitt (2014) ²
Extremely Strong	6	In normal circumstances, this should be very rare in a field situation. For an offensive type of odour, the reaction would be to immediately mitigate against further exposure until the exposure level is reduced. The odour cannot be tolerated.
Very Strong	5	The odour character is clearly recognisable. For an offensive type of odour, exposure to this level is considered unpleasant/undesirable to the point that action to mitigate against further exposure is considered or taken.
Strong	4	The odour character is clearly recognisable. For an offensive type of odour, exposure to this level would be considered unpleasant/undesirable.
Distinct	3	The odour character is clearly recognisable. Note that this must still apply even if in a different context or situation - for example, not knowing or expecting what type of odour may be present. The odour is tolerable – even for an offensive odour.
Weak	2	A detectable weak odour stronger than very weak and less strong than distinct.
Very Weak	1	Odour only just detectable.
Not Perceptible	0	No odour present.

Locations for the field odour observations were selected to cover one upwind location for reference of background odour and downwind locations at various distances from the targeted odour source.

In addition to recording odour intensity observations, wind conditions (wind direction and wind speed) were also recorded for each observation.

The results of the field odour intensity observations are summarised in the results section below. Result pie charts of the intensity observations for each observation location were plotted on an aerial image along with the wind direction at the time of the observation. This provides an overview of the observation

² Pitt, D. (2014). Field odour assessments for estimating odour concentrations. Air Quality and Climate Change, 48(1), 24-32.

VDI. (1993). Determination of odorants in ambient air by field inspections intensity VDI3940. Dusseldorf: Kommission Reinhaltung der Luft im VDI und DIN.

results summarising where odour was observed as well as the level of odour observed, frequency of different odour intensities and the wind directions.

Wind Data

Local wind data is relevant to consider in odour assessments as it indicates where impacts will occur. Annual prevailing wind directions as well as time of day and seasonal prevailing wind directions are relevant to consider from a potential exposure point of view. Wind data from the Noarlunga BoM weather station, the nearest weather station to site, is presented below.

Separation Distance Guidelines

Relevant SA EPA guidelines on separation distance requirements include:

- Evaluation Distances for Effective Air Quality and Noise Management (SA EPA, 2016)³
- Wastewater Lagoon Construction (SA EPA, 2014)⁴

The evaluation distances guideline states:

There is no recommended evaluation distance for recycled water storage lagoons, so a site-specific assessment is recommended.

This statement is further expanded on in the wastewater lagoon construction guideline:

Separation distances for recycled water storage lagoons are not specified. This is because air (odour) and noise issues are not generally associated with these lagoons, providing wastewater has been treated to minimise odour and they contain no mechanical treatment processes which generate noise. For recycled water storage lagoons a site-specific assessment should be undertaken to determine appropriate separation from sensitive receptors.

Wind Data

Wind data for the Noarlunga BoM weather station, approximately 4 km to the north of the proposed SRWRA storage dam location, is presented in Figure 3 to Figure 5. The data⁵ shows annual prevailing wind directions as north (N), east (E) and southeast (SE). These are broken down as follows:

- The prevailing wind direction in summer months is SE.
- The prevailing wind direction in autumn months is E.
- The prevailing wind direction in winter months is N.
- Overnight prevailing wind directions are E to SE.
- Day time prevailing wind directions are N and E in mornings and W with afternoon sea breezes.

For the nearest future sensitive receptors to the NW (the Seaford heights residential development), there is potential exposure with SE winds, especially in summer months. However, it should be observed that Noarlunga BoM station is located in a windy location (very low frequency of low wind speeds) and that the proposed SRWRA storage dam site location is located on hilltop at a higher elevation than the Noarlunga weather station, which should give greater exposure to winds. This means that the site location can be expected to be windier than Noarlunga and this provides good dispersion conditions.

³ SA EPA. (2016). Evaluation distances for effective air quality and noise management.

⁴ SA EPA. (2014). Wastewater Lagoons Construction.

⁵ Wind roses for 2009 included

The concept design drawings (see attached) show that there will be a banks (at the hill crest) between the storage dam and the nearby sensitive receptors. From this and the hilltop location, it follows that there should be no reason to suspect that there would be any directed drainage flows (and associated odour issues) in the direction towards the nearest sensitive receptors. The prevailing N winds show potential for exposure of the sensitive receptor to the south, however the N prevailing winds occur during wintertime daytime conditions with higher wind speeds in good dispersion conditions.

While there is potential exposure of the nearby sensitive receptors (with prevailing SE and N winds for part of the year), dispersion conditions at the elevated site location should be good and the residential receptors are not in locations, relative to the storage dam, that would pose any particular exposure risk⁶.

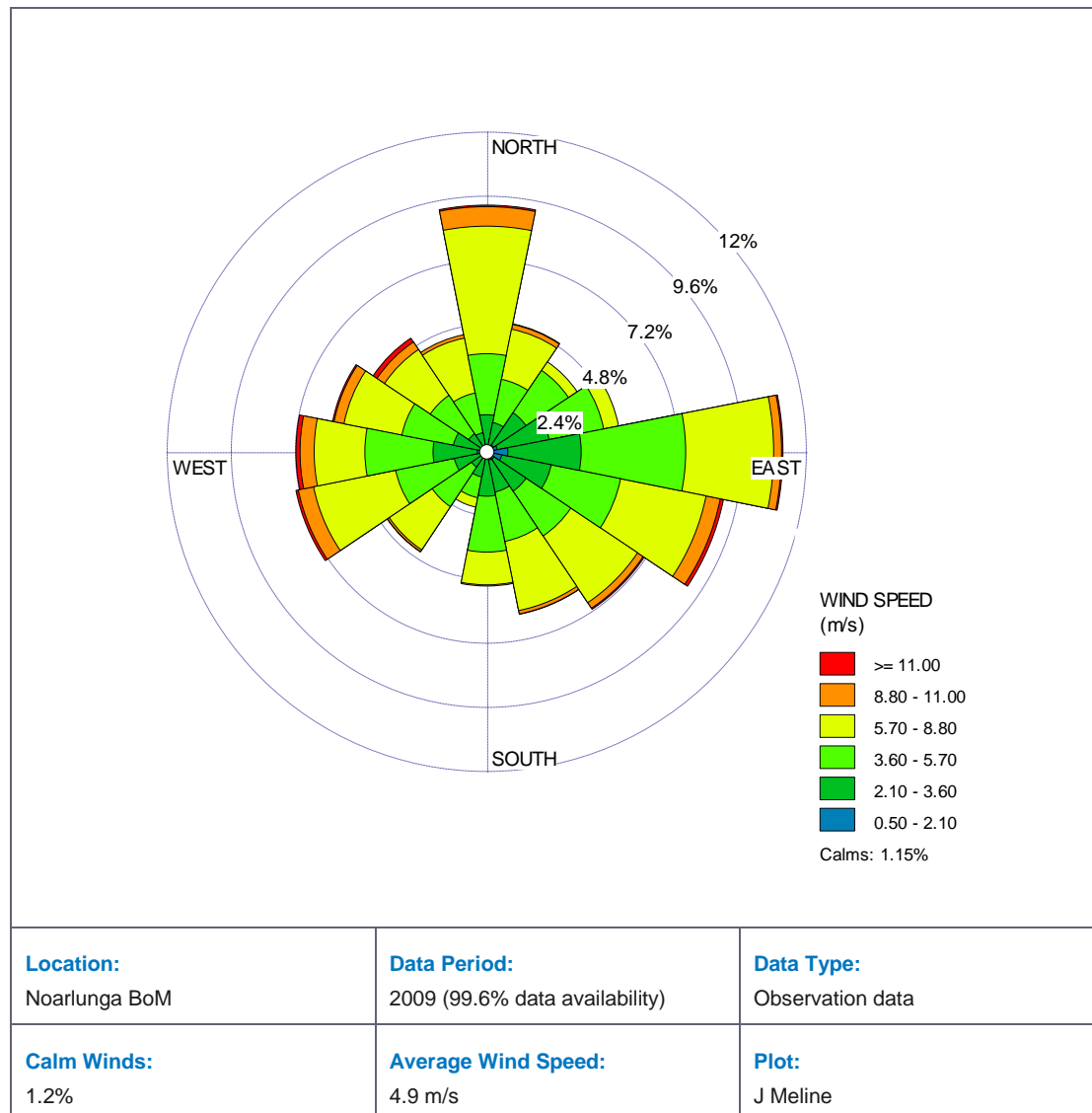


Figure 3: Annual wind rose for Noarlunga BoM

⁶ Examples of this would be the dam located in valley where there could be cold air drainage transporting odour to down gradient sensitive receptors or a situation with receptors on a hillside above the dam location where winds could blow an odour plume uphill and towards ground and receptors.

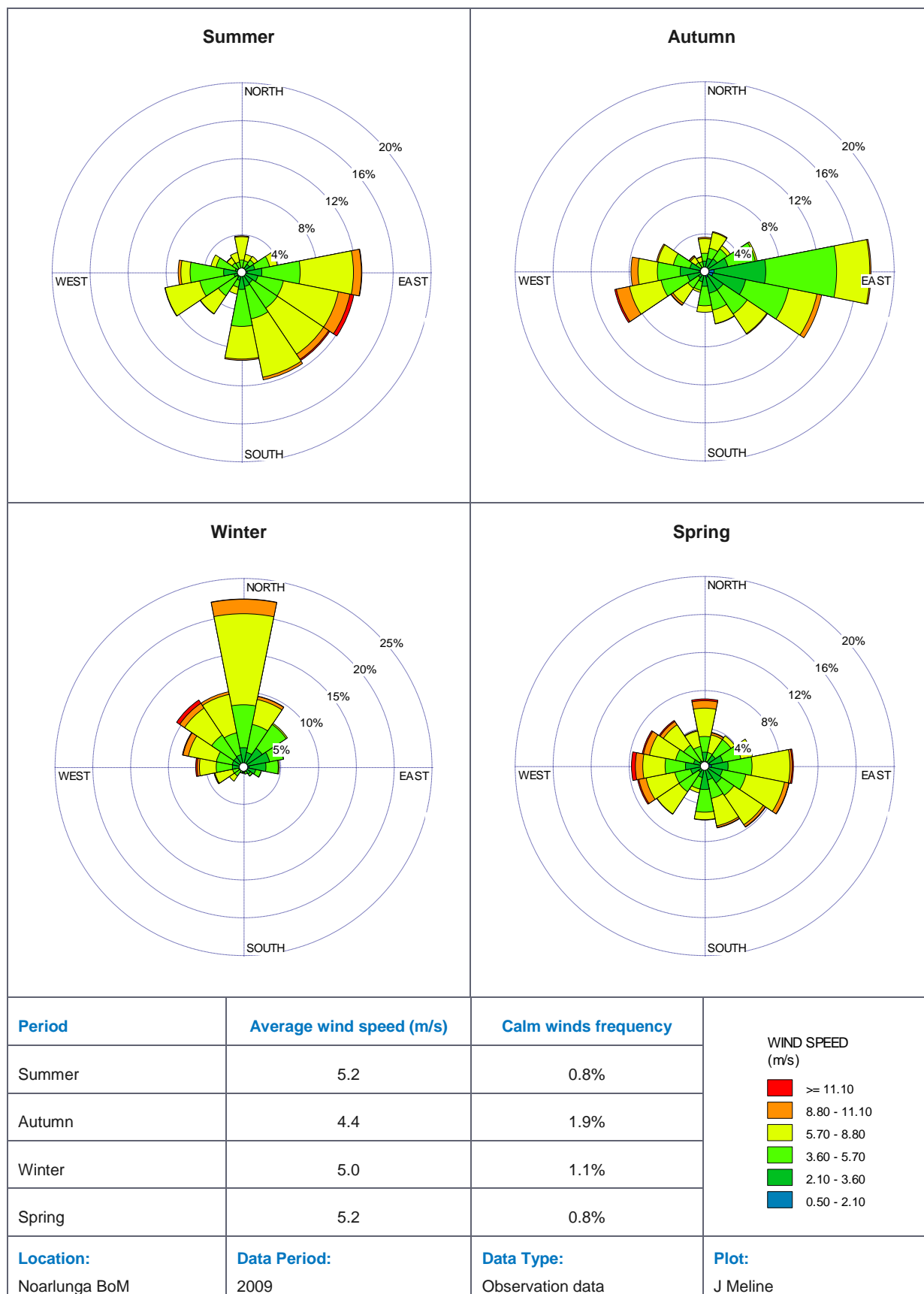


Figure 4: Seasonal wind roses for Noarlunga BoM

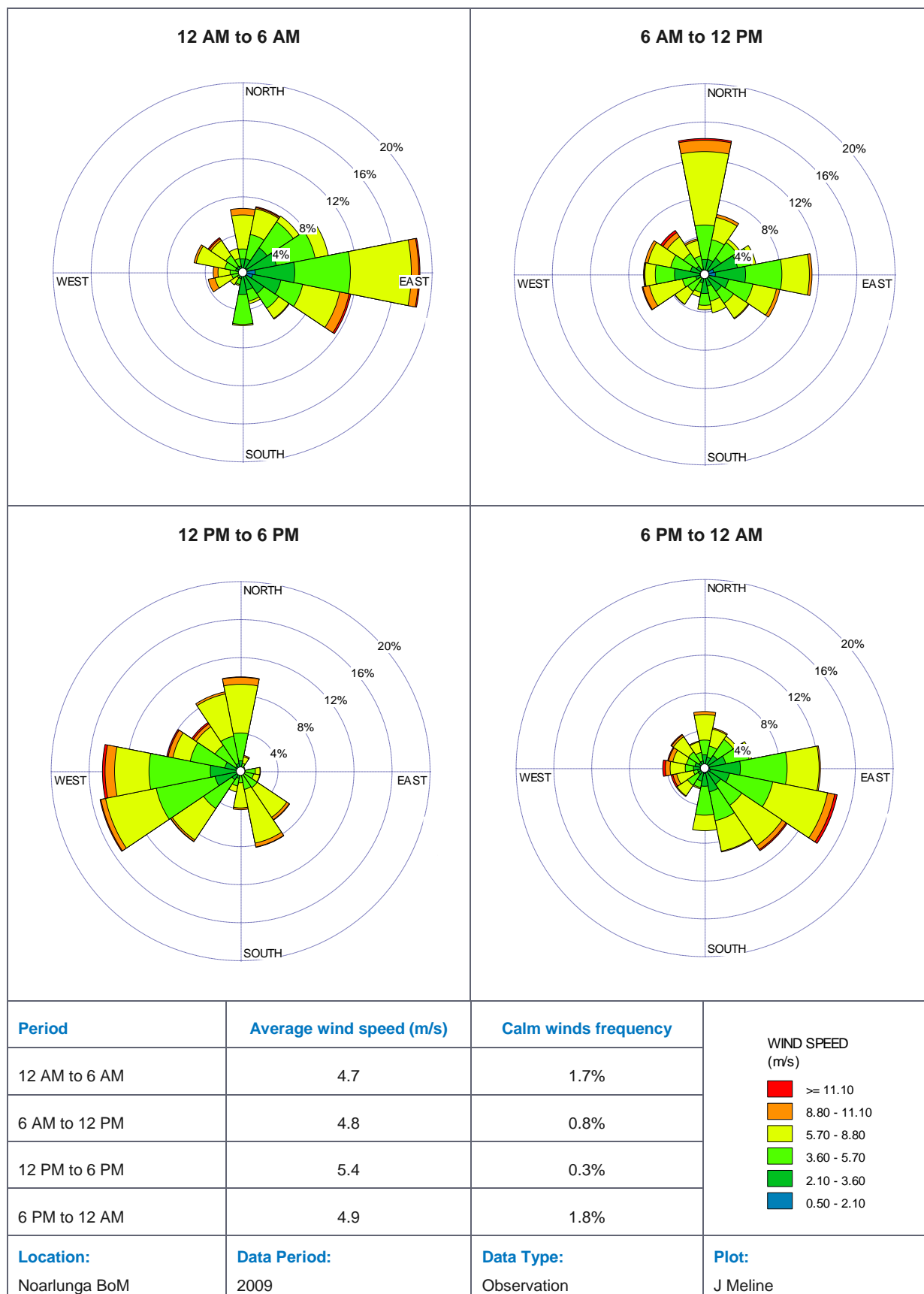


Figure 5: Time of day wind roses for Noarlunga BoM

Field Odour Intensity Observation Results

Field odour observations were performed on 16 August 2018 at the following treated water storage dams:

- Aldinga Storage Basin (south of the Aldinga WWTP)
- Quarry Road treated water storage dam (just north of the proposed SRWRA storage location)
- Little Road treated water storage dams (northwest of Willunga)

The log sheets for each observation location are provided as attachments.

General Observations

Odour from the treated water storage dams is recognisable, but not perceived as offensive, and typically present intermittently at low levels even very close to the dams. While the treated water is a product from a wastewater treatment plant, the odour from the storage dams is not perceived as wastewater related. The character of the odour of the treated water is closer in resemblance to muddy lake or pond water.

Aldinga Storage Basin

Site access was not available for the Aldinga Storage Basin south of the Aldinga WWTP. Odour observations were collected around the site perimeter along Plains and Hahn Road. Observations were performed early morning in near calm conditions (<0.5 m/s wind speed) with air movement from the north. There was no background odour observed (at upwind location) and no odour observed south (downwind) of the storage basin. The distance of observation from the treated water storage edge to the observation locations was approximately 110 m. The field odour observation results are summarised in Figure 6.

Quarry Road Treated Water Storage Dam

The water stored is treated water from Christies Beach WWTP, which is the same as for the proposed SRWRA storage dam. Conditions at the time of the observations were light WSW winds. The observations showed intermittent very weak to weak odours downwind from the dam with no odour observed for most of the durations. Closer to the water edge, odour was detected more frequently (about a quarter of the time) than at the site boundary. Very little odour was observed at the site boundary at distances of approximately 20 m to 40 m from the dam water edge.

Overall observations were perceived as low level odour and not of an offensive nature. The field odour observation results are summarised in Figure 7.

Little Road Treated Water Storage Dams

The water currently stored is treated water from the onsite Onkaparinga Council WWTP, but it is blended with Christies Beach water later in each season. Although the current water is not identical to the Christies Beach treated water, it is treated to the same quality as for the proposed storage dam.

Conditions at the time of the observations were light NW winds and odour observations were performed to the east of the storage dam along the boundary fence line and closer to the dam location to collect data on variations in the odour observations with distance from the water edge. The observations showed intermittent very weak to weak odours downwind from the dam with no odour observed for most of the durations. Closer to the water edge, odour was detected more frequently. Very little odour was observed at an approximate distance of 50 m from the dam water edge and no odour was observed at a distance of approximately 90 m from the dam water edge.

At the storage dam located south of the treatment plant at the site there was no odour observed at the downwind dam water edge. The field odour observation results are summarised in Figure 8.

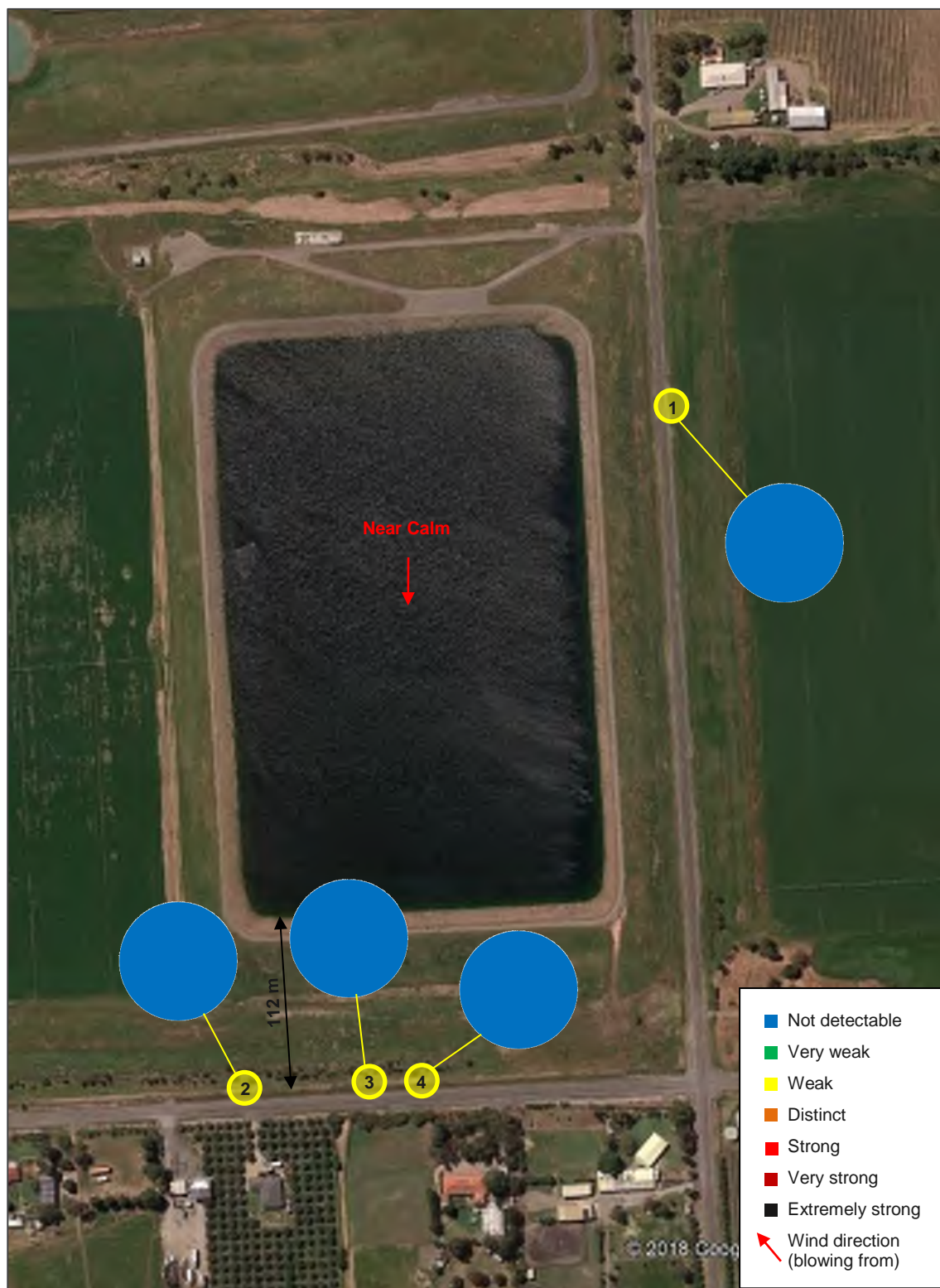


Figure 6: Aldinga Storage Basin field odour observation results

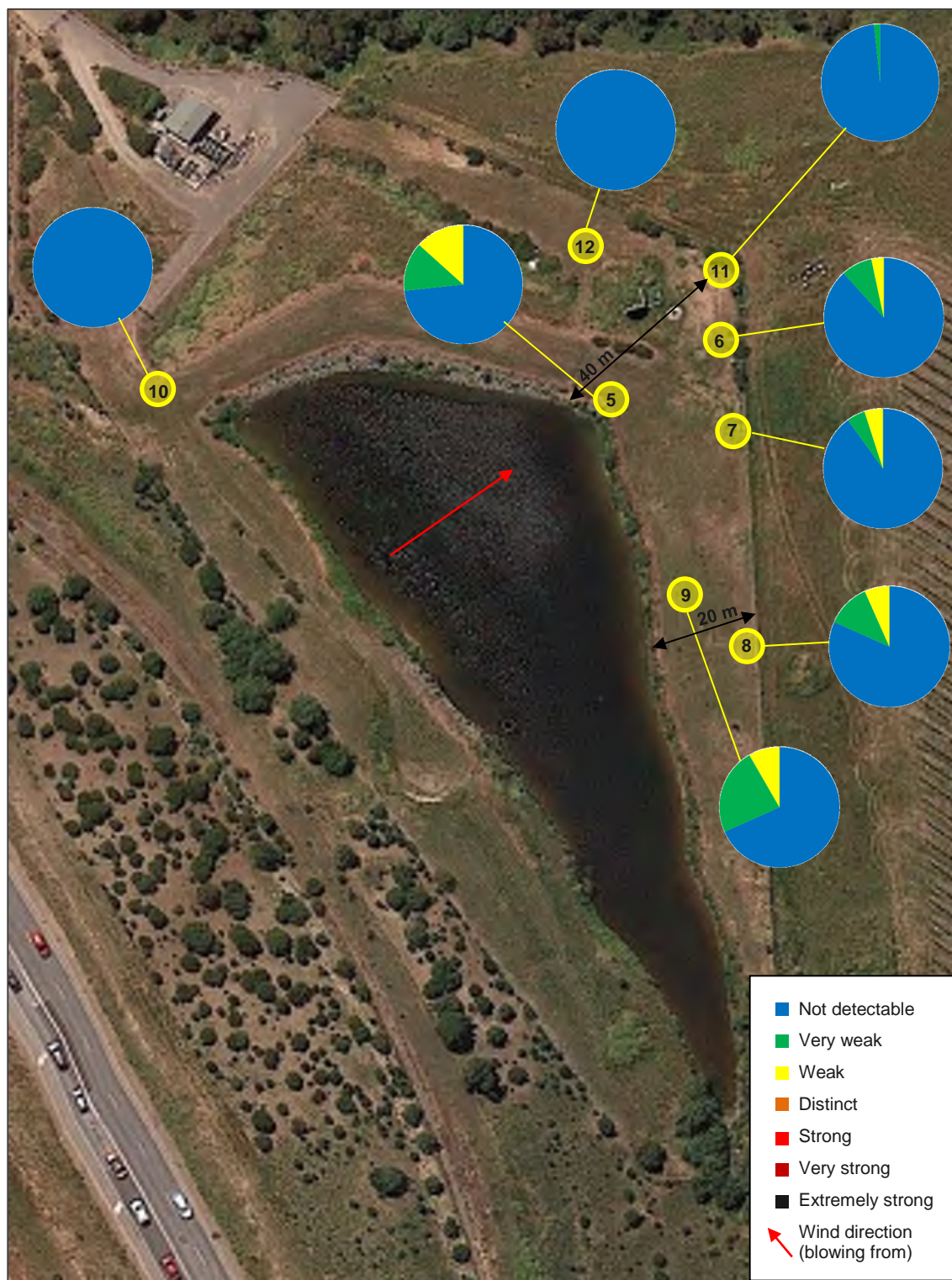


Figure 7: Quarry Road treated water storage dam field odour observation results

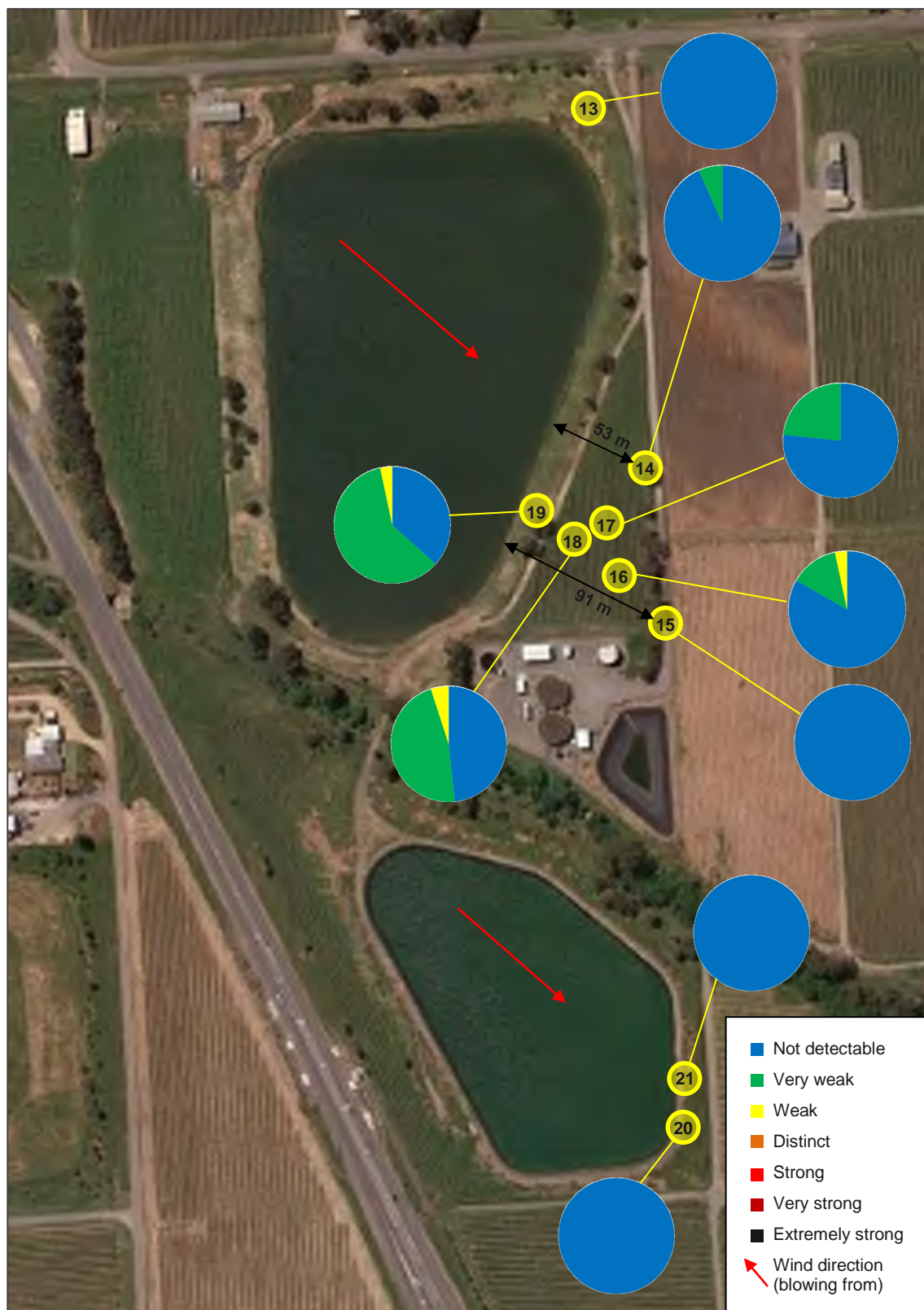


Figure 8: Little Road treated water storage dams field odour observation results

Conclusions and Recommendations

The field odour observations showed the following:

- There is odour associated with treated water storage dams. However, the character of the odour is not perceived as offensive, and it is not a wastewater related odour.
- The levels of odour observed were mostly low level and intermittent, especially at distance from the sources.
- At most locations no odour was observed for most of the time.
- No distinct or strong intensity odours were observed.

The review of the dam location and wind data review showed the following:

- The nearest sensitive receptors at the Seaford Height residential development, currently under construction, is at a distance of approximately 78 m from the water edge of the proposed dam maximum fill height.
- The nearest existing sensitive receptor location is a residence to the south of the dam at a distance of 105 m from the water edge of the proposed dam maximum fill height.
- The Seaford Heights residential development is in the summer time prevailing downwind wind direction and the sensitive receptor to the south is in the winter daytime prevailing downwind wind direction. However, dispersion conditions at the elevated hilltop location should be very good given the elevation and windy conditions.

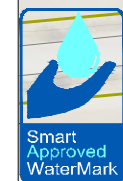
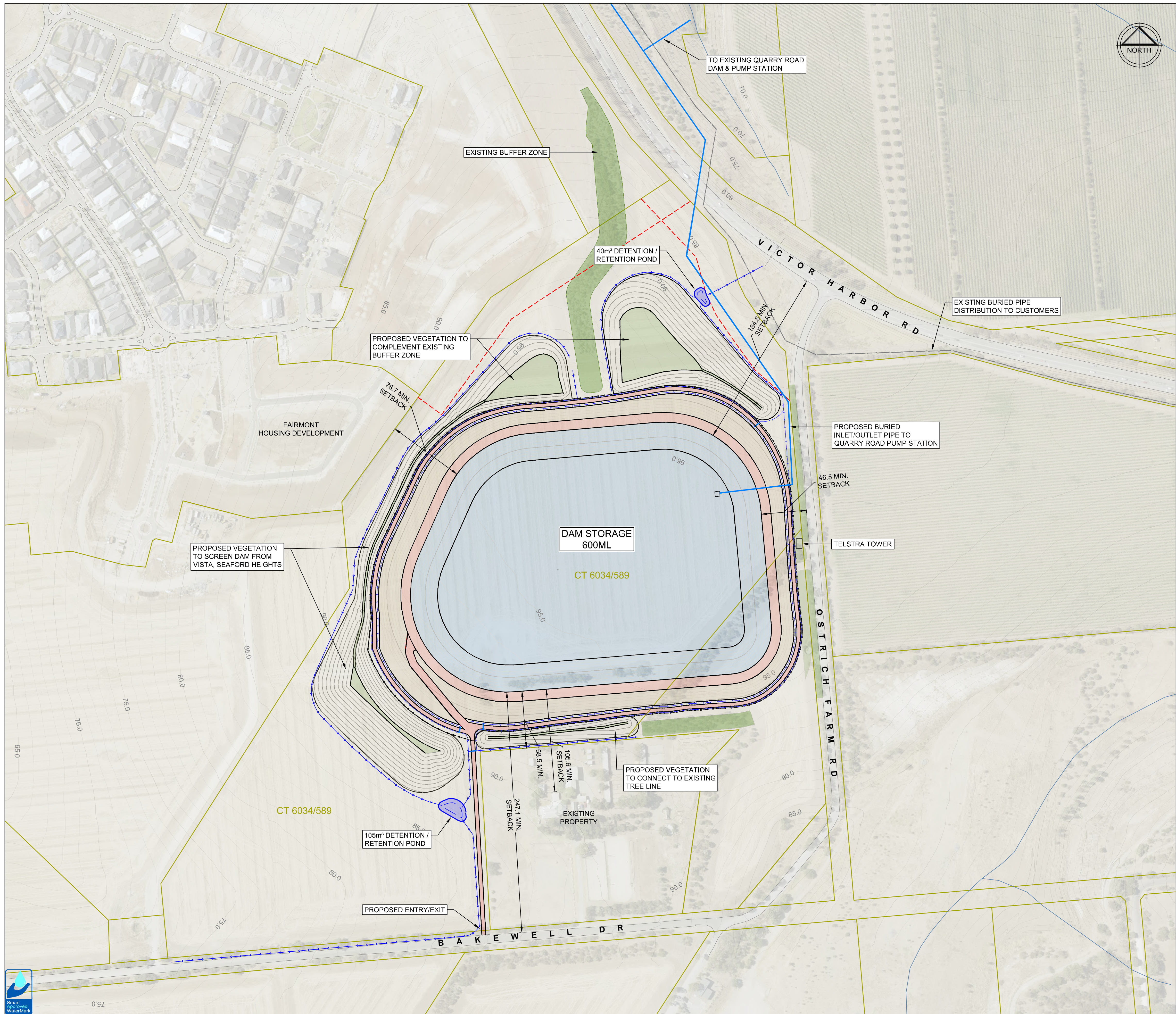
From the field odour observations and the assessment it cannot be concluded that there will be no odour at the nearest sensitive receptor locations at the Seaford heights residential development as a result of the construction of the treated water storage dam as proposed. However, what the assessment shows is that any odour would be very low level (low odour concentration and intermittent) and not of an offensive nature.

Dispersion modelling was not performed for the assessment since it is difficult to characterise emissions and odour impacts from low level non offensive odour sources to then produce impact predictions that could be used for realistic separation distance requirements. However, for any dispersion modelling the applicable odour assessment criteria for the location would likely be 2 odour units. This means that a very low level of odour is acceptable at the location.

In accordance with operations to “good practice”, it is recommended that an Operations Management Plan, that includes odour management, be developed for the treated water storage dam. The Operations Management Plan should include routine water quality monitoring protocols and site inspections specifically targeting observation of odour for monitoring of performance. For operations and mitigations, details should be provided on preventative measures for maintenance of water quality and an incident response plan (should an odour event occur) should be included.

With an effective Operations Management Plan in place, there is a low risk of elevated odour from the proposed treated water storage.

Drawing file: Z:\WBW\14689 SRWRA Dam\Drawings\SK013-d7 (57MM - Mounds) dwg - 16/11/2018 5:08 PM Original Size: ISO Full Bleed A1 (841.00 X 594.00 MM)



SITeworks Legend

- PROPERTY LINE
- PROPOSED PIPELINE
- PROPOSED SWALE
- EXISTING PIPELINE
- BUFFER LAND BOUNDARY LINE

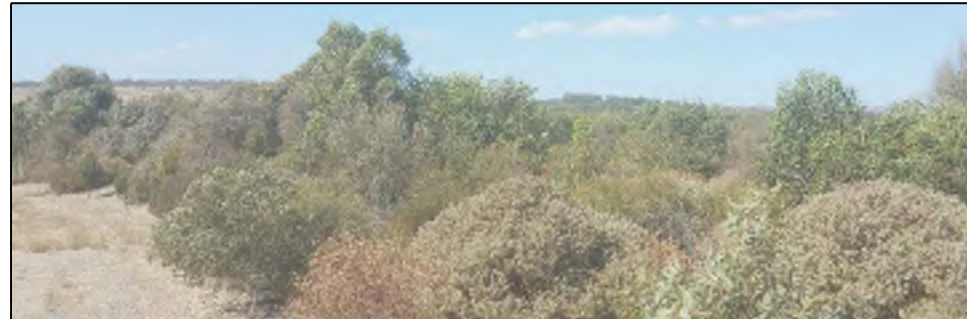
FINISHED SURFACE Legend

- RUBBLE AREA
- STORAGE AREA (PLASTIC LINED)
- OUTSIDE BATTER AREA

VEGETATION Legend

EXTENDED VEGETATION AREA:
(FOR SCREENING - INDICATIVE ONLY)

EXAMPLE:



NOTE: VEGETATION PLAN TO BE AGREED WITH BIODIVERSITY McLaren VALE AND DEW. VEGETATION TO SCREEN A 1.8m HIGH SECURITY FENCE ON THE INTERNAL SIDE OF EXTENDED VEGETATION ALIGNMENT.

EXISTING VEGETATION AREA:

EXAMPLES:



SCALE 1:2000 ORIGINAL SIZE A1

3	16/11/2018	JT	JG/BH	FOR DISCUSSION					
2	22/10/2018	JT	JG/BH	FOR DISCUSSION					
1	03/10/2018	JT	JG/BH	FOR DISCUSSION					
0	20/09/2018	JT	JG/BH	FOR DISCUSSION					
REV	ISSUED	D.DWN	APRVD	REVISION DESCRIPTION	REV	ISSUED	D.DWN	APRVD	REVISION DESCRIPTION



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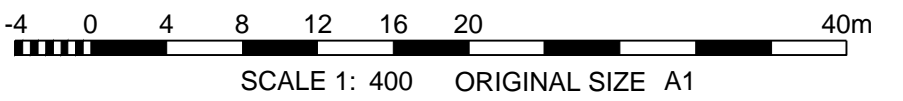
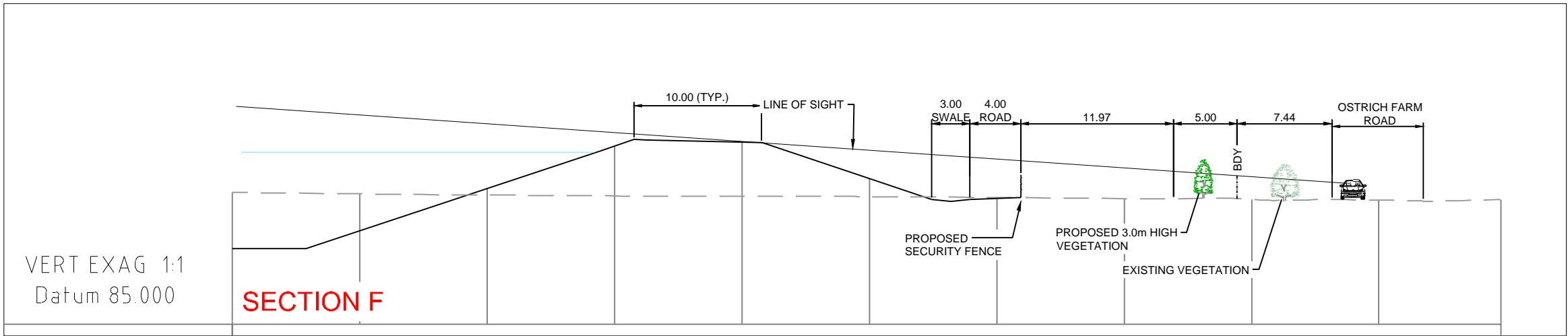
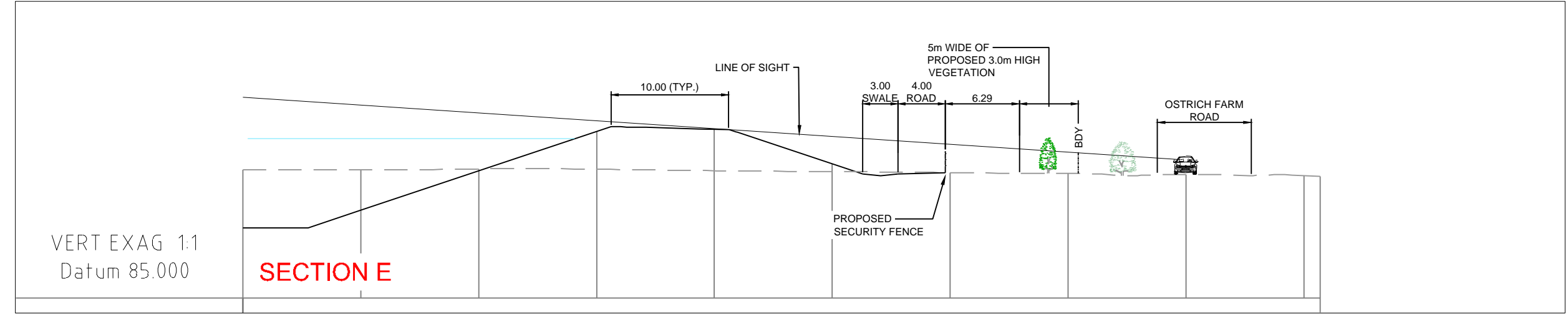
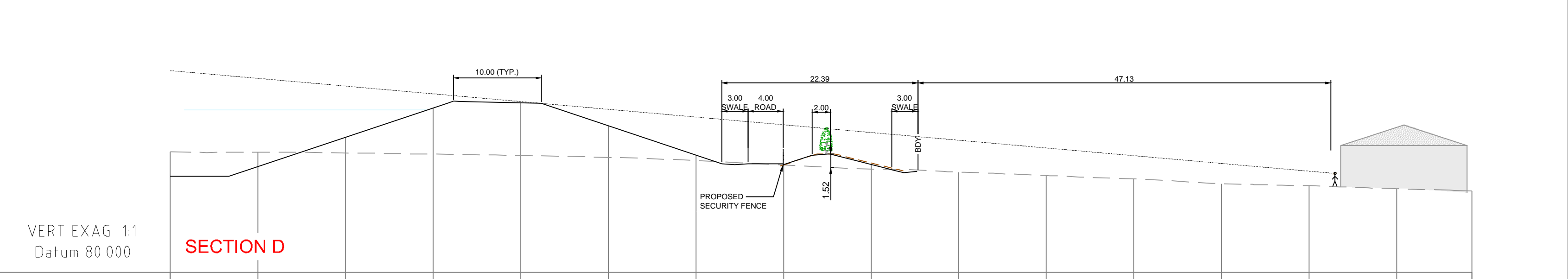
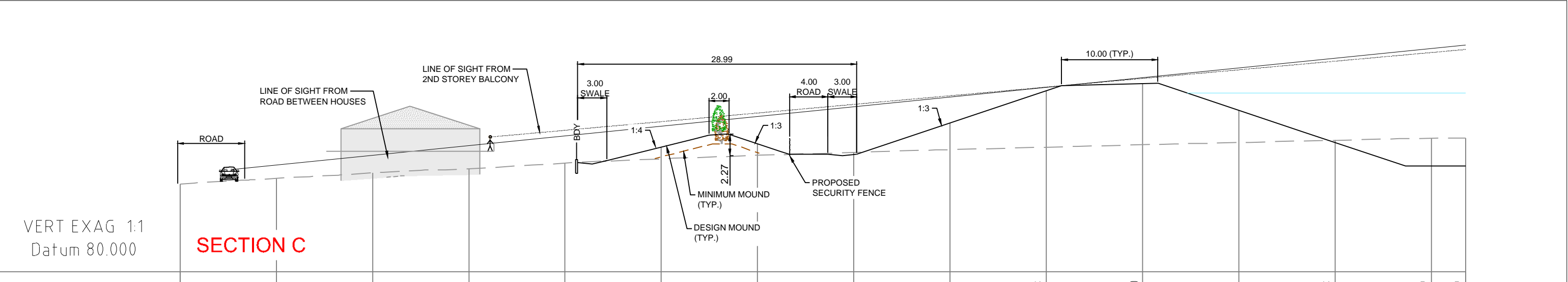
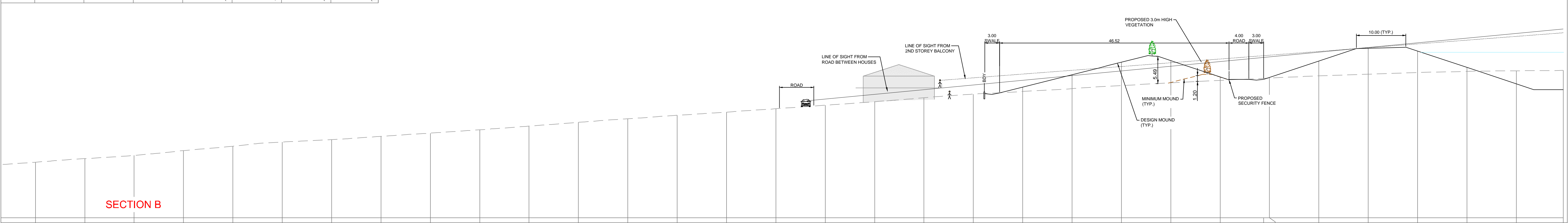
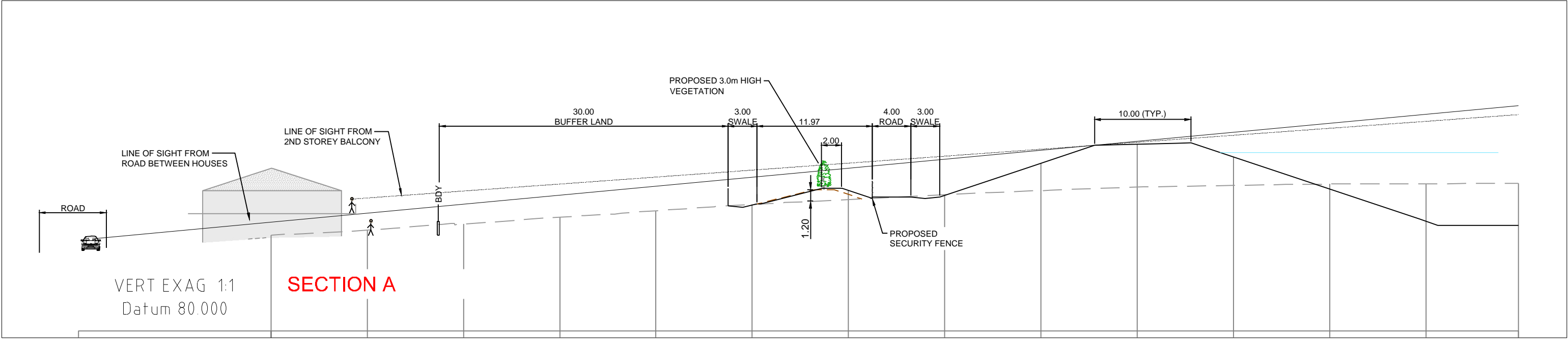
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The arrangement and general details as shown on
this drawing are essentially diagrammatic and must
be applied to the circumstances as found on site.

DES/DRAWN: JT
CHECKED: BH
APPROVED: JG
DATE: 29/03/2018
DRAFT REF: 2-WBW-d7

CLIENT: WILLUNGA BASIN WATER
PROJECT: SRWRA STORAGE
CONCEPT DESIGN PLAN WITH MOUNDS
DRAWING No. 14689-SK017
SHEET 1 OF 1
REVISION 3

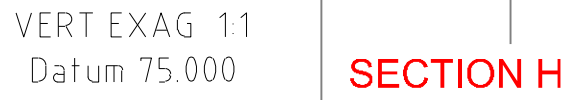
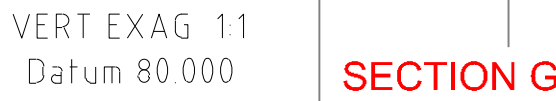


0	??/09/2018	JT	JG/BH	FOR DISCUSSION	-				-
REV	ISSUED	D.DWN	APRVD	REVISION DESCRIPTION	REV	ISSUED	D.DWN	APRVD	REVISION DESCRIPTION

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The arrangement and general details as shown on this drawing are essentially diagrammatic and must be applied to the circumstances as found on site.		SHEET 2 OF 3 REVISION 0

[illegible]

Field Odour Intensity Observation Log Sheet

Panelist Name: Johan Meline
 Date: 16/08/2018
 Start Time: 6:59
 Site Code: 1 Aldinga Storage Basin
 GPS Location: X: 271,302 Y: 6,091,617 54H

Wind Speed: near calm
 Wind Direction: N
 Temperature: 9 °C

Intensity Scale:

0	1	2	3	4	5	6
Not Detectable	Very Weak	Weak	Distinct	Strong	Very Strong	Extremely Strong

Perceived Odour Source:

Targeted odour: treated water storage odour

Photo:
 (in Wdir blowing from)



Time	Intensity	Source	Time	Intensity	Source	Time	Intensity	Source
0:10	0		3:30	0		6:50	0	
0:20	0		3:40	0		7:00	0	
0:30	0		3:50	0		7:10	0	
0:40	0		4:00	0		7:20	0	
0:50	0		4:10	0		7:30	0	
1:00	0		4:20	0		7:40	0	
1:10	0		4:30	0		7:50	0	
1:20	0		4:40	0		8:00	0	
1:30	0		4:50	0		8:10	0	
1:40	0		5:00	0		8:20	0	
1:50	0		5:10	0		8:30	0	
2:00	0		5:20	0		8:40	0	
2:10	0		5:30	0		8:50	0	
2:20	0		5:40	0		9:00	0	
2:30	0		5:50	0		9:10	0	
2:40	0		6:00	0		9:20	0	
2:50	0		6:10	0		9:30	0	
3:00	0		6:20	0		9:40	0	
3:10	0		6:30	0		9:50	0	
3:20	0		6:40	0		10:00	0	

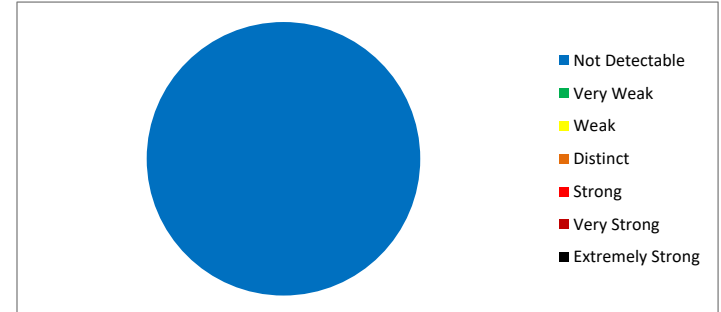
Colour coding of intensity observations:

0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

Summary odour intensity observations:

Intensity	No obs	%	Descriptor
0	60	100%	Not Detectable
1	0	0%	Very Weak
2	0	0%	Weak
3	0	0%	Distinct
4	0	0%	Strong
5	0	0%	Very Strong
6	0	0%	Extremely Strong
	60	100%	

Plot of percentages of odour intensity observations:



Field Odour Intensity Observation Log Sheet

Panelist Name: Johan Meline
 Date: 16/08/2018
 Start Time: 7:19
 Site Code: 2 Aldinga Storage Basin
 GPS Location: X: 271,037 Y: 6,091,175 54H

Wind Speed: near calm
 Wind Direction: N
 Temperature: 9 °C

Intensity Scale:

0	1	2	3	4	5	6
Not Detectable	Very Weak	Weak	Distinct	Strong	Very Strong	Extremely Strong

Perceived Odour Source:

Targeted odour: treated water storage odour

Photo:
 (in Wdir blowing from)



Time	Intensity	Source	Time	Intensity	Source	Time	Intensity	Source
0:10	0		3:30	0		6:50	0	
0:20	0		3:40	0		7:00	0	
0:30	0		3:50	0		7:10	0	
0:40	0		4:00	0		7:20	0	
0:50	0		4:10	0		7:30	0	
1:00	0		4:20	0		7:40	0	
1:10	0		4:30	0		7:50	0	
1:20	0		4:40	0		8:00	0	
1:30	0		4:50	0		8:10	0	
1:40	0		5:00	0		8:20	0	
1:50	0		5:10	0		8:30	0	
2:00	0		5:20	0		8:40	0	
2:10	0		5:30	0		8:50	0	
2:20	0		5:40	0		9:00	0	
2:30	0		5:50	0		9:10	0	
2:40	0		6:00	0		9:20	0	
2:50	0		6:10	0		9:30	0	
3:00	0		6:20	0		9:40	0	
3:10	0		6:30	0		9:50	0	
3:20	0		6:40	0		10:00	0	

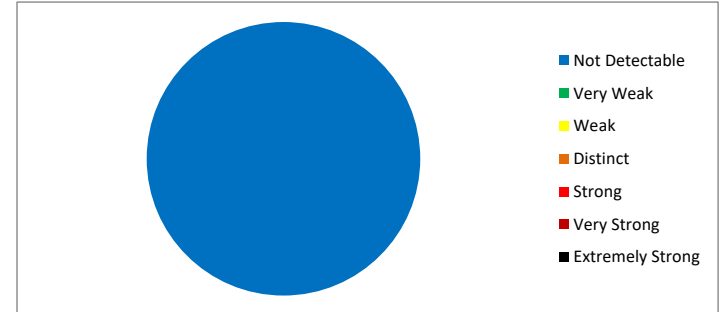
Colour coding of intensity observations:

0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

Summary odour intensity observations:

Intensity	No obs	%	Descriptor
0	60	100%	Not Detectable
1	0	0%	Very Weak
2	0	0%	Weak
3	0	0%	Distinct
4	0	0%	Strong
5	0	0%	Very Strong
6	0	0%	Extremely Strong
	60	100%	

Plot of percentages of odour intensity observations:



Field Odour Intensity Observation Log Sheet

Panelist Name: Johan Meline
 Date: 16/08/2018
 Start Time: 7:28
 Site Code: 3 Aldinga Storage Basin
 GPS Location: X: 271,121 Y: 6,091,184 54H

Wind Speed: near calm
 Wind Direction: N
 Temperature: 9 °C

Intensity Scale:

0	1	2	3	4	5	6
Not Detectable	Very Weak	Weak	Distinct	Strong	Very Strong	Extremely Strong

Perceived Odour Source:

Targeted odour: treated water storage odour

Photo:

(in Wdir blowing from)



Time	Intensity	Source	Time	Intensity	Source	Time	Intensity	Source
0:10	0		3:30	0		6:50	0	
0:20	0		3:40	0		7:00	0	
0:30	0		3:50	0		7:10	0	
0:40	0		4:00	0		7:20	0	
0:50	0		4:10	0		7:30	0	
1:00	0		4:20	0		7:40	0	
1:10	0		4:30	0		7:50	0	
1:20	0		4:40	0		8:00	0	
1:30	0		4:50	0		8:10	0	
1:40	0		5:00	0		8:20	0	
1:50	0		5:10	0		8:30	0	
2:00	0		5:20	0		8:40	0	
2:10	0		5:30	0		8:50	0	
2:20	0		5:40	0		9:00	0	
2:30	0		5:50	0		9:10	0	
2:40	0		6:00	0		9:20	0	
2:50	0		6:10	0		9:30	0	
3:00	0		6:20	0		9:40	0	
3:10	0		6:30	0		9:50	0	
3:20	0		6:40	0		10:00	0	

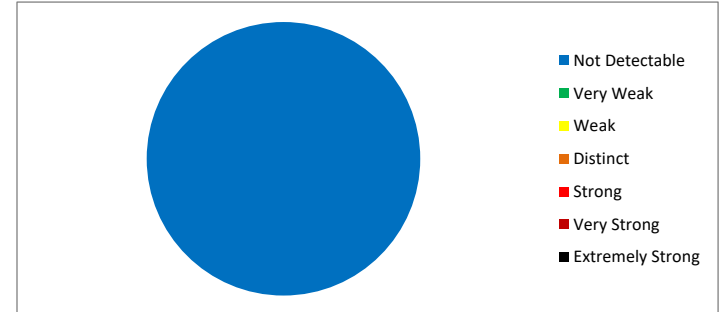
Colour coding of intensity observations:

0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

Summary odour intensity observations:

Intensity	No obs	%	Descriptor
0	60	100%	Not Detectable
1	0	0%	Very Weak
2	0	0%	Weak
3	0	0%	Distinct
4	0	0%	Strong
5	0	0%	Very Strong
6	0	0%	Extremely Strong
	60	100%	

Plot of percentages of odour intensity observations:



Field Odour Intensity Observation Log Sheet

Panelist Name: Johan Meline
 Date: 16/08/2018
 Start Time: 8:08
 Site Code: 4 Aldinga Storage Basin
 GPS Location: X: 271,150 Y: 6,091,185 54H

Wind Speed: near calm
 Wind Direction: N
 Temperature: 10 °C

Intensity Scale:

0	1	2	3	4	5	6
Not Detectable	Very Weak	Weak	Distinct	Strong	Very Strong	Extremely Strong

Perceived Odour Source:

Targeted odour: treated water storage odour

Photo:
 (in Wdir blowing from)



Time	Intensity	Source	Time	Intensity	Source	Time	Intensity	Source
0:10	0		3:30	0		6:50	0	
0:20	0		3:40	0		7:00	0	
0:30	0		3:50	0		7:10	0	
0:40	0		4:00	0		7:20	0	
0:50	0		4:10	0		7:30	0	
1:00	0		4:20	0		7:40	0	
1:10	0		4:30	0		7:50	0	
1:20	0		4:40	0		8:00	0	
1:30	0		4:50	0		8:10	0	
1:40	0		5:00	0		8:20	0	
1:50	0		5:10	0		8:30	0	
2:00	0		5:20	0		8:40	0	
2:10	0		5:30	0		8:50	0	
2:20	0		5:40	0		9:00	0	
2:30	0		5:50	0		9:10	0	
2:40	0		6:00	0		9:20	0	
2:50	0		6:10	0		9:30	0	
3:00	0		6:20	0		9:40	0	
3:10	0		6:30	0		9:50	0	
3:20	0		6:40	0		10:00	0	

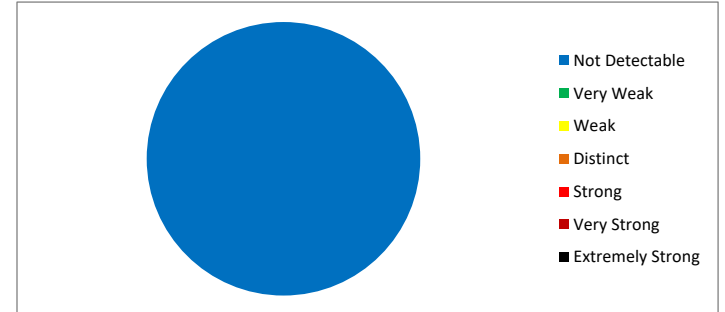
Colour coding of intensity observations:

0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

Summary odour intensity observations:

Intensity	No obs	%	Descriptor
0	60	100%	Not Detectable
1	0	0%	Very Weak
2	0	0%	Weak
3	0	0%	Distinct
4	0	0%	Strong
5	0	0%	Very Strong
6	0	0%	Extremely Strong
	60	100%	

Plot of percentages of odour intensity observations:



Field Odour Intensity Observation Log Sheet

Panelist Name: Johan Meline
 Date: 16/08/2018
 Start Time: 9:00
 Site Code: 5 Quarry Road Storage Dam
 GPS Location: X: 272,574 Y: 6,102,913 54H
 Intensity Scale:

Wind Speed: 1-2 m/s
 Wind Direction: WSW
 Temperature: 11 °C

Photo:
 (in Wdir blowing from)



0	1	2	3	4	5	6
Not Detectable	Very Weak	Weak	Distinct	Strong	Very Strong	Extremely Strong

Perceived Odour Source:
 Targeted odour: treated water storage odour

Time	Intensity	Source	Time	Intensity	Source	Time	Intensity	Source
0:10	0		3:30	2		6:50	1	
0:20	2		3:40	2		7:00	1	
0:30	0		3:50	0		7:10	0	
0:40	1		4:00	1		7:20	0	
0:50	0		4:10	2		7:30	0	
1:00	0		4:20	0		7:40	0	
1:10	0		4:30	0		7:50	0	
1:20	0		4:40	0		8:00	1	
1:30	1		4:50	0		8:10	2	
1:40	0		5:00	0		8:20	1	
1:50	0		5:10	2		8:30	0	
2:00	0		5:20	0		8:40	0	
2:10	0		5:30	0		8:50	0	
2:20	0		5:40	0		9:00	0	
2:30	0		5:50	0		9:10	0	
2:40	0		6:00	0		9:20	0	
2:50	0		6:10	0		9:30	2	
3:00	0		6:20	0		9:40	1	
3:10	0		6:30	0		9:50	0	
3:20	0		6:40	2		10:00	0	

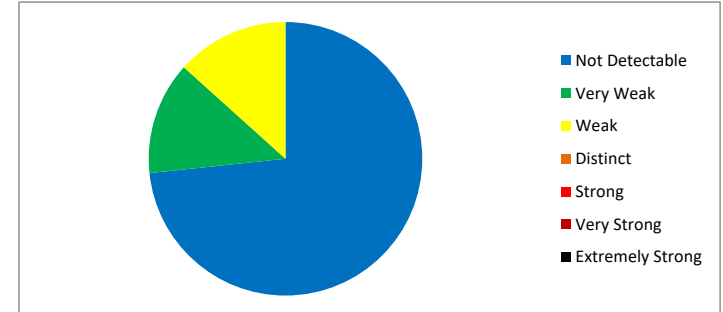
Colour coding of intensity observations:

0	0	2	0	2
2	0	0	0	1
0	0	0	0	0
1	0	0	2	0
0	0	0	1	0
0	0	0	1	0
0	0	2	0	0
0	0	0	0	0
1	2	0	0	2
0	2	0	0	1
0	0	0	0	0
0	1	0	1	0

Summary odour intensity observations:

Intensity	No obs	%	Descriptor
0	44	73%	Not Detectable
1	8	13%	Very Weak
2	8	13%	Weak
3	0	0%	Distinct
4	0	0%	Strong
5	0	0%	Very Strong
6	0	0%	Extremely Strong
60		100%	

Plot of percentages of odour intensity observations:



Field Odour Intensity Observation Log Sheet

Panelist Name: Johan Meline
 Date: 16/08/2018
 Start Time: 9:11
 Site Code: 6 Quarry Road Storage Dam
 GPS Location: X: 272,596 Y: 6,102,920 54H

Wind Speed: 1-2 m/s
 Wind Direction: WSW
 Temperature: 11 °C

Intensity Scale:

0	1	2	3	4	5	6
Not Detectable	Very Weak	Weak	Distinct	Strong	Very Strong	Extremely Strong

Perceived Odour Source:

Targeted odour: treated water storage odour

Photo:

(in Wdir blowing from)



Time	Intensity	Source	Time	Intensity	Source	Time	Intensity	Source
0:10	0		3:30	0		6:50	0	
0:20	0		3:40	0		7:00	0	
0:30	0		3:50	0		7:10	2	
0:40	0		4:00	0		7:20	1	
0:50	0		4:10	0		7:30	1	
1:00	0		4:20	0		7:40	0	
1:10	0		4:30	0		7:50	0	
1:20	1		4:40	0		8:00	0	
1:30	0		4:50	0		8:10	0	
1:40	0		5:00	0		8:20	0	
1:50	0		5:10	0		8:30	0	
2:00	0		5:20	0		8:40	0	
2:10	0		5:30	0		8:50	0	
2:20	0		5:40	0		9:00	0	
2:30	1		5:50	0		9:10	0	
2:40	0		6:00	1		9:20	0	
2:50	0		6:10	2		9:30	0	
3:00	0		6:20	0		9:40	0	
3:10	0		6:30	0		9:50	0	
3:20	0		6:40	0		10:00	0	

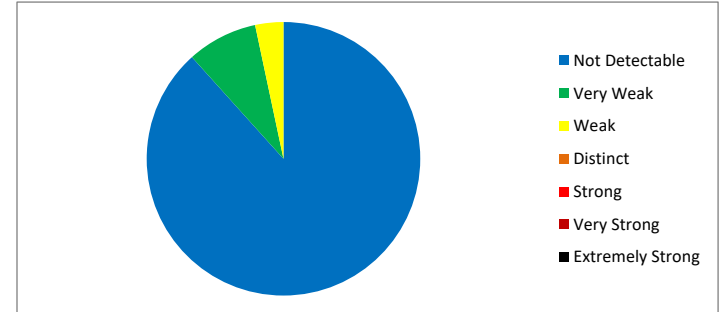
Colour coding of intensity observations:

0	0	0	2	0
0	0	0	0	0
0	1	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	2	0
1	0	0	1	0
0	0	0	1	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	1	0	0

Summary odour intensity observations:

Intensity	No obs	%	Descriptor
0	53	88%	Not Detectable
1	5	8%	Very Weak
2	2	3%	Weak
3	0	0%	Distinct
4	0	0%	Strong
5	0	0%	Very Strong
6	0	0%	Extremely Strong
60		100%	

Plot of percentages of odour intensity observations:



Field Odour Intensity Observation Log Sheet

Panelist Name: Johan Meline
 Date: 16/08/2018
 Start Time: 9:22
 Site Code: 7 Quarry Road Storage Dam
 GPS Location: X: 272,599 Y: 6,102,903 54H
 Intensity Scale:

Wind Speed: 1-2 m/s
 Wind Direction: WSW
 Temperature: 12 °C

Photo:
 (in Wdir blowing from)



0	1	2	3	4	5	6
Not Detectable	Very Weak	Weak	Distinct	Strong	Very Strong	Extremely Strong

Perceived Odour Source:

Targeted odour: treated water storage odour

Time	Intensity	Source	Time	Intensity	Source	Time	Intensity	Source
0:10	2		3:30	0		6:50	0	
0:20	2		3:40	0		7:00	0	
0:30	0		3:50	0		7:10	0	
0:40	0		4:00	0		7:20	0	
0:50	0		4:10	0		7:30	0	
1:00	0		4:20	0		7:40	0	
1:10	0		4:30	0		7:50	0	
1:20	0		4:40	1		8:00	0	
1:30	0		4:50	0		8:10	1	
1:40	0		5:00	0		8:20	0	
1:50	0		5:10	0		8:30	0	
2:00	0		5:20	0		8:40	0	
2:10	0		5:30	0		8:50	0	
2:20	2		5:40	0		9:00	0	
2:30	0		5:50	0		9:10	0	
2:40	0		6:00	1		9:20	0	
2:50	0		6:10	0		9:30	0	
3:00	0		6:20	0		9:40	0	
3:10	0		6:30	0		9:50	0	
3:20	0		6:40	0		10:00	0	

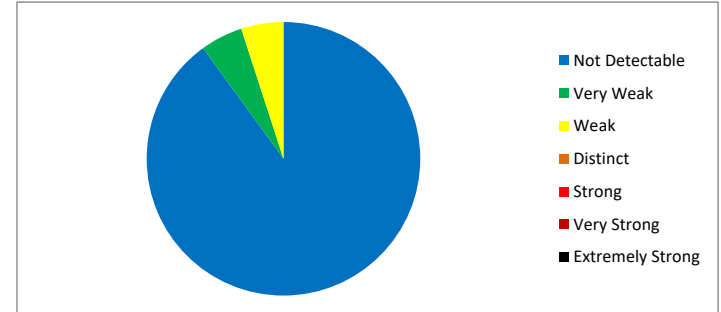
Colour coding of intensity observations:

2	0	0	0	1
2	2	0	0	0
0	0	0	0	0
0	0	1	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	1	0	0

Summary odour intensity observations:

Intensity	No obs	%	Descriptor
0	54	90%	Not Detectable
1	3	5%	Very Weak
2	3	5%	Weak
3	0	0%	Distinct
4	0	0%	Strong
5	0	0%	Very Strong
6	0	0%	Extremely Strong
	60	100%	

Plot of percentages of odour intensity observations:



Field Odour Intensity Observation Log Sheet

Panelist Name: Johan Meline
 Date: 16/08/2018
 Start Time: 9:34
 Site Code: 8 Quarry Road Storage Dam
 GPS Location: X: 272,601 Y: 6,102,864 54H
 Intensity Scale:

Wind Speed: 1-2 m/s
 Wind Direction: WSW
 Temperature: 12 °C

Photo:
 (in Wdir blowing from)



0	1	2	3	4	5	6
Not Detectable	Very Weak	Weak	Distinct	Strong	Very Strong	Extremely Strong

Perceived Odour Source:

Targeted odour: treated water storage odour

Time	Intensity	Source	Time	Intensity	Source	Time	Intensity	Source
0:10	0		3:30	1		6:50	0	
0:20	0		3:40	2		7:00	1	
0:30	0		3:50	1		7:10	0	
0:40	2		4:00	0		7:20	0	
0:50	2		4:10	0		7:30	0	
1:00	0		4:20	0		7:40	0	
1:10	0		4:30	1		7:50	0	
1:20	0		4:40	0		8:00	0	
1:30	0		4:50	0		8:10	0	
1:40	0		5:00	0		8:20	0	
1:50	1		5:10	0		8:30	0	
2:00	0		5:20	0		8:40	0	
2:10	0		5:30	0		8:50	0	
2:20	0		5:40	0		9:00	0	
2:30	1		5:50	0		9:10	0	
2:40	0		6:00	0		9:20	0	
2:50	0		6:10	2		9:30	0	
3:00	0		6:20	0		9:40	1	
3:10	0		6:30	0		9:50	0	
3:20	0		6:40	0		10:00	0	

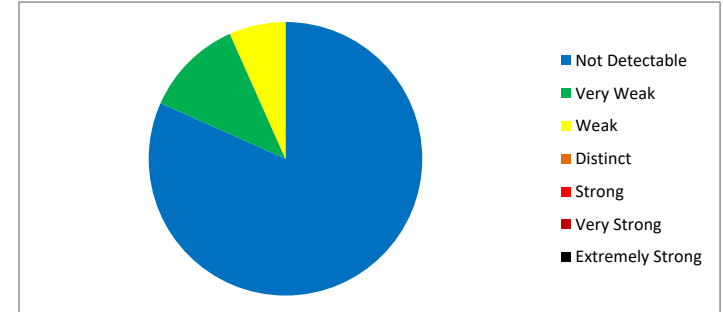
Colour coding of intensity observations:

0	0	0	2	0
0	0	0	0	0
0	1	1	0	0
2	0	0	0	0
2	0	0	0	0
0	0	0	1	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	1	0	0	0
0	2	0	0	1
1	1	0	0	0
0	0	0	0	0

Summary odour intensity observations:

Intensity	No obs	%	Descriptor
0	49	82%	Not Detectable
1	7	12%	Very Weak
2	4	7%	Weak
3	0	0%	Distinct
4	0	0%	Strong
5	0	0%	Very Strong
6	0	0%	Extremely Strong
60		100%	

Plot of percentages of odour intensity observations:



Field Odour Intensity Observation Log Sheet

Panelist Name: Johan Meline
 Date: 16/08/2018
 Start Time: 9:45
 Site Code: 9 Quarry Road Storage Dam
 GPS Location: X: 272,587 Y: 6,102,873 54H

Wind Speed: 1-2 m/s
 Wind Direction: WSW
 Temperature: 13 °C

Photo:
 (in Wdir blowing from)



0	1	2	3	4	5	6
Not Detectable	Very Weak	Weak	Distinct	Strong	Very Strong	Extremely Strong

Perceived Odour Source:

Targeted odour: treated water storage odour

Time	Intensity	Source	Time	Intensity	Source	Time	Intensity	Source
0:10	0		3:30	0		6:50	1	
0:20	0		3:40	0		7:00	1	
0:30	1		3:50	0		7:10	2	
0:40	1		4:00	1		7:20	0	
0:50	0		4:10	2		7:30	0	
1:00	0		4:20	0		7:40	0	
1:10	0		4:30	1		7:50	0	
1:20	0		4:40	2		8:00	0	
1:30	0		4:50	0		8:10	0	
1:40	0		5:00	0		8:20	0	
1:50	1		5:10	0		8:30	0	
2:00	2		5:20	0		8:40	0	
2:10	1		5:30	0		8:50	0	
2:20	0		5:40	0		9:00	1	
2:30	1		5:50	0		9:10	1	
2:40	0		6:00	0		9:20	0	
2:50	2		6:10	0		9:30	1	
3:00	0		6:20	0		9:40	0	
3:10	0		6:30	0		9:50	1	
3:20	0		6:40	0		10:00	1	

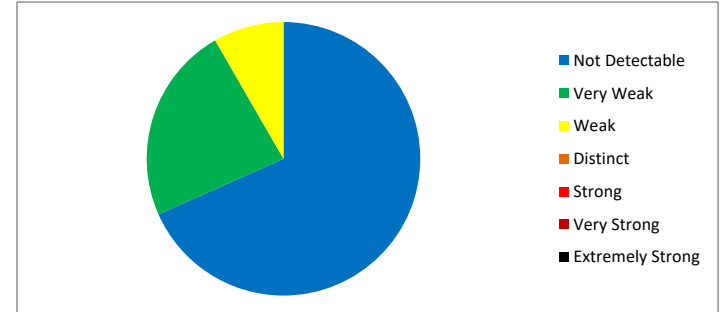
Colour coding of intensity observations:

0	1	2	0	0
0	0	0	0	0
1	1	1	0	0
1	0	2	0	0
0	2	0	1	0
0	0	0	1	1
0	0	0	2	1
0	0	0	0	0
0	0	0	0	1
0	0	0	0	0
1	0	0	0	1
2	1	0	0	1

Summary odour intensity observations:

Intensity	No obs	%	Descriptor
0	41	68%	Not Detectable
1	14	23%	Very Weak
2	5	8%	Weak
3	0	0%	Distinct
4	0	0%	Strong
5	0	0%	Very Strong
6	0	0%	Extremely Strong
60		100%	

Plot of percentages of odour intensity observations:



Field Odour Intensity Observation Log Sheet

Panelist Name: Johan Meline
 Date: 16/08/2018
 Start Time: 9:57
 Site Code: 10 Quarry Road Storage Dam
 GPS Location: X: 272,487 Y: 6,102,910 54H
 Intensity Scale:

Wind Speed: 1-2 m/s
 Wind Direction: WSW
 Temperature: 13 °C

Photo:
 (in Wdir blowing from)

0	1	2	3	4	5	6
Not Detectable	Very Weak	Weak	Distinct	Strong	Very Strong	Extremely Strong

Perceived Odour Source:

Targeted odour: treated water storage odour



Time	Intensity	Source	Time	Intensity	Source	Time	Intensity	Source
0:10	0		3:30	0		6:50	0	
0:20	0		3:40	0		7:00	0	
0:30	0		3:50	0		7:10	0	
0:40	0		4:00	0		7:20	0	
0:50	0		4:10	0		7:30	0	
1:00	0		4:20	0		7:40	0	
1:10	0		4:30	0		7:50	0	
1:20	0		4:40	0		8:00	0	
1:30	0		4:50	0		8:10	0	
1:40	0		5:00	0		8:20	0	
1:50	0		5:10	0		8:30	0	
2:00	0		5:20	0		8:40	0	
2:10	0		5:30	0		8:50	0	
2:20	0		5:40	0		9:00	0	
2:30	0		5:50	0		9:10	0	
2:40	0		6:00	0		9:20	0	
2:50	0		6:10	0		9:30	0	
3:00	0		6:20	0		9:40	0	
3:10	0		6:30	0		9:50	0	
3:20	0		6:40	0		10:00	0	

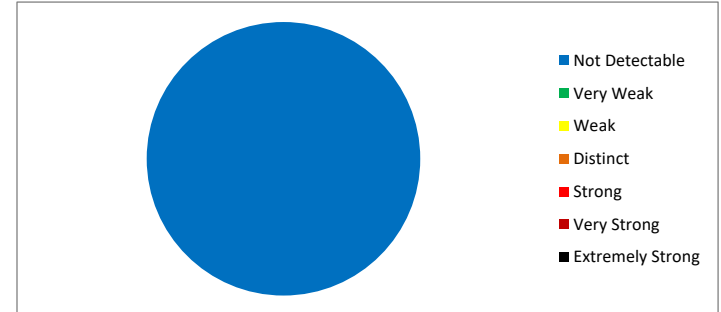
Colour coding of intensity observations:

0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

Summary odour intensity observations:

Intensity	No obs	%	Descriptor
0	60	100%	Not Detectable
1	0	0%	Very Weak
2	0	0%	Weak
3	0	0%	Distinct
4	0	0%	Strong
5	0	0%	Very Strong
6	0	0%	Extremely Strong
	60	100%	

Plot of percentages of odour intensity observations:



Field Odour Intensity Observation Log Sheet

Panelist Name: Johan Meline
 Date: 16/08/2018
 Start Time: 10:10
 Site Code: 11 Quarry Road Storage Dam
 GPS Location: X: 272,597 Y: 6,102,935 54H

Wind Speed: 1-2 m/s
 Wind Direction: WSW
 Temperature: 13 °C

Photo:
 (in Wdir blowing from)



0	1	2	3	4	5	6
Not Detectable	Very Weak	Weak	Distinct	Strong	Very Strong	Extremely Strong

Perceived Odour Source:

Targeted odour: treated water storage odour

Time	Intensity	Source	Time	Intensity	Source	Time	Intensity	Source
0:10	0		3:30	0		6:50	0	
0:20	0		3:40	0		7:00	0	
0:30	0		3:50	0		7:10	1	
0:40	0		4:00	0		7:20	0	
0:50	0		4:10	0		7:30	0	
1:00	0		4:20	0		7:40	0	
1:10	0		4:30	0		7:50	0	
1:20	0		4:40	0		8:00	0	
1:30	0		4:50	0		8:10	0	
1:40	0		5:00	0		8:20	0	
1:50	0		5:10	0		8:30	0	
2:00	0		5:20	0		8:40	0	
2:10	0		5:30	0		8:50	0	
2:20	0		5:40	0		9:00	0	
2:30	0		5:50	0		9:10	0	
2:40	0		6:00	0		9:20	0	
2:50	0		6:10	0		9:30	0	
3:00	0		6:20	0		9:40	0	
3:10	0		6:30	0		9:50	0	
3:20	0		6:40	0		10:00	0	

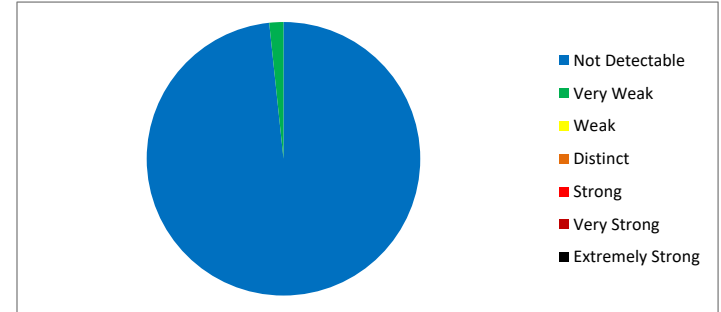
Colour coding of intensity observations:

0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	1	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

Summary odour intensity observations:

Intensity	No obs	%	Descriptor
0	59	98%	Not Detectable
1	1	2%	Very Weak
2	0	0%	Weak
3	0	0%	Distinct
4	0	0%	Strong
5	0	0%	Very Strong
6	0	0%	Extremely Strong
60		100%	

Plot of percentages of odour intensity observations:



Field Odour Intensity Observation Log Sheet

Panelist Name: Johan Meline
 Date: 16/08/2018
 Start Time: 10:21
 Site Code: 12 Quarry Road Storage Dam
 GPS Location: X: 272,566 Y: 6,102,937 54H

Wind Speed: 1-2 m/s
 Wind Direction: WSW
 Temperature: 13 °C

Intensity Scale:

0	1	2	3	4	5	6
Not Detectable	Very Weak	Weak	Distinct	Strong	Very Strong	Extremely Strong

Perceived Odour Source:

Targeted odour: treated water storage odour

Photo:
 (in Wdir blowing from)



Time	Intensity	Source	Time	Intensity	Source	Time	Intensity	Source
0:10	0		3:30	0		6:50	0	
0:20	0		3:40	0		7:00	0	
0:30	0		3:50	0		7:10	0	
0:40	0		4:00	0		7:20	0	
0:50	0		4:10	0		7:30	0	
1:00	0		4:20	0		7:40	0	
1:10	0		4:30	0		7:50	0	
1:20	0		4:40	0		8:00	0	
1:30	0		4:50	0		8:10	0	
1:40	0		5:00	0		8:20	0	
1:50	0		5:10	0		8:30	0	
2:00	0		5:20	0		8:40	0	
2:10	0		5:30	0		8:50	0	
2:20	0		5:40	0		9:00	0	
2:30	0		5:50	0		9:10	0	
2:40	0		6:00	0		9:20	0	
2:50	0		6:10	0		9:30	0	
3:00	0		6:20	0		9:40	0	
3:10	0		6:30	0		9:50	0	
3:20	0		6:40	0		10:00	0	

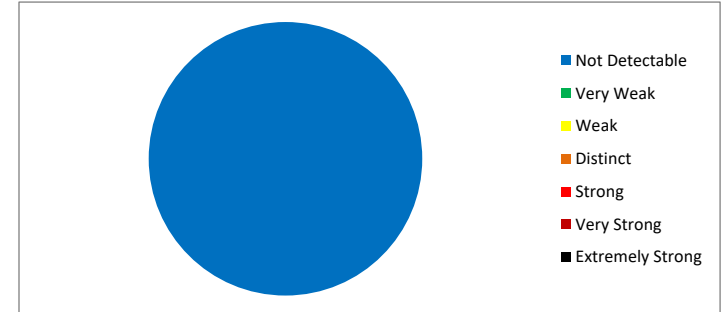
Colour coding of intensity observations:

0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

Summary odour intensity observations:

Intensity	No obs	%	Descriptor
0	60	100%	Not Detectable
1	0	0%	Very Weak
2	0	0%	Weak
3	0	0%	Distinct
4	0	0%	Strong
5	0	0%	Very Strong
6	0	0%	Extremely Strong
	60	100%	

Plot of percentages of odour intensity observations:



Field Odour Intensity Observation Log Sheet

Panelist Name: Johan Meline
 Date: 16/08/2018
 Start Time: 14:41
 Site Code: 13 Little Road Storage Dam
 GPS Location: X: 275,942 Y: 6,095,083 54H
 Intensity Scale:

Wind Speed: 1-3 m/s
 Wind Direction: NW
 Temperature: 13 °C

Photo:
 (in Wdir blowing from)



0	1	2	3	4	5	6
Not Detectable	Very Weak	Weak	Distinct	Strong	Very Strong	Extremely Strong

Perceived Odour Source:

Targeted odour: treated water storage odour

Time	Intensity	Source	Time	Intensity	Source	Time	Intensity	Source
0:10	0		3:30	0		6:50	0	
0:20	0		3:40	0		7:00	0	
0:30	0		3:50	0		7:10	0	
0:40	0		4:00	0		7:20	0	
0:50	0		4:10	0		7:30	0	
1:00	0		4:20	0		7:40	0	
1:10	0		4:30	0		7:50	0	
1:20	0		4:40	0		8:00	0	
1:30	0		4:50	0		8:10	0	
1:40	0		5:00	0		8:20	0	
1:50	0		5:10	0		8:30	0	
2:00	0		5:20	0		8:40	0	
2:10	0		5:30	0		8:50	0	
2:20	0		5:40	0		9:00	0	
2:30	0		5:50	0		9:10	0	
2:40	0		6:00	0		9:20	0	
2:50	0		6:10	0		9:30	0	
3:00	0		6:20	0		9:40	0	
3:10	0		6:30	0		9:50	0	
3:20	0		6:40	0		10:00	0	

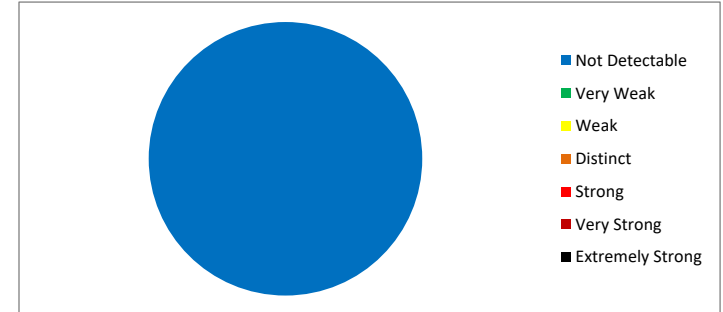
Colour coding of intensity observations:

0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

Summary odour intensity observations:

Intensity	No obs	%	Descriptor
0	60	100%	Not Detectable
1	0	0%	Very Weak
2	0	0%	Weak
3	0	0%	Distinct
4	0	0%	Strong
5	0	0%	Very Strong
6	0	0%	Extremely Strong
	60	100%	

Plot of percentages of odour intensity observations:



Field Odour Intensity Observation Log Sheet

Panelist Name: Johan Meline
 Date: 16/08/2018
 Start Time: 14:59
 Site Code: 14 Little Road Storage Dam
 GPS Location: X: 275,983 Y: 6,094,910 54H

Wind Speed: 1-3 m/s
 Wind Direction: NW
 Temperature: 13 °C

Photo:
 (in Wdir blowing from)



0	1	2	3	4	5	6
Not Detectable	Very Weak	Weak	Distinct	Strong	Very Strong	Extremely Strong

Perceived Odour Source:

Targeted odour: treated water storage odour

Time	Intensity	Source	Time	Intensity	Source	Time	Intensity	Source
0:10	0		3:30	0		6:50	0	
0:20	0		3:40	0		7:00	0	
0:30	0		3:50	0		7:10	0	
0:40	0		4:00	0		7:20	0	
0:50	0		4:10	0		7:30	0	
1:00	0		4:20	0		7:40	1	
1:10	0		4:30	1		7:50	0	
1:20	0		4:40	0		8:00	0	
1:30	0		4:50	0		8:10	0	
1:40	0		5:00	0		8:20	0	
1:50	0		5:10	0		8:30	0	
2:00	0		5:20	0		8:40	0	
2:10	0		5:30	0		8:50	0	
2:20	0		5:40	0		9:00	0	
2:30	0		5:50	0		9:10	0	
2:40	0		6:00	0		9:20	0	
2:50	0		6:10	1		9:30	0	
3:00	0		6:20	0		9:40	0	
3:10	1		6:30	0		9:50	0	
3:20	0		6:40	0		10:00	0	

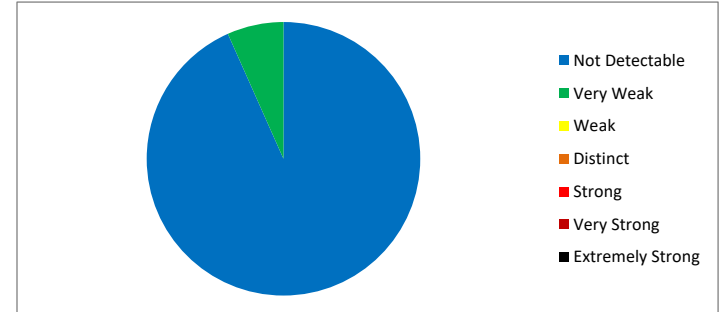
Colour coding of intensity observations:

0	0	0	1	0
0	0	0	0	0
0	0	1	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	1	0	0	0
0	0	0	0	0
0	0	0	1	0
0	0	0	0	0
0	0	0	0	0

Summary odour intensity observations:

Intensity	No obs	%	Descriptor
0	56	93%	Not Detectable
1	4	7%	Very Weak
2	0	0%	Weak
3	0	0%	Distinct
4	0	0%	Strong
5	0	0%	Very Strong
6	0	0%	Extremely Strong
60		100%	

Plot of percentages of odour intensity observations:



Field Odour Intensity Observation Log Sheet

Panelist Name: Johan Meline
 Date: 16/08/2018
 Start Time: 15:10
 Site Code: 15 Little Road Storage Dam
 GPS Location: X: 275,997 Y: 6,094,837 54H
 Intensity Scale:

Wind Speed: 1-3 m/s
 Wind Direction: NW
 Temperature: 13 °C

Photo:
 (in Wdir blowing from)



0	1	2	3	4	5	6
Not Detectable	Very Weak	Weak	Distinct	Strong	Very Strong	Extremely Strong

Perceived Odour Source:

Targeted odour: treated water storage odour

Time	Intensity	Source	Time	Intensity	Source	Time	Intensity	Source
0:10	0		3:30	0		6:50	0	
0:20	0		3:40	0		7:00	0	
0:30	0		3:50	0		7:10	0	
0:40	0		4:00	0		7:20	0	
0:50	0		4:10	0		7:30	0	
1:00	0		4:20	0		7:40	0	
1:10	0		4:30	0		7:50	0	
1:20	0		4:40	0		8:00	0	
1:30	0		4:50	0		8:10	0	
1:40	0		5:00	0		8:20	0	
1:50	0		5:10	0		8:30	0	
2:00	0		5:20	0		8:40	0	
2:10	0		5:30	0		8:50	0	
2:20	0		5:40	0		9:00	0	
2:30	0		5:50	0		9:10	0	
2:40	0		6:00	0		9:20	0	
2:50	0		6:10	0		9:30	0	
3:00	0		6:20	0		9:40	0	
3:10	0		6:30	0		9:50	0	
3:20	0		6:40	0		10:00	0	

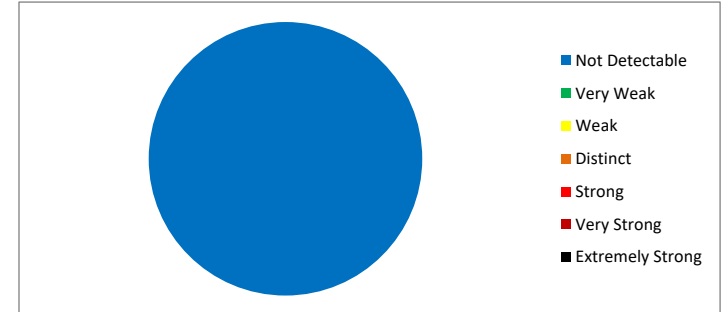
Colour coding of intensity observations:

0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

Summary odour intensity observations:

Intensity	No obs	%	Descriptor
0	60	100%	Not Detectable
1	0	0%	Very Weak
2	0	0%	Weak
3	0	0%	Distinct
4	0	0%	Strong
5	0	0%	Very Strong
6	0	0%	Extremely Strong
	60	100%	

Plot of percentages of odour intensity observations:



Field Odour Intensity Observation Log Sheet

Panelist Name: Johan Meline
 Date: 16/08/2018
 Start Time: 15:21
 Site Code: 16 Little Road Storage Dam
 GPS Location: X: 275,968 Y: 6,094,862 54H
 Intensity Scale:

Wind Speed: 1-3 m/s
 Wind Direction: NW
 Temperature: 13 °C

Photo:
 (in Wdir blowing from)



0	1	2	3	4	5	6
Not Detectable	Very Weak	Weak	Distinct	Strong	Very Strong	Extremely Strong

Perceived Odour Source:

Targeted odour: treated water storage odour

Time	Intensity	Source	Time	Intensity	Source	Time	Intensity	Source
0:10	1		3:30	0		6:50	0	
0:20	2		3:40	1		7:00	0	
0:30	0		3:50	0		7:10	0	
0:40	1		4:00	0		7:20	0	
0:50	0		4:10	1		7:30	0	
1:00	0		4:20	1		7:40	0	
1:10	0		4:30	0		7:50	0	
1:20	0		4:40	0		8:00	0	
1:30	0		4:50	0		8:10	1	
1:40	0		5:00	0		8:20	0	
1:50	0		5:10	0		8:30	0	
2:00	0		5:20	0		8:40	2	
2:10	0		5:30	0		8:50	0	
2:20	0		5:40	0		9:00	0	
2:30	0		5:50	0		9:10	0	
2:40	0		6:00	0		9:20	0	
2:50	0		6:10	0		9:30	0	
3:00	0		6:20	0		9:40	0	
3:10	0		6:30	1		9:50	0	
3:20	0		6:40	1		10:00	0	

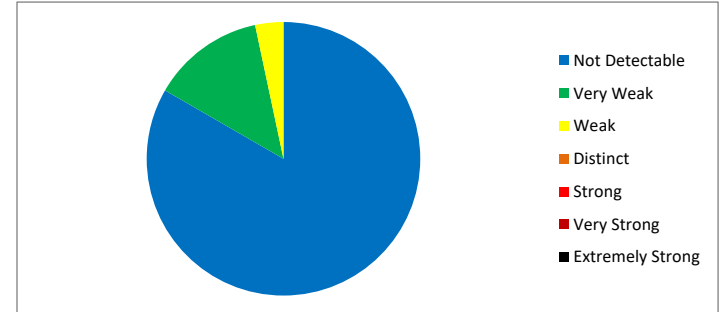
Colour coding of intensity observations:

1	0	1	0	1
2	0	1	0	0
0	0	0	1	0
1	0	0	1	2
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	1	0	0	0
0	0	0	0	0
0	0	0	0	0

Summary odour intensity observations:

Intensity	No obs	%	Descriptor
0	50	83%	Not Detectable
1	8	13%	Very Weak
2	2	3%	Weak
3	0	0%	Distinct
4	0	0%	Strong
5	0	0%	Very Strong
6	0	0%	Extremely Strong
	60	100%	

Plot of percentages of odour intensity observations:



Field Odour Intensity Observation Log Sheet

Panelist Name: Johan Meline
 Date: 16/08/2018
 Start Time: 15:37
 Site Code: 17 Little Road Storage Dam
 GPS Location: X: 275,959 Y: 6,094,885 54H
 Intensity Scale:

Wind Speed: 1-3 m/s
 Wind Direction: NW
 Temperature: 12 °C

Photo:
 (in Wdir blowing from)



0	1	2	3	4	5	6
Not Detectable	Very Weak	Weak	Distinct	Strong	Very Strong	Extremely Strong

Perceived Odour Source:
 Targeted odour: treated water storage odour

Time	Intensity	Source	Time	Intensity	Source	Time	Intensity	Source
0:10	0		3:30	1		6:50	0	
0:20	0		3:40	0		7:00	1	
0:30	0		3:50	0		7:10	1	
0:40	1		4:00	0		7:20	0	
0:50	0		4:10	0		7:30	0	
1:00	0		4:20	0		7:40	1	
1:10	0		4:30	1		7:50	0	
1:20	0		4:40	0		8:00	0	
1:30	0		4:50	0		8:10	0	
1:40	0		5:00	0		8:20	0	
1:50	1		5:10	0		8:30	0	
2:00	1		5:20	0		8:40	0	
2:10	1		5:30	0		8:50	0	
2:20	1		5:40	1		9:00	0	
2:30	1		5:50	0		9:10	0	
2:40	0		6:00	0		9:20	0	
2:50	0		6:10	0		9:30	1	
3:00	0		6:20	0		9:40	0	
3:10	1		6:30	0		9:50	0	
3:20	0		6:40	0		10:00	0	

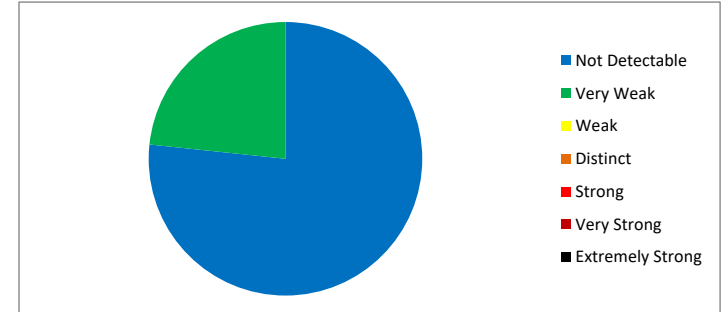
Colour coding of intensity observations:

0	1	0	0	0
0	1	0	0	0
0	1	1	0	0
1	0	0	0	0
0	0	0	0	0
0	0	0	1	0
0	1	0	1	0
0	0	0	0	0
0	1	0	0	1
0	0	1	1	0
1	0	0	0	0
1	0	0	0	0

Summary odour intensity observations:

Intensity	No obs	%	Descriptor
0	46	77%	Not Detectable
1	14	23%	Very Weak
2	0	0%	Weak
3	0	0%	Distinct
4	0	0%	Strong
5	0	0%	Very Strong
6	0	0%	Extremely Strong
60		100%	

Plot of percentages of odour intensity observations:



Field Odour Intensity Observation Log Sheet

Panelist Name: Johan Meline
 Date: 16/08/2018
 Start Time: 15:50
 Site Code: 18 Little Road Storage Dam
 GPS Location: X: 275,949 Y: 6,094,881 54H
 Intensity Scale:

Wind Speed: 1-3 m/s
 Wind Direction: NW
 Temperature: 12 °C

Photo:
 (in Wdir blowing from)



0	1	2	3	4	5	6
Not Detectable	Very Weak	Weak	Distinct	Strong	Very Strong	Extremely Strong

Perceived Odour Source:

Targeted odour: treated water storage odour

Time	Intensity	Source	Time	Intensity	Source	Time	Intensity	Source
0:10	0		3:30	1		6:50	0	
0:20	0		3:40	0		7:00	1	
0:30	1		3:50	0		7:10	0	
0:40	1		4:00	0		7:20	0	
0:50	0		4:10	1		7:30	0	
1:00	1		4:20	0		7:40	2	
1:10	0		4:30	0		7:50	1	
1:20	0		4:40	1		8:00	0	
1:30	0		4:50	2		8:10	0	
1:40	0		5:00	1		8:20	0	
1:50	1		5:10	0		8:30	1	
2:00	1		5:20	1		8:40	1	
2:10	1		5:30	1		8:50	1	
2:20	2		5:40	1		9:00	0	
2:30	0		5:50	0		9:10	1	
2:40	1		6:00	0		9:20	1	
2:50	0		6:10	0		9:30	1	
3:00	0		6:20	1		9:40	0	
3:10	1		6:30	1		9:50	1	
3:20	1		6:40	1		10:00	0	

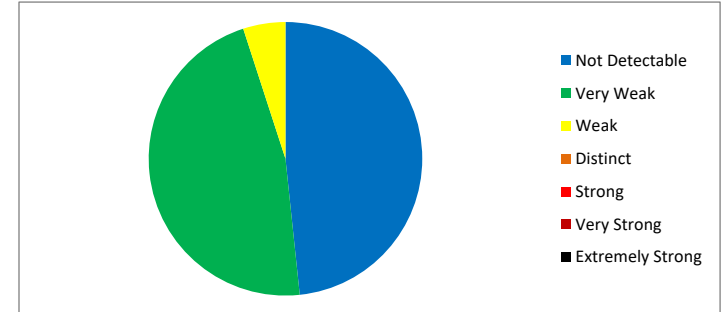
Colour coding of intensity observations:

0	1	1	0	0
0	2	0	1	0
1	0	0	1	1
1	1	1	1	1
0	0	2	0	1
1	0	1	1	0
0	1	0	0	1
0	1	1	0	1
0	1	1	0	1
0	0	1	2	0
1	0	0	1	1
1	0	0	0	0

Summary odour intensity observations:

Intensity	No obs	%	Descriptor
0	29	48%	Not Detectable
1	28	47%	Very Weak
2	3	5%	Weak
3	0	0%	Distinct
4	0	0%	Strong
5	0	0%	Very Strong
6	0	0%	Extremely Strong
60		100%	

Plot of percentages of odour intensity observations:



Field Odour Intensity Observation Log Sheet

Panelist Name: Johan Meline
 Date: 16/08/2018
 Start Time: 16:01
 Site Code: 19 Little Road Storage Dam
 GPS Location: X: 275,930 Y: 6,094,889 54H
 Intensity Scale:

Wind Speed: 2-4 m/s
 Wind Direction: NW
 Temperature: 12 °C

Photo:
 (in Wdir blowing from)



0	1	2	3	4	5	6
Not Detectable	Very Weak	Weak	Distinct	Strong	Very Strong	Extremely Strong

Perceived Odour Source:
 Targeted odour: treated water storage odour

Time	Intensity	Source	Time	Intensity	Source	Time	Intensity	Source
0:10	1		3:30	0		6:50	0	
0:20	1		3:40	2		7:00	0	
0:30	1		3:50	1		7:10	0	
0:40	1		4:00	1		7:20	0	
0:50	1		4:10	1		7:30	1	
1:00	1		4:20	1		7:40	1	
1:10	1		4:30	0		7:50	1	
1:20	1		4:40	1		8:00	1	
1:30	1		4:50	1		8:10	1	
1:40	1		5:00	1		8:20	1	
1:50	1		5:10	0		8:30	1	
2:00	1		5:20	1		8:40	0	
2:10	0		5:30	1		8:50	0	
2:20	0		5:40	2		9:00	0	
2:30	0		5:50	1		9:10	0	
2:40	1		6:00	1		9:20	0	
2:50	0		6:10	1		9:30	0	
3:00	1		6:20	0		9:40	1	
3:10	1		6:30	0		9:50	0	
3:20	1		6:40	0		10:00	0	

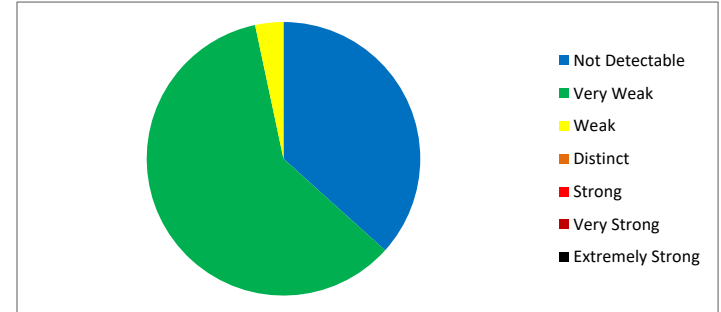
Colour coding of intensity observations:

1	0	1	1	1
1	0	1	0	1
1	0	0	0	1
1	1	1	0	0
1	0	1	0	0
1	1	1	0	0
1	1	0	0	0
1	1	1	0	0
1	0	1	1	0
1	2	2	1	1
1	1	1	1	0
1	1	1	1	0

Summary odour intensity observations:

Intensity	No obs	%	Descriptor
0	22	37%	Not Detectable
1	36	60%	Very Weak
2	2	3%	Weak
3	0	0%	Distinct
4	0	0%	Strong
5	0	0%	Very Strong
6	0	0%	Extremely Strong
60		100%	

Plot of percentages of odour intensity observations:



Field Odour Intensity Observation Log Sheet

Panelist Name: Johan Meline
 Date: 16/08/2018
 Start Time: 16:47
 Site Code: 20 Little Road Storage Dam
 GPS Location: X: 276,008 Y: 6,094,582 54H

Wind Speed: 2 m/s
 Wind Direction: NW
 Temperature: 12 °C

Intensity Scale:

0	1	2	3	4	5	6
Not Detectable	Very Weak	Weak	Distinct	Strong	Very Strong	Extremely Strong

Perceived Odour Source:

Targeted odour: treated water storage odour

Photo:

(in Wdir blowing from)



Time	Intensity	Source	Time	Intensity	Source	Time	Intensity	Source
0:10	0		3:30	0		6:50	0	
0:20	0		3:40	0		7:00	0	
0:30	0		3:50	0		7:10	0	
0:40	0		4:00	0		7:20	0	
0:50	0		4:10	0		7:30	0	
1:00	0		4:20	0		7:40	0	
1:10	0		4:30	0		7:50	0	
1:20	0		4:40	0		8:00	0	
1:30	0		4:50	0		8:10	0	
1:40	0		5:00	0		8:20	0	
1:50	0		5:10	0		8:30	0	
2:00	0		5:20	0		8:40	0	
2:10	0		5:30	0		8:50	0	
2:20	0		5:40	0		9:00	0	
2:30	0		5:50	0		9:10	0	
2:40	0		6:00	0		9:20	0	
2:50	0		6:10	0		9:30	0	
3:00	0		6:20	0		9:40	0	
3:10	0		6:30	0		9:50	0	
3:20	0		6:40	0		10:00	0	

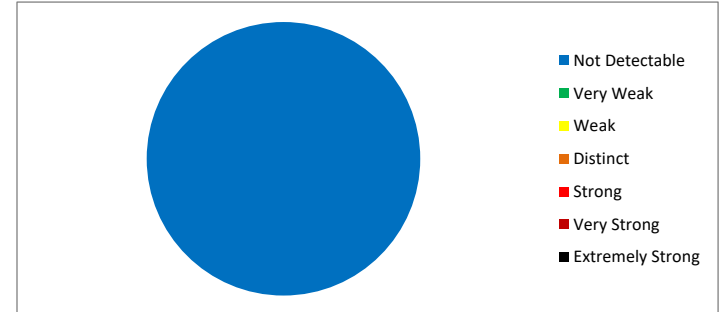
Colour coding of intensity observations:

0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

Summary odour intensity observations:

Intensity	No obs	%	Descriptor
0	60	100%	Not Detectable
1	0	0%	Very Weak
2	0	0%	Weak
3	0	0%	Distinct
4	0	0%	Strong
5	0	0%	Very Strong
6	0	0%	Extremely Strong
	60	100%	

Plot of percentages of odour intensity observations:



Field Odour Intensity Observation Log Sheet

Panelist Name: Johan Meline
 Date: 16/08/2018
 Start Time: 16:58
 Site Code: 21 Little Road Storage Dam
 GPS Location: X: 276,009 Y: 6,094,603 54H

Wind Speed: 2-3 m/s
 Wind Direction: NW
 Temperature: 12 °C

Intensity Scale:

0	1	2	3	4	5	6
Not Detectable	Very Weak	Weak	Distinct	Strong	Very Strong	Extremely Strong

Perceived Odour Source:

Targeted odour: treated water storage odour

Photo:

(in Wdir blowing from)



Time	Intensity	Source	Time	Intensity	Source	Time	Intensity	Source
0:10	0		3:30	0		6:50	0	
0:20	0		3:40	0		7:00	0	
0:30	0		3:50	0		7:10	0	
0:40	0		4:00	0		7:20	0	
0:50	0		4:10	0		7:30	0	
1:00	0		4:20	0		7:40	0	
1:10	0		4:30	0		7:50	0	
1:20	0		4:40	0		8:00	0	
1:30	0		4:50	0		8:10	0	
1:40	0		5:00	0		8:20	0	
1:50	0		5:10	0		8:30	0	
2:00	0		5:20	0		8:40	0	
2:10	0		5:30	0		8:50	0	
2:20	0		5:40	0		9:00	0	
2:30	0		5:50	0		9:10	0	
2:40	0		6:00	0		9:20	0	
2:50	0		6:10	0		9:30	0	
3:00	0		6:20	0		9:40	0	
3:10	0		6:30	0		9:50	0	
3:20	0		6:40	0		10:00	0	

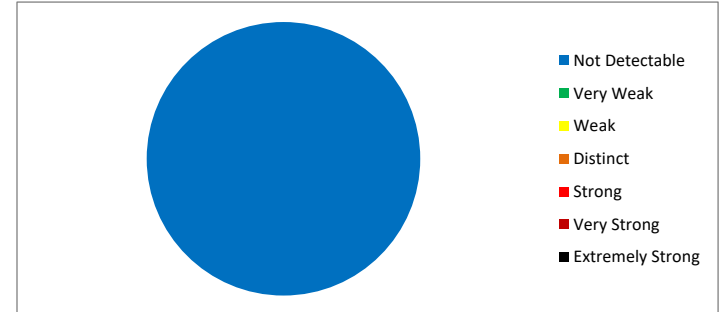
Colour coding of intensity observations:

0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

Summary odour intensity observations:

Intensity	No obs	%	Descriptor
0	60	100%	Not Detectable
1	0	0%	Very Weak
2	0	0%	Weak
3	0	0%	Distinct
4	0	0%	Strong
5	0	0%	Very Strong
6	0	0%	Extremely Strong
	60	100%	

Plot of percentages of odour intensity observations:





eA985824

Mr Craig Heidenreich
General Manager
Willunga Basin Water Company Pty Ltd
178 Main Road
MCLAREN VALE SA 5171

Public Health Services

Citi Centre Building
11 Hindmarsh Square
Adelaide SA 5000

PO Box 6
Rundle Mail SA 5000
DX 243

Tel 08 8226 7100
Fax 08 8226 7102
ABN 97 643 356 590
www.health.sa.gov.au

Dear Mr Heidenreich,

**VARIATION TO THE APPROVAL FOR THE USE OF RECYCLED WATER
THROUGH THE WILLUNGA BASIN PIPELINE SYSTEM BY WILLUNGA
BASIN WATER COMPANY**

Pursuant to the South Australian Public Health (Wastewater) Regulations 2013, the approval granted to Willunga Basin Water Company (WBWC) for the use of recycled water through the Willunga Basin Pipeline [7 October 2016] has been varied to include additional uses. These are dust suppression, municipal irrigation and private landscape irrigation in accord with the information submitted to the Department for Health and Ageing in September 2017. Clauses 2, 4 and 5 have been varied as below:

2. The recycled water can be used for the following
- drip irrigation of grapevines, fruit trees, nut crops and flowers.
 - dust suppression with restricted public access
 - restricted municipal spray irrigation
 - restricted spray irrigation of gardens and landscapes.

There is to be no direct contact of the recycled water with any grapes, nuts or fruit harvested and supplied for human consumption without further processing. Spray irrigation is not to be used for food crops. Additional uses of the recycled water require prior approval from the Department for Health and Ageing.

4. With regard to access and signage;
- 4.1 Public access is to be prevented during spray irrigation and dust suppression activities
- 4.2 The irrigated areas are to be signposted to indicate recycled water is being used for irrigation – do not drink
- 4.3 Accessible taps and fittings are to be marked to indicate recycled water-do not drink
- 4.4 Recycled water for dust suppression should be carted in a dedicated vehicle/vessel and marked to indicate that the contents are not suitable for drinking.

5. Spray and spray drift from irrigation is to be contained within the boundaries of the irrigation site and runoff and ponding of recycled water is to be prevented. Irrigation should not be undertaken in windy conditions.

All other conditions remain the same. A copy of the amended approval is attached.

Approved by

Date 29 September 2017



Dr David Cunliffe
Principal Water Quality Advisor, Public Health

Delegate of the Minister for Health, pursuant to the South Australian Public Health (Wastewater) Regulations 2013



eA985824

Mr Craig Heidenreich
General Manager
Willunga Basin Water Company Pty Ltd
178 Main Road
MCLAREN VALE SA 5171

Public Health Services

Citi Centre Building
11 Hindmarsh Square
Adelaide SA 5000

PO Box 6
Rundle Mall SA 5000
DX 243

Tel 08 8226 7100
Fax 08 8226 7102
ABN 97 643 356 590
www.health.sa.gov.au

Dear Mr Heidenreich,

**VARIATION TO THE APPROVAL FOR THE USE OF RECYCLED WATER
THROUGH THE WILLUNGA BASIN PIPELINE SYSTEM BY WILLUNGA
BASIN WATER COMPANY**

Pursuant to the South Australian Public Health (Wastewater) Regulations 2013, approval is granted to Willunga Basin Water Company (WBWC) for the use of recycled water through the Willunga Basin Pipeline. The approval issued to WBWC on 7 October 2016 has been rescinded and is now replaced by this approval. The approval is subject to the following conditions:

1. The Willunga Basin Water Company will take responsibility for the operation of the scheme including the proper use of recycled water by each participant.
2. The recycled water is only to be used for the following
 - drip irrigation of grapevines, fruit trees, nut crops and flowers
 - dust suppression with restricted public access
 - restricted municipal spray irrigation
 - restricted spray irrigation of landscapes and gardens

There is to be no direct contact of the recycled water with any grapes, nuts or fruit harvested and supplied for human consumption without further processing. Spray irrigation is not to be used for food crops. Additional uses of the recycled water require prior approval from the Department for Health and Ageing.

3. The Willunga Basin Water Company is to provide the Department for Health and Ageing with a list of properties or sites irrigated with recycled water on an annual (financial year) basis.

4. With regard to access and signage;
 - 4.1 Public access is to be prevented during spray irrigation and dust suppression activities
 - 4.2 The irrigated areas are to be signposted to indicate recycled water is being used for irrigation – do not drink
 - 4.3 Accessible taps and fittings are to be marked to indicate recycled water-do not drink.
 - 4.4 Recycled water for dust suppression should be carted in a dedicated vehicle/vessel and marked to indicate that the contents are not suitable for drinking.
5. Spray and spray drift from irrigation is to be contained within the boundaries of the irrigation site and runoff and ponding of recycled water is to be prevented. Irrigation should not be undertaken in windy conditions.
6. The sources of the water distributed by the pipeline are
 - 6.1 the Christies Beach Wastewater Treatment Plant
 - 6.2 the Willunga Wastewater Treatment Plant
 - 6.3 the Aldinga Wastewater Treatment Plant and
 - 6.4 the Sellicks Beach Wastewater Treatment Plant.

These source waters are to contain ≤ 100 *E.coli* per 100 mL (median value). Water from Christies Beach, Willunga and Sellicks Beach is to contain ≤ 20 mg/L BOD₅ (mean value) and ≤ 30 mg/L suspended solids (mean value) while water from Aldinga is to contain ≤ 20 mg/L soluble BOD₅ (mean value). Water produced by Sellicks Beach will have a total chlorine residual of ≥ 1 mg/L. Water quality will be tested by the suppliers.

7. Recycled water from the irrigation system must not be allowed to contaminate potable water outlets. There will be no cross connections with any other water supply without backflow prevention to protect that supply as specified in AS3500 and in the case of public mains water supplies without approval from the South Australian Water Corporation.
8. The recycled water distribution system including associated fittings is to be marked or colour coded to indicate the carriage of reclaimed (or recycled) water. Leakage of water from the pipeline is to be prevented and drainage is only to be undertaken in a manner approved by the Environment Protection Agency and the Department for Health and Ageing.
9. Storage dams within the recycled water distribution system are to be sealed to prevent leakage of recycled water, will be protected from stormwater and will not be allowed to overtop the embankments. The storages are to incorporate minimum embankment freeboards of 600 mm above design storage capacity.

The storages are not to provide a source of offensive odours or nuisance conditions including breeding of vectors such as mosquitoes. The storages are to be protected against ingress of human and animal waste and stock access is to be prevented. The storages are to be enclosed by man-proof

fencing and are to be signposted other to indicate, reclaimed (or recycled) water storage – no swimming.

10. All employees, irrigators and others who could potentially be exposed to recycled water are to be instructed in appropriate health and safety procedures pursuant to the *Work Health and Safety Act 2012*.
11. Non-compliance with any of the conditions for approval is to be rectified immediately and is to be reported to the Department for Health and Ageing as soon as practicable and within 24 hours of the failure being detected.
12. Pursuant to the South Australian Public Health (Wastewater) Regulations 2013, the Department for Health and Ageing reserves the right to revoke all or any of the approval conditions and require the repair, replacement, rectification, alteration of the system or part thereof:
 - 12.1 at any time should the system or component thereof not be manufactured, installed and/or operated in accordance with the approval conditions; or
 - 12.2 at any time the system is defective and not able to perform the function for which the approval is issued; or
 - 12.3 it is operated in a manner that is prejudicial to public and environmental health or raises environmental nuisance.

Approved by

Date 29 September 2017



Dr David Cunliffe
Principal Water Quality Advisor, Public Health

Delegate of the Minister for Health, pursuant to the South Australian Public Health (Wastewater) Regulations 2013.

NOTE 1: The approval issued does not alleviate responsibilities for obtaining relevant approvals, permits or licenses under other Acts or Regulations.

From: [Craig Heidenreich](#)
To: [Richard Dwyer](#)
Subject: FW: Proposed Water Storage Facility
Date: Thursday, 24 January 2019 12:22:15 PM
Attachments: [image003.png](#)
[image004.png](#)

FYI -

Craig Heidenreich
General Manager | Water Utilities Australia



Telephone +61 8 7999 8555
Mobile +61 439 399 974
Address Suite 1005, 147 Pirie Street, Adelaide SA 5000
Email cheidenreich@wua.com.au | **Website** waterutilitiesgroup.com.au



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From: Health:Public Health Water Quality <waterquality@sa.gov.au>
Sent: Wednesday, 22 August 2018 8:44 AM
To: Craig Heidenreich <CHeidenreich@wua.com.au>
Cc: Health:Public Health Water Quality <waterquality@sa.gov.au>
Subject: RE: Proposed Water Storage Facility

Hi Craig

As outlined in your proposal there are no fundamental differences from a public health perspective between the Bowering Hill Dam and the new proposal. SA Health considers that based on the proposed design the storage does not present any significant public health risks

Best Regards

David Cunliffe

Dr David Cunliffe
Principal Water Quality Adviser
Public Health Services
SA Health
david.cunliffe@sa.gov.au
61 8 8226 7153

From: Craig Heidenreich [<mailto:CHeidenreich@wua.com.au>]
Sent: Thursday, 2 August 2018 4:42 PM
To: Cunliffe, David (Health)

Cc: Health:Public Health Water Quality
Subject: RE: Proposed Water Storage Facility

Hi David,

The Bowering Hill Dam did not proceed due to the inability of WBWC to secure access to the land. We did not progress through the Development Application process in full. We have subsequently investigated another site which is adjacent to WBWC's existing Quarry Road Pump Station. The proposal incorporated a 600ML treated water storage dam and drawings of the proposed dam are attached.

As with the Bowering Hill Dam the storage is around 9m deep and incorporates a 1:3 internal batter for the dam walls and due to different soil conditions the facility will be plastic lined with an under-drain system for leak protection.

The site is adjacent to the Seaford Vista housing estate with the top of bank being set-back 57m from the boundary of the estate. A native buffer planting is proposed around the storage dam as shown on the drawings. Attached is a regional map showing the proposed site relative to the housing estate.

The only difference fundamental between the Bowering Hill proposal and this proposal is the proximity to the Seaford Vista housing estate.

Can you advise SA Health's position on this proposal noting your prior advice on the Bowering Hill proposal.

Please advise if you would like to meet to discuss this proposal before responding.

Regards, Craig.

Craig Heidenreich
General Manager | Water Utilities Australia



Telephone +61 8 7999 8555

Mobile +61 439 399 974

Address Suite 1005, 147 Pirie Street, Adelaide SA 5000

Email cheidenreich@wua.com.au | **Website** waterutilitiesgroup.com.au



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From: Cunliffe, David (Health) <David.Cunliffe@sa.gov.au>

Sent: Wednesday, 19 July 2017 2:41 PM

To: Craig Heidenreich <CHeidenreich@wua.com.au>
Cc: Health:Public Health Water Quality <waterquality@sa.gov.au>
Subject: RE: Proposed Water Storage Facility

Hi Craig,

Based on the information provided the Bowering Hill Dam should represent a low risk for supporting mosquito breeding.

The key to reducing risk is incorporation of specific design features. Past experience in South Australia has shown that these design features are effective in controlling/preventing mosquito growth in storages that collect or hold recycled water. The design features that you have described for Bowering Hill Dam are consistent with those required to minimise mosquito breeding. It is suggested that this could be confirmed by regular visits to the storage particularly during the first year of operation.

Best Regards

David Cunliffe

Dr David Cunliffe
Principal Water Quality Adviser
Public Health Services
SA Health
david.cunliffe@sa.gov.au
61 8 8226 7153

From: Craig Heidenreich [<mailto:CHeidenreich@wua.com.au>]
Sent: Wednesday, 19 July 2017 11:38 AM
To: Cunliffe, David (Health)
Cc: Health:Public Health Water Quality
Subject: Proposed Water Storage Facility
Importance: High

Hi David,

Willunga Basin Water are currently planning an expansion of the supply infrastructure for the McLaren Vale Region. The plans currently contemplate a large above ground water storage located on the corner of Iverene Road and Old Coach Road north of Aldinga.

We have a website that has been developed for consultation which is www.boweringhilldam.org.au which has information on the exact location, design, etc. The design on this site contemplates a 1,200ML storage and while this is not necessarily the final design, the information is indicative of the facility we are considering.

I note the condition below in WBWC's current SA Health Approval dated 7 October 2017.

9. Storage dams within the recycled water distribution system are to be sealed to prevent leakage of recycled water, will be protected from stormwater and will not be allowed to overtop the embankments. The storages are to incorporate minimum embankment freeboards of 600 mm above design storage capacity.

The storages are not to provide a source of offensive odours or nuisance conditions including breeding of vectors such as mosquitoes. The storages are to be protected against ingress of human and animal waste and stock access is to be prevented. The storages are to be enclosed by man-proof fencing and are to be signposted other to indicate, reclaimed (or recycled) water storage – no swimming.

There is some concern in the local community on a number of issues and one particular issue is the potential for mosquito and associated virus outbreaks and would like some feedback on experiences SA Health has had when these treated wastewater storages have been constructed elsewhere across the state.

SA Health have published a guidance document on mosquito management called the "South Australian Integrated Mosquito Management Resource Package 2006". This document provides some guidance for the construction of man-made water storages which includes the following recommendations:

- **Construction should occur away from "people intensive" areas such as high density residential area, schools and aged care facilities.**

The Bowering Hill Dam is located at least 1 km from a high density residential area, school or aged care facility. There is a caravan park approximately 800m to the west of the land and there are 6 properties within 500m of the site.

- **Wetlands should be constructed in open areas subject to wind action.**

The Bowering Hill Dams are at the top of a rise and will be exposed to wind action in particular sea breezes given its proximity to the coast.

- **Shallow water and dense vegetation is attractive to mosquitos whereas deeper, open water bodies with steep margins free from vegetation are less appealing as a habitat source.**
- **Wetlands should be greater than 60cm in depth overall and with steep sides to discourage mosquito breeding.**

The Bowering Hill Dam is 9m deep with a 1 in 3 internal bank gradient. The banks will be rock lined and will be kept free from vegetation. The design will be almost identical to the design of the 850ML storage dam at the Aldinga WWTP.

- **Choose vegetation that will not vigorously invade the water body or the surrounding banks and requires minimal maintenance.**

The Bowering Hill Dam will be rock lined and will be filled and emptied on an annual basis. By

having the water level move up and down regularly any mosquito larvae that might build up on the rock lining will be exposed to sunlight. The draining of the dams occurs in summer when water demand is high and the exposure of the larvae to sunlight will be most effective. This will also limit grass growth and enable spraying to occur to minimise grass growth.

I also note the requirement for the facility not to provide a source of offensive odours. The treated wastewater to be stored in the lagoon will be from Christies Beach WWTP which has been stored at the Aldinga site for a number of years. Due to the co-location of the storage with the Aldinga wastewater treatment plant there is some confusion in the community around the odours that arise from the wastewater plant which has sludge lagoons etc. as compared to a stand-alone treated wastewater storage facility. From an operational perspective, WBWC is inclined to draw water from the storages and not leave stored water to accumulate for a number of years due to the impact of long term evaporation on water salinity which is an issue for our customers. In the case of this storage we can choose to use this water rather than drawing water from CBWWTP in wetter years to ensure we continually turn over the storage contents to avoid excessive aged water accumulating.

In regard to access the suite will be secured with a 6ft high fence and suitable signage will be applied consistent with our other facilities.

Given the current reference sites for large water storages in McLaren Vale are co-located with wastewater treatment facilities (i.e. Aldinga and Willunga), can you comment on SA Health's position on this proposed water storage facility in particular with regard to the potential risk of mosquito's or other public health related diseases and the risk of odours from such a facility where they have been constructed elsewhere across the state.

Thanks, Craig.

Craig Heidenreich
General Manager | Water Utilities Australia



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Reference Number:
ATS5240-BakDrPTA

24 September 2018

Ekistics
Attn: Richard Dwyer Managing Director
PO Box 32
Goodwood SA 5034

Dear Richard,

Re: Bakewell Drive, Seaford Heights – Regulated and Significant Trees

I have inspected the trees noted at the above address on Monday 24 September 2018 and made observations in relation to their legislative control status under the *Development Act 1993* pertaining to Regulated and Significant Trees and the *Native Vegetation Act 1991*.

There are approximately 200 juvenile trees located within the windbreak and a row of mature olive trees also noted at site. The juvenile trees are planted specimens and are all less than two metres in circumference, these trees are therefore not controlled by the *Development Act 1993* or the *Native Vegetation Act 1991*.

The mature olive trees within the site have been planted for the purpose of fruit production; these trees are exempt from control as per the *Development Act 1993*. As the trees are planted specimens they are not identified as native vegetation. The trees are not controlled by the *Development Act 1993* or the *Native Vegetation Act 1991* and therefore their removal is permitted and no approval from the local council or the Native Vegetation Council is required.

Thank you for the opportunity to provide this information. Should you have any questions or require further information, please contact me and I will be happy to assist.

Yours sincerely

JASON WILLIAMS
Consulting Arboriculturist
Diploma of Arboriculture
Graduate Certificate in Arboriculture
ISA- Tree Risk Assessment Qualified
Arbiculture Australia Licensed Consulting Arborist AL-2703



Tree Location



Identified Trees



Mature olive trees

Planted trees within the windbreak





18SHD (Seaford Heights Dam)

Visual Impact Assessment of the Proposed SRWRA Water Storage at Seaford Heights

Prepared for Water Utilities Australia

By Warwick Digby Charles Keates

17 October 2018

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1 Introduction and Background

1 Introduction and Background

1.1 Relevant Experience of Warwick Keates

- 1.1.1 Warwick is a director of WAX Design with over 25 years' experience in Landscape Architecture practising in South Australia, Australia, Middle East and the United Kingdom. During this period of time, he has prepared numerous visual impact and landscape assessments for Planning Appeals, Expert Witness Statements and Environmental Impact Assessments.
- 1.1.2 Warwick has prepared visual assessments for a variety of developments, including major road corridors, telecommunication towers, residential developments, significant trees, wind farms and numerous mine expansions. During the course of his employment, he has appeared as an expert witness before the Environment, Resources and Development Court and Development Assessment Commission on numerous occasions. Warwick has also made presentations at Parliamentary Hearings, both in Australia and the United Kingdom and presented a number of papers on visual impact assessment.

1.2 Qualifications

- 1.2.1 Graduate Diploma in Landscape Architecture 1990, Leeds Polytechnic, UK
- 1.2.2 Bachelor of Landscape Architecture (Honours) 1988, Leeds Polytechnic, UK

1.3 Affiliations

- 1.3.1 Associate Member of the Australian Institute of Landscape Architects (Past President of the South Australian Chapter)
- 1.3.2 Registered Landscape Architect
- 1.3.3 Member of the Landscape Institute (United Kingdom)

1.4 Visual Impact Assessment Methodology

- 1.4.1 The visual assessment methodology uses site observations and Global Positioning System (GPS) to identify the extent to which the proposed development is visible in the locality and over what distance. Using the GPS and site investigations the location and visual extent of the subject land within the locality were assessed.
- 1.4.2 This methodology quantifies where the subject land is in the locality (relative distance between proposed development and viewpoint) and whether it is visible and to what extent.
- 1.4.3 The visual character and extent are assessed and discussed in Section 3 of this report. This allows a detailed understanding to the visual effect of the proposed development to be developed.
- 1.4.4 The visual assessment contained in this report has been undertaken on site. It should be noted that due to the differences between viewing the subject land on site in person and the constraints of reproducing this photographically at a smaller scale and on paper, the site photos and photomontages contained in this report can only give an indication of the visual effects and should be taken into consideration alongside the visual assessment discussion and analysis.

1.5 Relevant Documents

- 1.5.1 In forming my opinion and the preparation of the Visual Impact Assessment, I have viewed the following documentation:

1 Introduction and Background

- Hydroplan Drawing No. 14689-SK017. Date 29 March 2018. Concept Plan
- Ekistics DPTI Sponsor Request, dated 9 August 2018
- Arborman Tree Solutions Report, dated 24 September 2018

1.6 Locality

1.6.1 In assessing the landscape character of the site, a landscape character locality has been determined in which the subject land sits. This includes the following as indicated in Figure 1:

- The edge of Robinson Road to the north of the subject land
- Land to the north, incorporating the Onkaparinga River Valley
- The surrounding vineyards and hills to the east, including the Victor Harbor Road corridor
- The northern portion of the SRWRA landfill site and the local ridgelines and fields
- Main South Road and associated residential development forming the western edge



Figure 1: Locality plan

2 Landscape Character and Site Context

2 Landscape Character and Site Context

2.1 Description of Development

- 2.1.1 The proposed development is currently in the concept design phase and entails the development of a 600mL water storage dam. The proposed dam will measure 325 metres in length, 295m in width and 8.5 metres in depth.
- 2.1.2 The dam will be constructed as a 'turkey's nest' with the top of the dam embankment elevated above the natural ground level of the subject land. The dam will sit approximately 5 metres higher than the existing ground level.
- 2.1.3 As a result of the sloping site, the dam embankments vary in height above ground level, varying between 4.15m to 7.60m.
- 2.1.4 The dam will be constructed with a 1 in 3 internal batter which will be plastic lined. There will be an external 1 in 3 slope surrounding the dam which will be constructed with compacted earth. At the base of this dam embankment will be an access road, security fencing and a swale to collect stormwater runoff.
- 2.1.5 Adjacent the dam embankment and access road will be a series of constructed earth mounds of varying heights (depending on existing ground level) between 1.4m – 7.8m at a slope of 1 in 4. These will be constructed using the excess fill excavated for the dam and will be vegetated with plants and trees in order to minimise visual impacts of the dam embankment. At the base of the mounds opposite the dam embankment, there will be a 3m wide swale which will collect stormwater runoff and direct it towards detention basins and off of the subject land.
- 2.1.6 The proposed mounds will be vegetated with site appropriate plant species which are currently present within the existing landscape buffer. These will grow to a mature height which will help to facilitate the visual management of the development.

2.2 The Site Context

- 2.2.1 The subject land is located on Bakewell Drive, Seaford Heights and comprises portion of Certificate of Title Volume 6034 Folio 589 (Allotment 108 of Deposited Plan 80592) and Certificate of Title Volume 5829 Folio 936 (Allotment 102 of Deposited Plan 46795). The subject land is proposed to include a 600mL water storage dam developed on a portion of the allotment. The subject land is located within the Onkaparinga Council area.
- 2.2.2 The subject land is formed by a wide gently sloping hilltop and ridgeline that extends in a north-south direction, parallel to the coastline. There are no discernible features and the land contains few topographic or vegetation elements. The existing land cover is arable cropping which results in seasonal variations in vegetation retention, harvesting and other agricultural operations on the land.
- 2.2.3 The existing landscape character of the locality is defined by the undulating agricultural landscape which contains vineyards, fields, valleys and significant belts of vegetation located on large allotments that follow the underlying topography of the hills environment.
- 2.2.4 The allotments typically include areas of vegetation along the cadastral boundaries with cleared land to allow for cropping or wine production.
- 2.2.5 The northern edge of the locality falls away to form the Onkaparinga River Valley resulting in panoramic views to the ocean and the suburbs of Old Noarlunga and Seaford.

2 Landscape Character and Site Context

- 2.2.6 To the west, a new residential subdivision is currently being developed by the Fairmont Group. The Vista development will include over 1,100 residential allotments. The development is located on a sloping allotment which falls away to the west towards the coast. The development is directly adjacent the subject land to the west.



Figure 2: View looking west towards the wide ridgeline of the subject land

2 Landscape Character and Site Context

2.3 The Subject Land and Development

- 2.3.1 The subject land is approximately 21 hectares in size and is currently used for primary production in the form of agricultural cropping.
- 2.3.2 Located on a portion of the allotment to the north is a landscape buffer. This area of vegetation was established under a Land Management Agreement to provide a buffer between the residential edge of the Vista development and McLaren Vale. The primary function of the vegetation is to interrupt views from Victor Harbor Road towards the urban edge of Seaford Heights to maintain the rural landscape character of McLaren Vale and reduce the impacts of urban development.
- 2.3.3 The mounding and vegetation provides a low screen 2-3m in height. The variety of species is well established and the visual effect provides significant amenity and visual screening to the locality.



Figure 3: Landscape buffer

- 2.3.4 The subject land contains a belt of mature Olive trees towards the southern boundary. There are no regulated or significant trees located on the subject land according to a report provided by Arborman Tree Solutions dated 24 September 2018. Other than vegetation along the cadastral boundaries, the vast majority of the subject land has been cleared to enable agricultural cropping.
- 2.3.5 The topography of the subject land is formed by a wide rolling hill, with the site of the proposed development at a high point above surrounding allotments. This increases the visual prominence of the subject land across the wider locality.

2 Landscape Character and Site Context

2.4 Adjoining Properties and Landscape Context

- 2.4.1 The Vista development is located to the west of the subject land and includes numerous residential allotments of various sizes, small areas of public open space and a neighbourhood centre. The underlying topography of the site has resulted in the construction of high retaining walls (up to 2m) across the eastern half of the site as well as benching to allow for level residential allotments. Retaining walls are located on the boundary between the subject land and the Vista development. This limits views from Vista into the subject land as residential rooflines, retaining walls and fencing disrupt views forming a built form boundary to the western edge of the subject land.
- 2.4.2 The property to the south at Allotment 10, Bakewell Road is the State Heritage listed Ostrich Farm which is situated on approximately 4 hectares of land. The property contains the original farm house as well as horse stables and training yards. The locations of these structures are in close proximity to the boundary with the subject land which forms a landscape backdrop to the property.
- 2.4.3 Ostrich farm is located at a lower elevation to the subject land and such has views of the subject land which rises to the north and north west.



Figure 4: Ostrich Farm

- 2.4.4 On the southern side of Bakewell Road is the SRWRA landfill site which is responsible for providing and operating waste management operations for the Onkaparinga, Marion and Holdfast Bay Councils. The landfill site is located on land which is significantly lower than the subject land and Ostrich Farm. The development of screening mounds and buffer planting means that the SRWRA landfill site is not visible from the subject land.

3 Visual Impact Assessment

3 Visual Assessment

3.1.1 The visual assessment considers the visibility of the proposed development and the contribution to the amenity of the locality that the proposed development will make. This assessment has been considered in relation to the viewpoints indicated in Appendix A.

3.2 Description of development, form and landscape

3.2.1 The visual character of the subject land to the south is defined by the Victor Harbor Road corridor from the intersection with Main South Road (indicated in Figure 5) where there are glimpsed views towards the subject land and the proposed development. The embankment of the proposed dam will sit at a height 4.45 metres above the existing ground level at this point, forming a new elevated landform backdrop. While the development of the dam embankment will create a new landform, the associated vegetated landscape mounds surrounding the development will add to the existing screening provided by the landscape buffer that has been developed in association with the Vista development.

3.2.2 Further along Victor Harbor Road, the visual character to the south is dominated by the Vista development which creates significant visual change within the local area. The undulating agricultural landscape which contains vineyards, open fields, valleys and significant belts of vegetation is replaced by a modified landform of benching, fence lines and patches of modified open space that facilitates the residential development, contrasting with the rural character of the landscape.



Figure 5: Victor Harbor Road looking south

3.2.3 At the intersection of Ostrich Farm Road and Victor Harbor Road, the existing landscape character is defined by the gently undulating landforms that create a rolling landscape that is typical of the locality. The existing vegetation colour is defined by arable cropping with belts of vegetation to cadastral boundaries and roads.

3 Visual Impact Assessment

- 3.2.4 Ostrich Farm Road is lined on both sides with established vegetation ranging in height between 6m-10m. This creates a significant screen to the road corridor with glimpsed views into the adjoining fields and towards the proposed development. The proposed dam embankment will result in a significant modification to the existing land form. The new landform associated with the proposed dam will be visual up to 6.25 metres above the existing highest point of the subject land.



Figure 6: Ostrich Farm Road at the intersection with Victor Harbor Road.

3 Visual Impact Assessment



Figure 7: Ostrich Farm Road illustrating screening vegetation to road corridor

- 3.2.5 At the corner of Ostrich Farm and Victor Harbor Road, the road sits on a 5 metre high road embankment elevated above the surrounding land. The local embankments associated with the road corridor typically measure between 4 metres and 6 metres. These landforms impact the visual character of the locality particularly to the east of the subject land. The profile of the existing landform is typically 1:2, rather than the slope profiles that are proposed for the dam embankment.
- 3.2.6 To the north-west of the subject land, Victor Harbor Road passes through a cutting close to the northern boundary of the subject land and the existing landscape buffer. Travelling south, the subject land forms part of the local rural landscape and the entrance to McLaren Vale. To the east, the landscape is dominated by the undulating landscape and vineyards of the McLaren Vale and to the west, including the subject land, the agricultural cropping and gently sloping profile of the fields.



Figure 8: View of the subject land from Victor Harbor Road

3 Visual Impact Assessment

- 3.2.7 Adjacent the subject land, Victor Harbor Road has a speed limit of 80km/hr which means that the duration of visibility of the subject land is significantly limited for a number of seconds with the views being oblique to the west. The existing landscape character is recognised as part of the agricultural landscape and there are few visual attractors from the viewpoint that draw your attention to the subject land.
- 3.2.8 The topography and elevation of the road corridor provides distant views north across the Onkaparinga Valley towards the coast. The progressive development of the Onkaparinga basin is clearly visible, including the infrastructure associated with the Seaford Rail Link. These views remain the dominant focus of the road corridor and visual character.



Figure 9: View from Victor Harbor Road which sits on a 5m high embankment, north across the Onkaparinga Valley. The subject site is located behind.

- 3.2.9 It is important to note that within the locality of the viewpoint and the subject land there are a number of modified landforms associated with the road corridor including 6-7 metre high cutting embankments as well as fill embankments. The landscape character is defined by the underlying agricultural land use with views to adjacent fields that contain vineyards and shelter belt planting.
- 3.2.10 The visual screening associated with the tree lined cadastral boundary to the adjacent vineyards as well as local landforms associated with the road corridor provide a degree of screening to the south western edge of the road corridor.
- 3.2.11 When viewed from Bakewell Road, the existing landscape character of the subject land is defined by the rolling agricultural landscape that exists around the subject land and to the west and south west of the development.
- 3.2.12 The elevated topography of the subject land forms a rolling hilltop with a wide gently sloping profile which forms the horizon line to the north. Vegetation associated with the Ostrich Farm is notable to the north and west of the site when view from Bakewell Road.

3 Visual Impact Assessment

- 3.2.13 From Bakewell Road, the subject land forms the horizon to the locality with a single land cover creating a visual monoculture. Views are mid-range extending over a few hundred metres. This visual character will continue after the development of the dam with views extending over several hundred metres. While the depth of field and topography will be altered, the establishment of landscape mounds with trees and shrubs will significantly increase the landscape amenity and visual diversity in the locality.
- 3.2.14 From Bakewell Road, the proposed development will be viewed as an increase in the landform associated with the hill. The extent of the sloped profile and arrangement of the vegetation will result in a defined belt of vegetation forming a new horizon line located approximately 7.8 metres above the existing landform, with an existing ground level RL89.20 and proposed level RL97.00.
- 3.2.15 In many regards the visual effect will be the addition of a high belt of vegetation above the existing agricultural ridgeline. The extent of cropping may be retained or slightly modified with additional vegetation being located above or on the existing horizon line.



Figure 10: View looking north-east from the northern edge of Bakewell Road

- 3.2.16 From Ostrich Farm, there are views of the southern edge of the subject land. These views contain a number of mature planted olive trees of a height of between 6-10 metres. The trees provide a visual buffer within the landscape screening views north and south from a vegetated horizon line.
- 3.2.17 The development of the site will result in the removal of these planted olive trees however the proposed land form of the dam embankment will provide opportunities for additional landforms and vegetation screening. The proposed development will introduce new landscape elements into the landscape above the existing horizon line. While the modification of the topography and vegetation is likely to create a moderate degree of visual change, due to its elevated location, the profiling of the proposed landform and screening vegetation will significantly reduce the visual effect. At the same time, the vegetated landscape mounds will increase the landscape character and amenity replacing the arable skyline with an undulating vegetative screen.

3 Visual Impact Assessment

- 3.2.18 From locations along Main South Road close to Bakewell Road, the site of the proposed development will not be visible as local ridgelines create screens. It is also important to note that the land to the west of the subject land will be redeveloped as part of the Vista development. This will result in retaining walls, buildings and road corridors altering the landscape and limiting the visibility towards the proposed development from Main South Road. As stated previously, the proposed development will create an elevated vegetated horizon line which is complimentary to the existing landscape character.
- 3.2.19 The built form development along Robinson Road which forms the northern edge of the Vista development creates a defined urban form. The two storey dwellings and large commercial buildings reduce the visibility of the subject land forming an urban corridor. Views and the visual character are focused along the road corridor.
- 3.2.20 At the highest point of the Vista development, the subject land is screened by the existing retaining walls and fencing. It is important to note that the houses to the eastern side of roads such as Cotterell Road are permitted to be two storeys and therefore may have the potential to look over the adjoining retaining walls and onto the proposed landscape mounds. The orientation of the houses as well as the allotments focus views to the west towards the coastline. It is anticipated that bedrooms or study's or utility rooms would be located to the rear of the property with potential views to the proposed landscape mounds and the south east.



Figure 11: View from Cotterell Road allotments with fence line forming a boundary with the subject land

- 3.2.21 The current allotment boundary of Vista and the subject land contains a Colorbond fence sitting on a retaining wall which results in the fence sky lining line along the local horizon. The proposed development will alter the local topography creating a vegetated screen above the fence line. This will result in an elevated landscape skyline which will significantly offset the visual effect of the current fence in terms of landscape character and amenity. Furthermore, the proposed vegetation treatments of the dam embankment will provide a landscape backdrop that will offset the uniformity and urban form of the existing fence line on future houses.

3 Visual Impact Assessment

3.2.22 Throughout Vista, the visual character is contained. Views typically exist along road corridors, however, the urban form of the development results in short road lengths before the road changes alignment reducing the visual corridor. The elevated topography creates a stepped built form increasing the visual containment of the buildings throughout Vista. The result is that the rooflines form the horizon line rather than the surrounding landscape character or the subject land. Views to the surrounding landscape to the north, south and east are extensively screened with glimpsed views to the southern vales afforded due to the lack of current development.

3.2.23 When the residential development is fully complete, the sense of visual enclosure will increase with limited views to the surrounding landscape. The existing topography, resulting residential development and presence of the coastline to the west increases the visual character and built form focus to the west away from the subject land.



Figure 12: Views from Cotterell Road towards the coast, the subject land is located directly behind this viewpoint

3.2.24 There are glimpsed views towards the subject land at the intersection of Main South Road and Robinson Road. While the subject land is not currently visible behind the linear form of the boundary fencing, the proposed development will form an elevated topography behind the fence line. The fence line forms a horizontal visual element that reinforces the residential edge of the Vista development.

3.2.25 The potential introduction of an elevated vegetated landform will reduce the visual effect and dominance of the urban form to the east. With appropriate landscape treatments the interface between the Vista development and the McLaren Vale edge will be reduced with a visual layering creating a backdrop of trees and shrubs rather than the defined horizon line of the fencing and rooflines.

3 Visual Impact Assessment



Figure 13: Views from the intersection of Main South Road and Robinson Road

3.3 Management of Visual Impacts

- 3.3.1 The visual effect of the proposed development will be mitigated through the addition of a series of vegetated landscape mounds in front of the dam embankments. The mounds will be constructed using the excess fill created during the excavation of the dam and will be located directly adjacent the dam embankment. The slope of each mound is 1 in 4 and varies in height between 1.6m-7.8m. A plan of the proposed development is located in Appendix C.
- 3.3.2 The mounds have been designed in positions which disrupt views of the dam embankment from viewpoints along Victor Harbor Road and Bakewell Road as well as the Vista development. The mounds will respond to the local topography and landscape character by presenting as a series of hills with vegetation. A list of the proposed species is located in Appendix B.
- 3.3.3 The landscape treatments, selected boundary treatments and species selection will reduce and limit the visibility of the dam embankment from viewpoints on Victor Harbor Road and Bakewell Road.
- 3.3.4 The introduction of the new landscape into the locality will be seen within the context of the wider landscape character. Existing ridgelines and hills to the north and east are covered with belts of vegetation and trees that provide amenity to the local landscape character. The proposed mounds and vegetated treatments aim to replicate these existing landscape characters providing areas of vegetation over elevated landforms.
- 3.3.5 The proposed development will create an extension of the existing vegetation buffer and vegetated horizon line when viewed from Main South Road and the Vista development. In many regards the Vista development provides the dominant visual impact along the Main South Road corridor.

3 Visual Impact Assessment

- 3.3.6 The development of the proposed site offers the opportunity to increase the vegetation character and screening associated with the land management agreement buffer planting area. The use of native species as well as tree and shrub species will significantly increase the landscape amenity, removing the monoculture of the existing arable cropping and replacing it with a diverse native vegetation character that will increase the visual amenity as well as provide increased habitat biodiversity.
- 3.3.7 As the dam will be elevated above the surrounding locality, the water within the dam will not be visible from any external points and in combination with the proposed landscape mounds, there will not be any indication that the subject land contains a water storage dam.

4 Development Plan Assessment

4 Development Plan Assessment

4.1 Relevant Development Plan provisions

- 4.1.1 The following provisions of the Onkaparinga Council Development Plan (consolidated 20 February 2018) have been considered as the most relevant to the assessment of the visual impact of the proposed development.

4.2 Primary Production Zone

4.2.1 Objectives:

- 4 Protection of primary production from encroachment by incompatible land uses and protection of scenic qualities or rural landscapes
- 6 The enhancement of the rural character, key scenic routes, scenic surrounds to townships, amenity and prominent landscape for the enjoyment of residents.

4.2.2 Principles of Development Control:

- 4 Development within the zone should be compatible with its use as a water catchment and storage area and with its values as an area of agricultural production and scenic beauty.
- 6 Development which would remove productive land from agriculture or diminish its overall productivity for primary production should not be undertaken unless the land is required for essential public purposes.
- 16 The excavation and/or filling of land should:
 - (a) be kept to a minimum and be limited to no greater than 1.5 metres so as to preserve the natural form of the land and the native vegetation.
 - (b) only be undertaken in order to reduce the visual impact of buildings, including structures, or in order to construct water storage facilities for use on the allotment.
 - (d) result in stable scree slopes which are covered with top soil and landscaped so as to preserve and enhance the natural character or assist in the re-establishment of the natural character of the region.
- 40 Excavation and earthworks should take place in a manner that is not extensively visible from surrounding localities.
- 41 The appearance of land, buildings and objects should not impair the amenity of the locality in which they are situated.
- 42 The rural character, comprising natural features and man-made activities, should be preserved by careful siting, design and landscaping of new building development and/or intensive land uses.
- 61 Landscape buffers located adjacent a residential or urban zone should be designed taking into account the nature, source and frequency of potential adverse impacts; prevailing winds in the locality; topography of the area; existing vegetation and the presence of potentially sensitive adjacent uses.

4 Development Plan Assessment

Assessment

- 4.2.3 The proposed development will incorporate a series of landscape mounds surrounding the perimeter of the water storage dam. These will be constructed with the excess fill created by excavating the site of the dam and will enable views of the dam embankment to be screened by vegetation which replicate the topography and landscape vegetation cover within the locality. This will ensure the protection of the scenic qualities of the locality and enhancement of the landscape character, as well as providing additional amenity to the subject land.
- 4.2.4 The dam will be compatible with the use of the area as a water catchment and storage area, whilst maintaining scenic quality within the locality.
- 4.2.5 The zone mentions that the excavation and/or filling of land should not exceed 1.5 metres above the natural ground level so as to preserve the natural form of the land and the native vegetation. The proposal includes mounds up to 7.8 metres in height. Whilst this is larger than anticipated in the zone, they are being constructed in response to the underlying topography of the land and will be used to introduce significantly areas of native vegetation to the subject land. The construction of the dam will result in large amounts of excess fill which will be used in the mounds, reducing the visual impact of the dam embankment and protecting the character of the locality.
- 4.2.6 The neighbouring residential zone has been taken into consideration when designing the location and size of the landscape mounds to reduce views of the dam embankment from these areas. The proposed design incorporated a series of vegetated landscape mounds which will increase the landscape amenity and will provide a vegetated backdrop to the residential zone when viewed from the west.

4.3 Siting and Visibility

4.3.1 Objectives:

- 1 Protection of scenically attractive areas, particularly natural, rural and coastal landscapes.

4.3.2 Principles of Development Control:

- 1 Development should be sited and designed to minimise its visual impact on:
 - (a) The natural, rural or heritage character of the area
 - (b) Areas of high visual or scenic value, particularly rural and coastal areas
 - (c) Views from the coast, near-shore waters, public reserves, tourist routes and walking trails

Assessment

- 4.3.3 The development seeks to protect the scenically attractive entrance to the McLaren Vale region by incorporating the landscape mounds surrounding the development to the north, west and south. The existing belt of established trees along Ostrich Farm Road to the east will limit views to the dam from this direction. The landscape mounds seek to increase and complement the amenity of the area and the natural character of the Onkaparinga Valley.

4 Development Plan Assessment

4.4 Character Preservation District Overlay

4.4.1 Objectives:

- 1 A district where:
 - (a) scenic and rural landscapes are highly valued, retained and protected
 - (b) development near entrances to towns and settlements does not diminish the rural setting, character and heritage values associated with those towns and settlements.

4.4.2 Objectives:

- 1 Development in the district should:
 - (a) when located near townships, contribute towards and maintain the identity of those townships
 - (b) retain the predominant rural landscape character and function

Assessment

- 4.4.3 With the development being located at the entrance to the McLaren Vale region, it is important to maintain the scenic qualities of the Character Preservation District. This has been taken into consideration with the design and location of each of the landscape mounds which seek protect and retain the rural landscape character and disrupting views towards the dam.
- 4.4.4 The landscape treatments include a series of mounds which will be constructed adjacent the dam embankment and will disrupt views of the embankment. The mounds will be planted with native vegetation and will increase the amenity of the proposed development from viewpoints on Victor Harbor Road and Bakewell Road. This approach replaces the existing arable cropping land with trees and shrubs to reflect the pockets of remnant vegetation east of Victor Harbor Road.

5 Conclusion and Opinion

5 Conclusion and Opinion

- 5.1.1 The assessment of the landscape character surrounding the subject land provides an understanding of the locality. The subject land is situated in the Primary Production Zone within the Onkaparinga Council, adjacent a residential housing development and other primary production allotments. The topography of the subject land varies, with a wide ridgeline forming a high point within the subject land. This results in the location of the dam being at a higher elevation than surrounding allotments, increasing the potential visibility of the development within the locality.
- 5.1.2 The visual assessment that has been undertaken highlights the potential issues associated with the visual effect of the dam within the defined locality. The 'turkey's nest' style of development and the elevation of the subject land results in the dam embankment being visible from certain areas within the locality. Engineering requirements state that these embankments must be free of vegetation. To lessen the visual impact of the dam embankments on the surrounding locality, a series of landscape mounds have been designed to the north, west and southern extents of the dam embankment using the excess fill created from excavating the dam. This allows for extensive planting of native vegetation and trees on the landscape mounds which reflects the rural and remnant vegetation of the surrounding locality.
- 5.1.3 Any potential views towards the dam embankment will be disrupted by the addition of these vegetated landscape mounds. Whilst the extent of mounding is quite large, with mounds ranging between 1.6m-7.8m above ground with a slope profile of 1 in 4, this is directly related to the scale of the proposed development and is required to adequately screen views towards the dam. The designs of the landscape mounds have taken into account the natural topography of the area and will replicate this through the addition of vegetated hills within the locality. .
- 5.1.4 The assessment acknowledges that the proposed dam embankment is of a larger form than surrounding topographic features or development in the locality. This could result in the embankment being visually prominent from viewpoints along Victor Harbor Road, Bakewell Drive and Vista without other design measures such as the landscape mounds. This approach will enhance the rural character of the locality with the planting of large areas of native vegetation.
- 5.1.5 The design and built form of the Vista development contains large retaining walls, fencing and roof lines which visually detract from the existing rural character of the area. Views towards the subject land from Vista are constrained by residential built form and the alignment of the road network, which provide small glimpses of the subject land. These will be further limited with the construction of more housing. The proposal will result in an elevated vegetated backdrop above the existing fence line which will significantly offset the visual effect of the current fencing and built form in terms of landscape character and amenity.
- 5.1.6 In conclusion, the development of a series of vegetated landscape mounds to the north, west and south as well as the retention of the existing tree line to the east. These landscape elements will adequately screen the proposed development from views on Victor Harbor Road, Bakewell Drive and from Vista. The subject land will be viewed as a series of landscape mounds with vegetated ridges above the existing arable land. This is reminiscent of the surrounding locality which contains many vegetated ridges, hills, vineyards and cropping land.

5 Conclusion and Opinion

I declare that I have made all enquiries which I believe are desirable and appropriate and that no matters of significance which I regard as relevant have, to my knowledge, been withheld as part of the preparation of this report.

A handwritten signature in black ink, appearing to read 'Warwick Keates', written in a cursive style.

Warwick Keates, BA (Hons), Grad.Dip.LA, MLI, AAILA

17 October 2018

Appendix A

Appendix A: GPS Locations

Waypoint (red) superimposed on Google Earth mapping



Figure 14: GPS Location and Tracks superimposed on Google Earth mapping

Appendix B

Appendix B: Proposed plant species

Trees



Acacia pycnantha

Width x height: 6m x 6m
Growing rate: FG
Density/Spacing: Specimen
Supply size: Tube

Description: fast growing shrub or small tree, which can be grown on recharge sites and a wide range of shallow soils



Allocasuarina verticillata

Width x height: 6m x 8m
Growing rate: MG
Density/Spacing: Specimen
Supply size: 45L

Description: A tree that can be grown on a range of sites. It is considered to have moderate growth rates and is a useful windbreak or shelterbelt species.



Bursaria spinosa

Width x height: 3m x 4m
Growing rate: FG
Density/Spacing: Specimen
Supply size: 140mm

Description: Once established bursarias are extremely hardy and will last 30-50 years.



Callitris gracilis

Width x height: 8m x 20m
Growing rate: MG
Density/Spacing: Specimen
Supply size: 45L

Description: The native pine can be used as a shelter tree, for shade or a windbreak, for stabilisation of dune country or as an excellent feature tree for large gardens or parks.



Dodonaea viscosa

Width x height: 3m x 4m
Growing rate: FG
Density/Spacing: 1 per m²
Supply size: 140mm

Description: A relatively fast growing shrub with an ability to pioneer degraded sites. Many of the subspecies are extremely frost and drought tolerant and are also considered a valuable source of pollen.



Eucalyptus porosa

Width x height: 12m x 14m
Growing rate:
Density/Spacing: Specimen
Supply size: 45L

Description: A robust, dark-barked mallee which can grow into an impressive single-trunked tree.

Maximum width x maximum height e.g. 4m x 4m

FG fast growing – 1-2 meters in first year

MG moderate growth – 1 meter in first year

SG slow growth – 50cm – 1 meter in first year

Trees



Pittosporum angustifolium

Width x height: 5m x 10m
Growing rate: SG
Density/Spacing: Specimen
Supply size: 140mm

Description: Usually attains about 6 m in height but is reported to grow up to 10 m tall. It grows across a wide range of habitats, often on sandy soils.



Melaleuca lanceolata

Width x height: 5m x 8m
Growing rate: FG
Density/Spacing: Specimen
Supply size: 200mm

Description: A relatively fast growing species. Has a dense canopy. Natural stands provide a particularly useful shelter as a windbreak on windy, near coastal sites.

Understorey



Acacia acinacea

Width x height: 4m x 2.5m
Growing rate: FG
Density/Spacing: 1 per m²
Supply size: 140-250mm

Description: A fast growing, frost and drought tolerant, nitrogen-fixing shrub. It is in demand in revegetation programs in some parts of it range for its ability to pioneer degraded sites.



Adriana quadripartita

Width x height: 3m x 2m
Growing rate:
Density/Spacing: 1 per m²
Supply size: 240-250mm

Description: A shrub species which is endemic to southern Australia.



Atriplex semibaccata

Width x height: 3m x 0.3m
Growing rate: FG
Density/Spacing: 2 per m²
Supply size: 140-250mm

Description: Soil and erosion control. Effective weed control.



Enchylaena tomentosa

Width x height: 1.5m x 1m
Growing rate:
Density/Spacing: 3 per m²
Supply size: 140-250mm

Description: Extremely hardy low shrub or ground cover for areas of neglect, particularly tolerant of coastal locations and calcareous soils.

Maximum width x maximum height e.g. 4m x 4m
FG fast growing – 1-2 meters in first year
MG moderate growth – 1 meter in first year
SG slow growth – 50cm – 1 meter in first year

Understorey



Goodenia albiflora

Width x height: 1m x 1m
Growing rate:
Density/Spacing: 3 per m²
Supply size: 140-250mm

Description: A hardy and contrasting foliage plant.



Olearia ramulosa

Width x height: 1m x 1.5m
Growing rate:
Density/Spacing: 2 per m²
Supply size: 140-250mm

Description: A dense, formal, rounded, aromatic shrub with small white daily flowers in late autumn.



Rhagodia candolleana

Width x height: 2m x 1m
Growing rate:
Density/Spacing: 2 per m²
Supply size: 140-250mm

Description: Can be used as a background shrub in mixed planting, suitable for coastal locations as a wind-break and soil control.



Rhagodia parabolica

Width x height: 5m x 3m
Growing rate: MG
Density/Spacing: 1 per m²
Supply size: 140-250mm

Description: A pale, grey-green, densely foliated spreading shrub with wide upright branches.



Myoporum parvifolium

Width x height: 2m x 0.2m
Growing rate: FG
Density/Spacing: 1 per m²
Supply size: 140-250mm

Description: Extremely hardy weed-suppressing ground cover for embankments, verges, streetscapes and high traffic areas. Acts as a living mulch and weed suppressor.

Maximum width x maximum height e.g. 4m x 4m

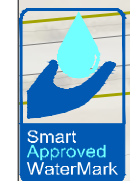
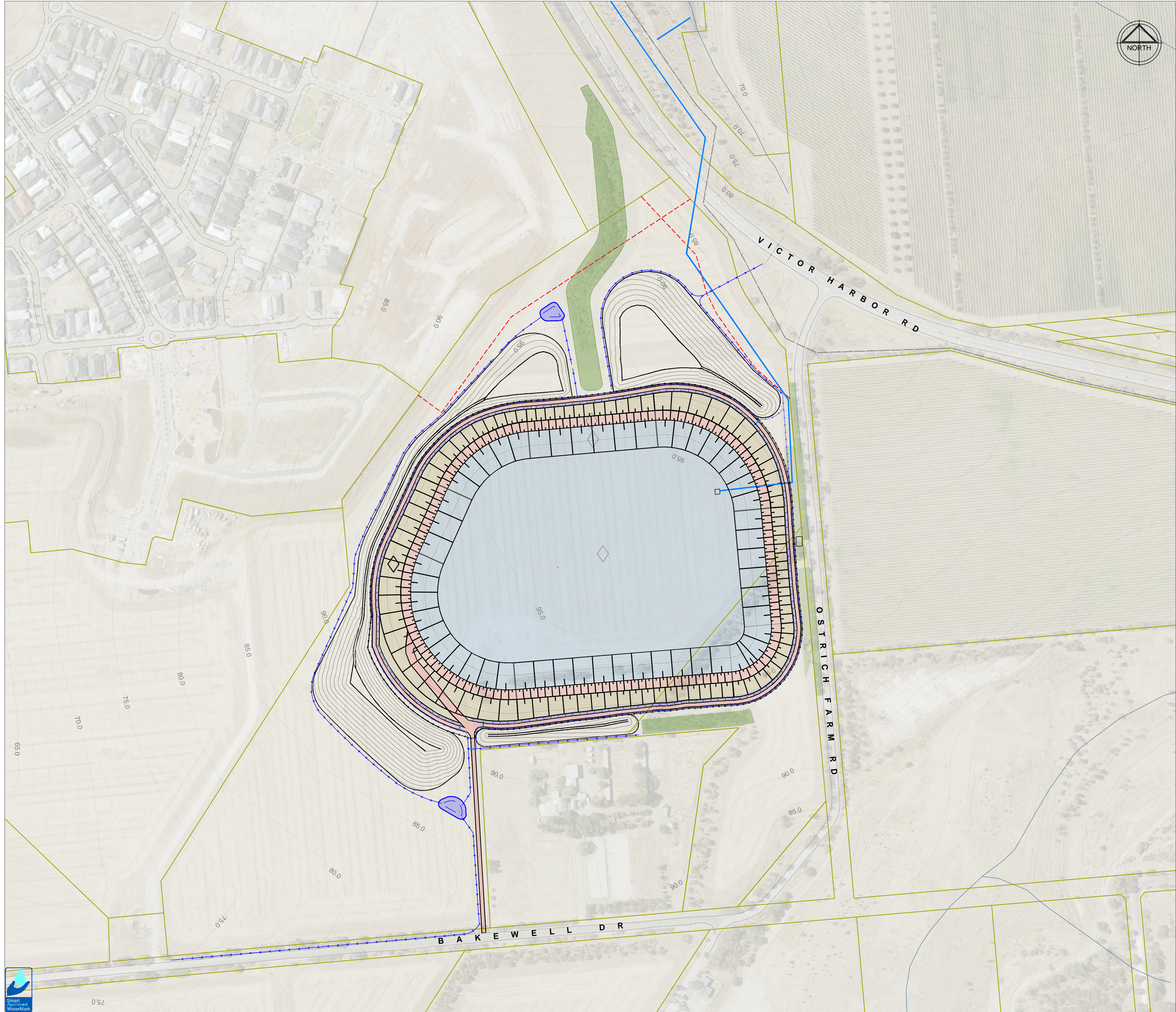
FG fast growing – 1-2 meters in first year

MG moderate growth – 1 meter in first year

SG slow growth – 50cm – 1 meter in first year

Appendix C

Appendix C: Concept Design prepared by Hydroplan



SITeworks Legend

- PROPERTY LINE
- PROPOSED PIPELINE
- PROPOSED SWALE
- EXISTING PIPELINE
- BUFFER LAND BOUNDARY LINE
- COORDINATES AS SHOWN ON DRAWING No. "1-3255" OF THE LAND MANAGEMENT AGREEMENT

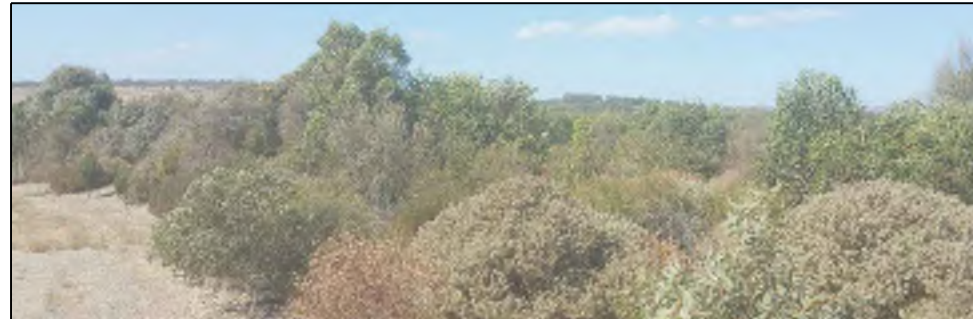
FINISHED SURFACE Legend

- RUBBLE AREA
- STORAGE AREA (PLASTIC LINED)
- OUTSIDE BATTER AREA

VEGETATION Legend

EXTENDED VEGETATION AREA: (FOR SCREENING - INDICATIVE ONLY)

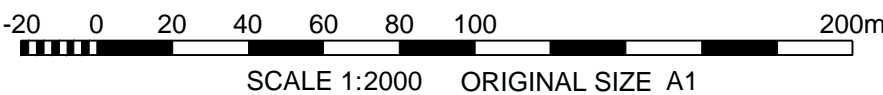
EXAMPLE:



NOTE: VEGETATION PLAN TO BE AGREED WITH BIODIVERSITY McLAREN VALE AND DEW. VEGETATION TO SCREEN A 1.8m HIGH SECURITY FENCE ON THE INTERNAL SIDE OF EXTENDED VEGETATION ALIGNMENT.

EXISTING VEGETATION AREA:

EXAMPLES:



REV	ISSUED	D.DWN	APRVD	REVISION DESCRIPTION	REV	ISSUED	D.DWN	APRVD	REVISION DESCRIPTION
1	08/10/2018	JT	JG/BH	FOR DISCUSSION					
0	20/09/2018	JT	JG/BH	FOR DISCUSSION	-				-



http://hydroplan.com.au

PERTH ADELAIDE SYDNEY BRISBANE BEIJING

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The arrangement and general details as shown on this drawing are essentially diagrammatic and must be applied to the circumstances as found on site.

DES/DRAWN: JT	CLIENT: WILLUNGA BASIN WATER
CHECKED: BH	
APPROVED: JG	PROJECT: SRWRA STORAGE
DATE: 29/03/2018	CONCEPT DESIGN PLAN WITH MOUNDS
DRAFT REF: 2-WBW-d4	DRAWING No. 14689-SK017
	SHEET 1 OF 1
	REVISION 1

Appendix D: Curriculum Vitae of Warwick Keates



WARWICK KEATES

DIRECTOR
LANDSCAPE ARCHITECTURE AND URBAN DESIGN



Warwick Keates is a landscape architect and urban designer with over twenty five years experience in private practice, academia and government. During this time, he has developed a diverse range of skills, working on awarded projects in the United Kingdom, Middle East and Australia. This experience has provided Warwick with a detailed understanding of the complex requirements associated with landscape and urban projects as well as the need for sensitive, high-quality design solutions.

Warwick is a Director of WAX Design and has worked in all aspects of the profession, including master plans for urban and civic spaces, placemaking programmes and open space strategies, as well as design for numerous parks and playspaces. His ability to actively listen and closely collaborate with clients, other professionals and the community, provides Warwick with a complete understanding of landscape and urban design, with respect to the creation of exceptional places that meet the needs of end users.

Qualification

Graduate Diploma in Landscape Architecture,
Leeds Polytechnic (United Kingdom) 1990
Bachelor of Arts (Hons) in Landscape Architecture, Leeds Polytechnic (UK) 1988

Professional Affiliations

Associate of the Australian Institute of Landscape Architects
Chartered Member of the Landscape Institute (UK) 1995

Specialist Expertise

Reserve and Play Space Design
Urban Design and Planning
Open Space Assessment and Planning
Large Scale Master Planning
Visual Impact Assessment
Global Information Systems (GIS)
Computer Aided Design and 3D Modelling
Consultation and Facilitation

Other Appointments

Member of the Community Participation and Sustainability Advisory Committee
Part Lecturer Adelaide University
Art for Public Places (panel member)

Relevant Experience

Victor Harbor Mainstreet Upgrade
Willunga Mainstreet Beautification Project
Rundle Street Arts Masterplan
Salisbury City Centre Urban Design Strategy
Gawler Town Centre Integrated Urban Design Precincts
Flinders University Landscape Masterplan
Inner West Precinct Place Making Strategy
Salisbury Oval Masterplan
Edwardstown Oval Redevelopment
Klemzig Recreation Ground Masterplan
Marion Sports Facility Masterplan
Bonython Park Playspace
Charles Sturt Open Space Strategy
Hazelwood Park Playspace
JB Ware Reserve Upgrade & Playspace
Kadina Mainstreet Masterplan
Nature's Playground, Adelaide Zoo
Suneden Special School Sensory
West Torrens Open Space and Urban Design Strategy

Appendix E

Appendix E: Visualisations and Landscape Masterplan



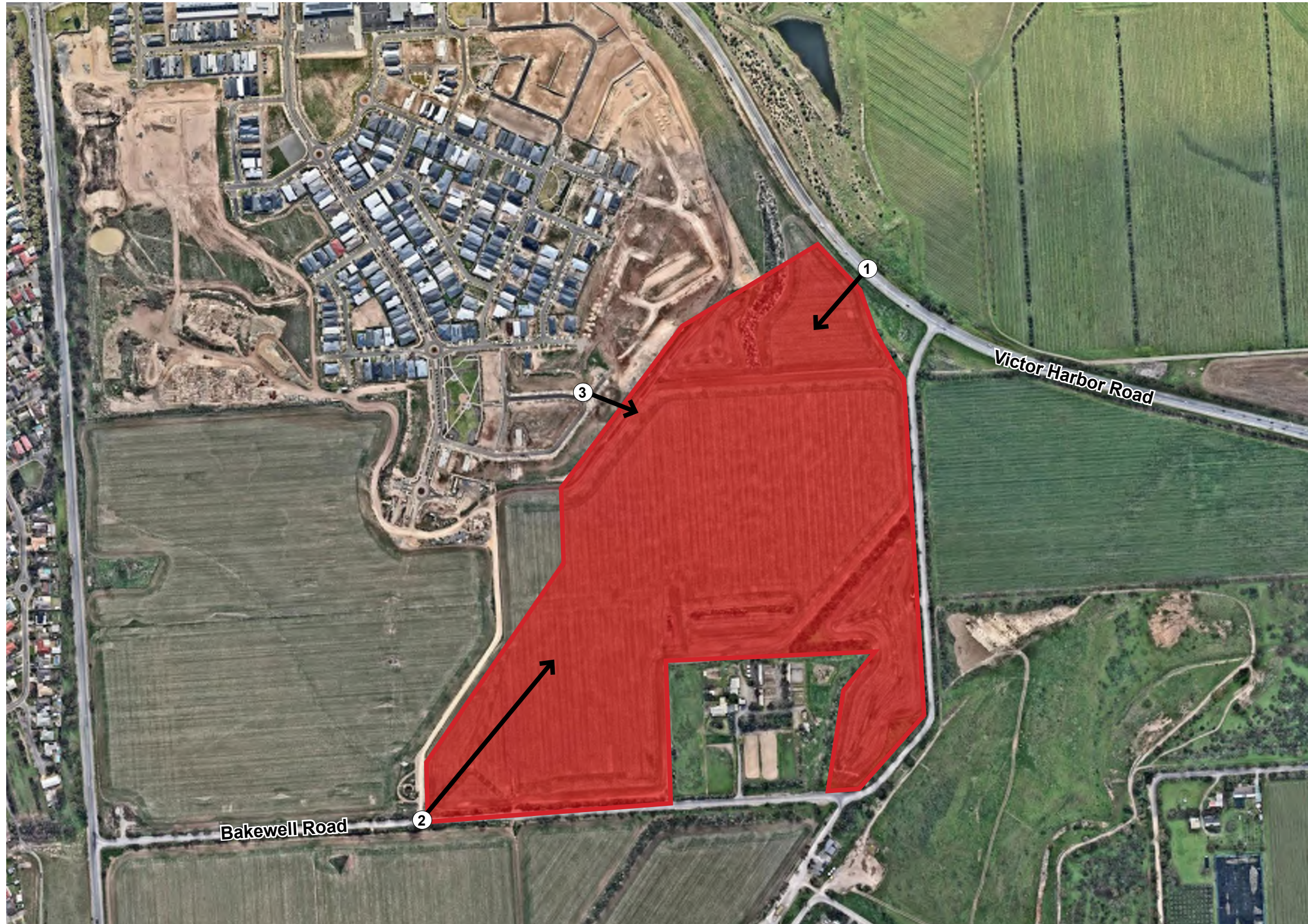
SEAFORD HEIGHTS DAM

VISUALISATIONS


17 OCTOBER 2018

SEAFORD HEIGHTS DAM

1.1 VIEWPOINT LOCATIONS



KEY

 Subject Site

 Viewpoints



SEAFORD HEIGHTS DAM

WAX

1.2 VIEWPOINT 1- VICTOR HARBOR ROAD



Existing viewpoint



Artists impression of proposed development superimposed on to existing viewpoint.

SEAFORD HEIGHTS DAM

WAX

1.3 VIEWPOINT 1- VICTOR HARBOR ROAD



Existing viewpoint



Artists impression of proposed development superimposed on to existing viewpoint.

SEAFORD HEIGHTS DAM

1.4 VIEWPOINT 2- BAKEWELL ROAD

WAX



Existing

Existing viewpoint



Post-Construction

Artists impression of proposed development superimposed on to existing viewpoint.

SEAFORD HEIGHTS DAM

1.5 VIEWPOINT 2- BAKEWELL ROAD

WAX



Existing

Existing viewpoint



5 Years

Artists impression of proposed development superimposed on to existing viewpoint.

SEAFORD HEIGHTS DAM

WAX

1.6 VIEWPOINT 3- CORNER EDISON AND COTTERELL ROAD



Existing

Existing viewpoint



5 Years

Artists impression of proposed development superimposed on to existing viewpoint.

SEAFORD HEIGHTS DAM

WAX

1.7 VIEWPOINT 3- CORNER EDISON AND COTTERELL ROAD



Existing

Existing viewpoint

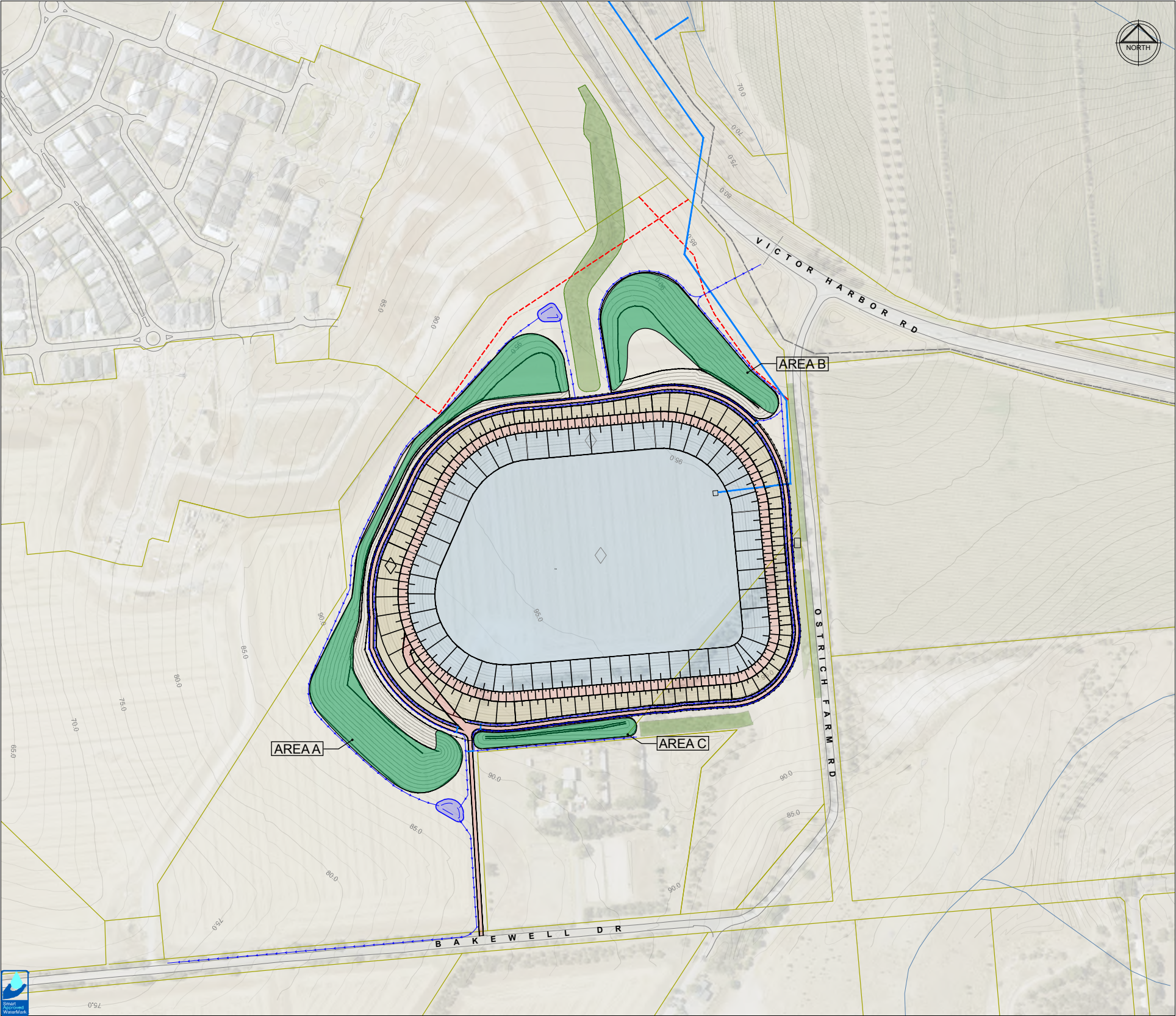


5 Years

Artists impression of proposed development superimposed on to existing viewpoint.

SEAFORD HEIGHTS DAM

LANDSCAPE MASTERPLAN



SITEWORKS LEGEND

- PROPERTY LINE
- PROPOSED PIPELINE
- PROPOSED SWALE
- EXISTING PIPELINE
- BUFFER LAND BOUNDARY LINE
- COORDINATES AS SHOWN ON DRAWING No. "1-3255" OF THE LAND MANAGEMENT AGREEMENT

FINISHED SURFACE LEGEND

- RUBBLE AREA
- STORAGE AREA (PLASTIC LINED)
- OUTSIDE BATTER AREA

VEGETATION LEGEND

EXTENDED VEGETATION AREA: (FOR SCREENING - INDICATIVE ONLY)

EXAMPLE:



NOTE: VEGETATION PLAN TO BE AGREED WITH BIODIVERSITY McLaren VALE AND DEW. VEGETATION TO SCREEN A 1.8m HIGH SECURITY FENCE ON THE INTERNAL SIDE OF EXTENDED VEGETATION ALIGNMENT.

EXISTING VEGETATION AREA:

EXAMPLES:



PLANT SPECIES

MASS MIX PLANTING ON MOUNDS USING TUBE STOCK OR SIMILAR, PLANTED ON GROUPS OF 5-7 OF THE SAME SPECIES @ 800MM CTRS

PLANT SPECIES MIX

TREE SPECIES MIX 1 (24%)

- ALLOCASUARINA VERTICILLATA 4%
- CALLITRIS GRACILIS 4%
- EUCALYPTUS MICROCARPA 4%
- EUCALYPTUS POROSA 4%
- PITTOSPORUM PHILLYREOIDES 4%
- MELALEUCA LANCEOLATE 4%

TREE SPECIES MIX 2 (36%)

- ACACIA PYCNANTHA 12%
- BURSARIA SPINOSE 12%
- DODONAEA VISCOSA 12%

UNDERSTOREY SPECIES MIX (40%)

- ACACIA ACINACEA 5%
- ADRIANA QUADRIpartite 5%
- ARIPLEX SEMIBACCATA 5%
- ENCHYLAENA TOMENTOSA 5%
- GOODENIA ALBIFLORA 5%
- OLEARIA RAMULOSA 5%
- RHAGODIA CANDOLLEANA 5%
- RHAGODIA PARABOLICA 5%

AREA A = 17,795.72m²
AREA B = 10,153.30m²
AREA C = 2,893.03m²

SCALE 1:2000 ORIGINAL SIZE A1

Seaford Heights Water Storage

Stormwater Management Plan

Willunga Basin Water Company

December 2018

Ref No. 20181776R001B

Document History and Status

Rev	Description	Author	Reviewed	Approved	Date
A	Draft for client comment	MM	OO	OO	07 December 2018
A	Final – for use	MM	OO	OO	14 December 2018

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Appendix A	Hydroplan concept design
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1 Introduction

1.1 Background

Willunga Basin Water Company (WBWC) is proposing to construct a 600 ML water storage at Seaford Heights and is seeking a stormwater management plan (SMP) to support the development application for the project.

A concept plan for the proposed works has been developed by Hydroplan (Rev 2, Appendix A). The concept shows a preliminary drainage design for the site and incorporates three outfall locations for discharge of stormwater from the site. This concept has been used as the basis to develop the SMP.

1.2 Site description

The site of the proposed water storage is bounded by Victor Harbor Road to the north, Ostrich Farm Road to the east and Bakewell Drive to the south, as shown on the locality plan in Figure 1.1.

The proposed location of the storage is situated at the top of a high point, resulting in a 'turkey nest' configuration. Observations made during a site visit combined with review of the available topographic information (2 m contours) indicates that runoff currently discharges from this high point via overland flow paths to a number of outfall locations, including the locations described below:

- South-western corner of the site, adjacent to the intersection of Bakewell Drive and the new access road (Figure 1.2).
- South-eastern corner of the site, at the intersection of Bakewell Drive and Ostrich Farm Road.
- An existing storage pond located in the north-eastern corner, adjacent to Victor Harbor Road (Figure 1.3).

Review of the topography of the site shows longitudinal grades varying between 1% and 6%. The site is predominantly agricultural in nature, however is bordered by a new residential development to the north-west and a rural residential lot to the south.

1.3 This report

This report provides a recommendation for the management of stormwater discharged from the developed site. Consideration is given to the requirements of the City of Onkaparinga (Council) as well as other relevant authorities. Details of the analyses that have been undertaken are also included.





Figure 1.2 Looking east along Bakewell Drive from the low spot in the south-western corner



Figure 1.3 Existing storage pond in the north-eastern corner adjacent Victor Harbor Road

2 Relevant policies

The site of the proposed basin is located in an area over which several policies apply. The policies, and their potential impact on the operations of the storage, are discussed in the following sections. The recommendations outlined in this SMP consider the requirements of each of these policies.

2.1 Onkaparinga Council Development Plan

Council's development plan outlines the expectations for the management of stormwater from new developments. Review of the development plan identified the following criteria that are relevant to the preparation of this SMP:

- Development, including earthworks associated with development, should not do any of the following:
 - Impede the flow of floodwaters through the land or other surrounding land.
 - Increase the potential hazard risk to public safety of persons during a flood event.
 - Increase the risk of flooding of other land.
 - Obstruct a watercourse.
- Water discharged from a development site should:
 - Not exceed the rate of discharge from the site as it existed in pre-development conditions.
 - Be of a physical, chemical and biological condition equivalent to or better than its pre-developed state.
- Development should include stormwater management systems to mitigate peak flows and manage the rate and duration of stormwater discharges from the site to ensure the carrying capacities of downstream systems are not overloaded.

2.2 Western Mount Lofty Ranges Water Allocation Plan

The site of the development is within the Western Mount Lofty Ranges (WMLR) Prescribed Water Resources Area (PWRA). Specifically, the site is within Surface Water Management Zone (SWMZ) O_OM12 within the catchment of the Onkaparinga River. The development is therefore subject to the requirements of the WMLR water allocation plan (WAP). The WAP sets the amount of water that will be available, how that water may be allocated to users, and the types of activities that are permitted with that water.

The WAP sets out the maximum amount of surface water and watercourse water that can be taken within an SWMZ. The limit aims to ensure sufficient flows for environmental water provisions as well as for downstream users. Each SWMZ also has a diversion limit which is the "total volume of surface water that can be collected or diverted by all dams and/or intercepted by existing and new commercial forests."

The extraction and diversion limits for SWMZ O_OM12, as set out in the WAP are as follows:

- Surface water extraction – 63 ML/year
- Main watercourse (Onkaparinga River) extraction – 2205 ML/year
- Diversion limit – 125 ML/year.

The storage is located on a high point and will not capture surface runoff. Modelling of the proposed development using the MUSIC model (refer Section 4.3 for details) shows that the development will not result in a reduced runoff volume from the site. It is therefore unlikely that WBWC will need a licence for the facility under the WMLR WAP.

2.3 McLaren Vale Water Allocation Plan

The site is situated within the McLaren Vale Prescribed Wells Area, and hence is subject to the conditions of the McLaren Vale Water Allocation Plan. This WAP pertains to the taking and use of groundwater.

A licence would only be required if extraction from groundwater was proposed as part of the operations of the storage.

3 Hydrological modelling

Hydrological modelling was undertaken to provide estimates of pre- and post-development peak flows leaving the site. The hydrological assessment is based upon the recommendations and guidance provided within the 2016 edition of Australian Rainfall and Runoff (ARR2016) and is consistent with the specifications of Council's Stormwater Management Design Guide (SMDG).

The modelling was undertaken using the DRAINS software package (version 2018.09). The model was run for all durations from five minutes to 168 hours. As recommended in ARR2016, for each duration the model was run for an ensemble of ten rainfall patterns using the latest (2016) intensity-frequency-duration (IFD) data.

Consistent with Council's requirements the model was run for a minor (10% annual exceedance probability (AEP)) and major (1% AEP) rainfall event.

3.1 Hydrological modelling parameters

The sub-catchments within the study area have been modelled in DRAINS using an ILSAX-type hydrological model. The model parameters provided in Table 3.1 have been adopted and are consistent with the values recommended in the SMDG. No supplementary areas were used, in accordance with the SMDG.

Table 3.1 DRAINS model parameters

Parameter	Value
Paved area depression storage (equivalent to an impervious area initial loss)	1 mm
Grassed area depression storage (equivalent to a pervious area initial loss)	5 mm
Soil type	3
Antecedent moisture content	2.5

3.2 Catchment characteristics

3.2.1 Sub-catchment definition

In the absence of a digital elevation model of the site, sub-catchments were delineated using topographical data available from ESRI satellite.

The Hydroplan concept (Appendix A) shows three discharge points from the site. Review of the topography of the site combined with observations made during the site visit identified a low point at the south-eastern corner (the intersection of Ostrich Farm Road and Bakewell Drive). The concept plan does not show a discharge at this location, but there appears to be an existing natural flow path to this area of the site.

The concept drainage design would require a section of the swale on the southern side of the storage to be constructed against the natural grade to allow runoff to drain to the outfall location to the west. This would result in a deep swale. It is therefore recommended that the drainage design be revised to incorporate a fourth outfall location at the south-eastern low point. This would utilise the natural fall of the land and would keep the post-development flow regime as close as possible to the existing flow regime. The SMP detailed in this report assumes that, consistent with the existing flow paths, there will be four discharge points from the site.

The sub-catchments contributing to each of the proposed four discharge locations were defined for the pre-development (Figure 3.1) and post-development (Figure 3.2) scenarios. A summary of the catchment areas is provided in Table 3.2. The reduction in catchment size for the post-development scenario is due to the fact that the storage will capture and retain all water that falls onto its surface.





Table 3.2 Sub-catchment areas

Sub-catchment	Pre-development (ha)	Post-development (ha)
North-east	5.26	3.62
North-west	1.76	1.19
Southern	12.68	11.52
South-east	11.73	6.56

3.2.2 Estimates of impervious area

The ILSAX hydrological model used in DRAINS requires users to estimate the proportion of impervious and pervious areas for each sub-catchment. Review of aerial imagery indicates that the current (pre-development) site is entirely pervious. This was confirmed during an inspection of the site.

Following development of the proposed storage basin, a compacted rubble track with an approximate width of 10 m will line the upper circumference of the basin. It is estimated that this represents approximately 5% of the total area. The track would normally be modelled in DRAINS as a supplementary area, however as the Council SMDG specifies that supplementary areas are not to be used, the compacted rubble portion of each catchment was modelled as a directly connected impervious area.

The modelling assumes a 0% impervious fraction for all catchments pre-development and 5% impervious for all catchments post-development.

3.2.3 Time of concentration

The times of concentration for each sub-catchment were estimated based on flow path lengths and slopes. The estimates assumed a Manning's roughness coefficient (n) of 0.035.

The estimated times of concentration are shown in Table 3.3. As is to be expected the steeper batter slopes and more formalised drainage paths (swales) result in lower times of concentration for the smaller sub-catchments in the post-development scenario.

Table 3.3 Times of concentration (minutes)

Sub-catchment	Pre-development	Post-development
North-east	18	12
North-west	19	15
Southern	26	26
South-east	25	16

3.3 Peak flows

The estimates of peak flows for each of the sub-catchments is summarised in Table 3.4.

Table 3.4 Modelled flowrates (L/s) for each sub-catchment

Sub-catchment	Pre-development 10% AEP	Post-development 10% AEP	Pre-development 1% AEP	Post-development 1% AEP
North-east	37	36	384	382
North-west	12	12	126	102
Southern	82	115	798	740
South-east	80	66	738	536

The results show that the post-development major and minor event flow rates for the north-east, north-west and south-east sub-catchments do not exceed the flowrates for the pre-development scenario. The slight increase in impervious area is off-set by the reduction in catchment size.

The modelling indicates that runoff from the southern catchment is higher for the post-development scenario. Measures to reduce the peak flows from this catchment will therefore be required.

4 Stormwater management plan

The DRAINS model described in the previous section was used to develop stormwater management measures required to meet Council's requirements. A summary of the recommended measures is provided in the following sections.

4.1 Detention basin

The modelling indicates that the development of the storage and associated works will result in an increase in the peak flow from the southern catchment in a 10% AEP event. A detention basin is therefore required.

The Council SMDG specifies that detention basins are to be designed with maximum side slopes of 1V:5H or flatter and a maximum water depth of 1.2 m in the 1% AEP event.

The DRAINS model was used to determine the following detention basin requirements:

- Basin volume: 60 m³
- Basin depth: 0.6 m
- Outlet pipe diameter: 375 mm

The modelling indicates that the basin configuration described above reduces the 10% AEP peak flows from the southern catchment to 74 L/s which is less than the pre-development peak flows (82 L/s).

The basin will overtop in high flow events and hence scour protection should be provided on the crest and outside of the downstream batters.

4.2 Swales

Drainage swales will be constructed around the circumference of the new storage to divert runoff to each outfall location. As part of this SMP, swale sizes to convey flows from the 1% AEP event have been determined using Manning's calculations. The calculations assume the swales will have a trapezoidal cross section with a base width of 0.3 m and 1V:3H side slopes. It is assumed that the swales will be grassed (Manning's roughness value of 0.035).

A summary of the minimum dimensions required for each swale are provided in Table 4.1

Table 4.1 Minimum swale dimension

Sub-catchment	1% AEP design flow (L/s)	Depth
North-east	382	0.3
North-west	102	0.2
Southern	740	0.4
South-east	536	0.4

4.3 Water quality measures

It is not considered that the operation of the storage on the site will impact the water quality of runoff from the site.

Further, the design of the storage incorporates a number of features that will reduce pollutant loads leaving the site. Specifically:

- The batters of the storage will be grassed which will act as buffer strips.
- The grassed swales used to convey flows to the discharge points will provide further treatment of the flow.

- The detention basin will provide additional water quality improvement for flows from the southern catchment.

A MUSIC (Model for Urban Stormwater Improvement Conceptualisation) model was developed to provide an understanding of the likely quality of stormwater runoff from the site.

4.3.1 Council requirements

Council's SMDG specifies the following pollutant reduction targets for development:

- Total suspended solids (TSS): 80%
- Total phosphorus (TP): 60%
- Total nitrogen (TN): 45%
- Gross pollutants (GP): 90%

4.3.2 Model set-up

The definition of catchment areas and characteristics was based on the catchments defined during the development of the DRAINS hydrological model. Rainfall and evaporation data were obtained from the Council meteorological template, which sources six-minute rainfall and daily evapotranspiration data from the Noarlunga weather station (station number 023885). The model incorporates the features of the development that will contribute to water quality improvement as described above. The layout of the model is shown in Figure 4.1.

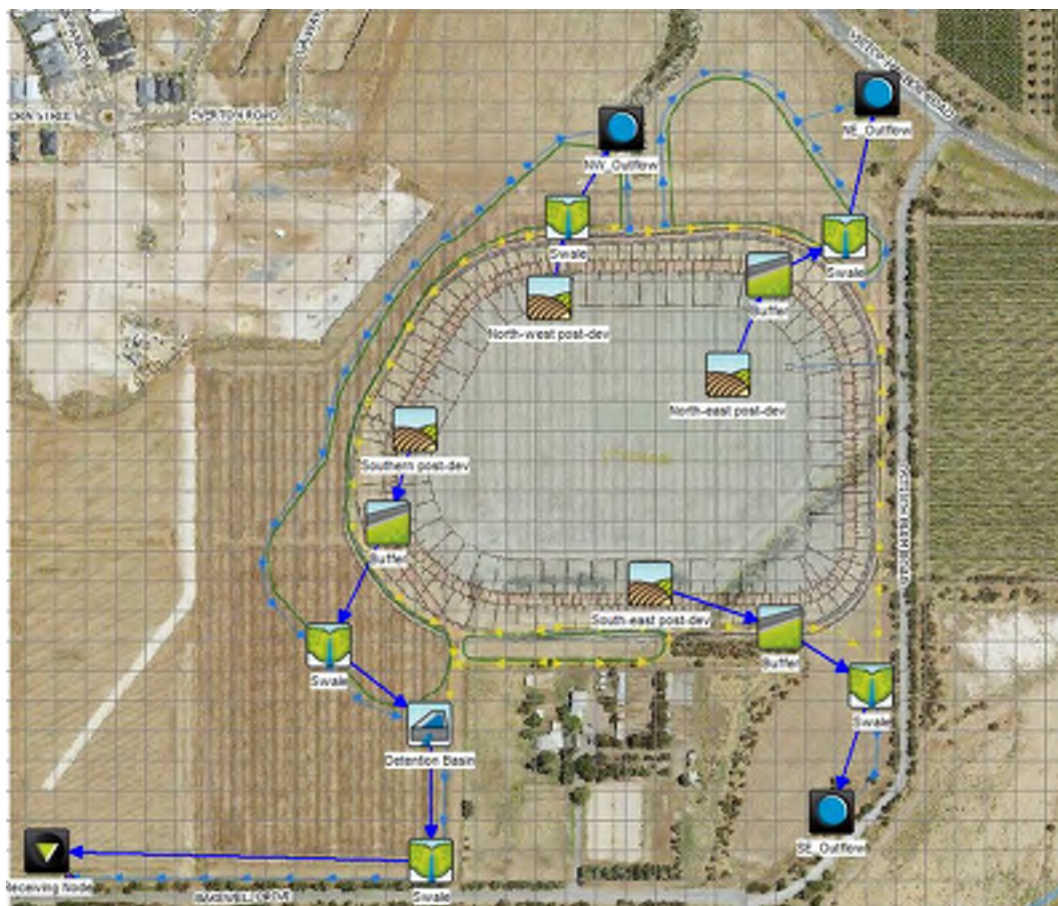


Figure 4.1 MUSIC model

A summary of the modelled pollutant reductions for each catchment is provided in Table 4.2. It can be seen that the features incorporated into the design provide a significant reduction in pollutant loads, with the whole of site reductions exceeding Council's guidelines.

Table 4.2 *Modelled pollutant reductions for the site*

Catchment	TSS	TP	TN	GP
North-east	99%	74%	57%	100%
North-west	92%	75%	55%	100%
Southern	93%	75%	60%	100%
South-east	90%	72%	33%	100%
Whole of site	92%	74%	51%	100%

Based on considerations of the nature of the development, and the results of the MUSIC modelling, it can be concluded that the development will not negatively impact the water quality of downstream receiving waters.

4.4 Stormwater management plan

A GIS-based plan detailing the recommended stormwater management measures to manage stormwater discharged from the site is shown in Figure 4.2.

The key features of the stormwater management strategy include:

- The use of grassed swales to convey flows to the discharge points.
- A detention basin to limit peak flow rates from the southern catchment.
- Vegetated batters.

The modelling undertaken as part of the development of this SMP confirms that the proposed measures comply with Council's requirements.



5 Construction – erosion and sediment control

During construction of the proposed storage, the water quality of site runoff should be managed to ensure that sediment is not transported into any downstream receiving waters. A soil erosion and drainage management plan (SEDMP) should be prepared by the contractor prior to the commencement of construction.

5.1 Preliminary erosion hazard assessment

A preliminary assessment of erosion hazard has been undertaken using the International Erosion Control Association Guidelines for Best Practice Erosion and Sediment Control (IECA, 2008).

A summary of the key parameters of the assessment is provided in Table 5.1.

Table 5.1 Erosion hazard assessment

Condition		Score ¹
Average slope of disturbance area	1-6%	2
Soil classification	Silty Clay	3
Emerson (Dispersion) class number	Not assessed	4
Duration of soil disturbance	4-6 months	4
Area of disturbance	13.4 ha	6
Waterway disturbance	No disturbance	0

¹ Score based on IECA (2008) Table F4

Based on the preliminary assessment the site is likely to be considered 'high risk' for erosion during construction and will require a detailed SEDMP. The area of the disturbance alone would trigger this requirement.

5.2 Likely requirements for erosion and sediment control

Development of a detailed SEDMP is beyond the scope of the SMP. The measures specified in the SEDMP will be required to address:

- Effective control of surface runoff entering and leaving the site.
- Erosion control works and measures to minimise the amount of site erosion.
- Sediment collection devices to prevent sediment leaving the site.
- Provision for stockpiles to be stored within the sediment barrier.
- Rehabilitation of all disturbed areas as soon as possible – temporary vegetation may be required.
- Maintenance of the erosion control and sediment collection devices.

Potential measures may include:

- Sedimentation basins.
- Sediment fences.
- Staging of construction.
- Sediment control at site entry and exit points.
- Management of stockpiles (covering).
- Temporary erosion protection during vegetation establishment.

The SEDMP will also need to specify maintenance requirements for the control measures. All sediment and erosion control measures should be inspected at least weekly and after any significant rain. Any necessary repairs (areas of erosion, torn sections of sediment fence etc.) should be addressed immediately.

6 References

City of Onkaparinga 2017, *Stormwater Management Design Guide*.

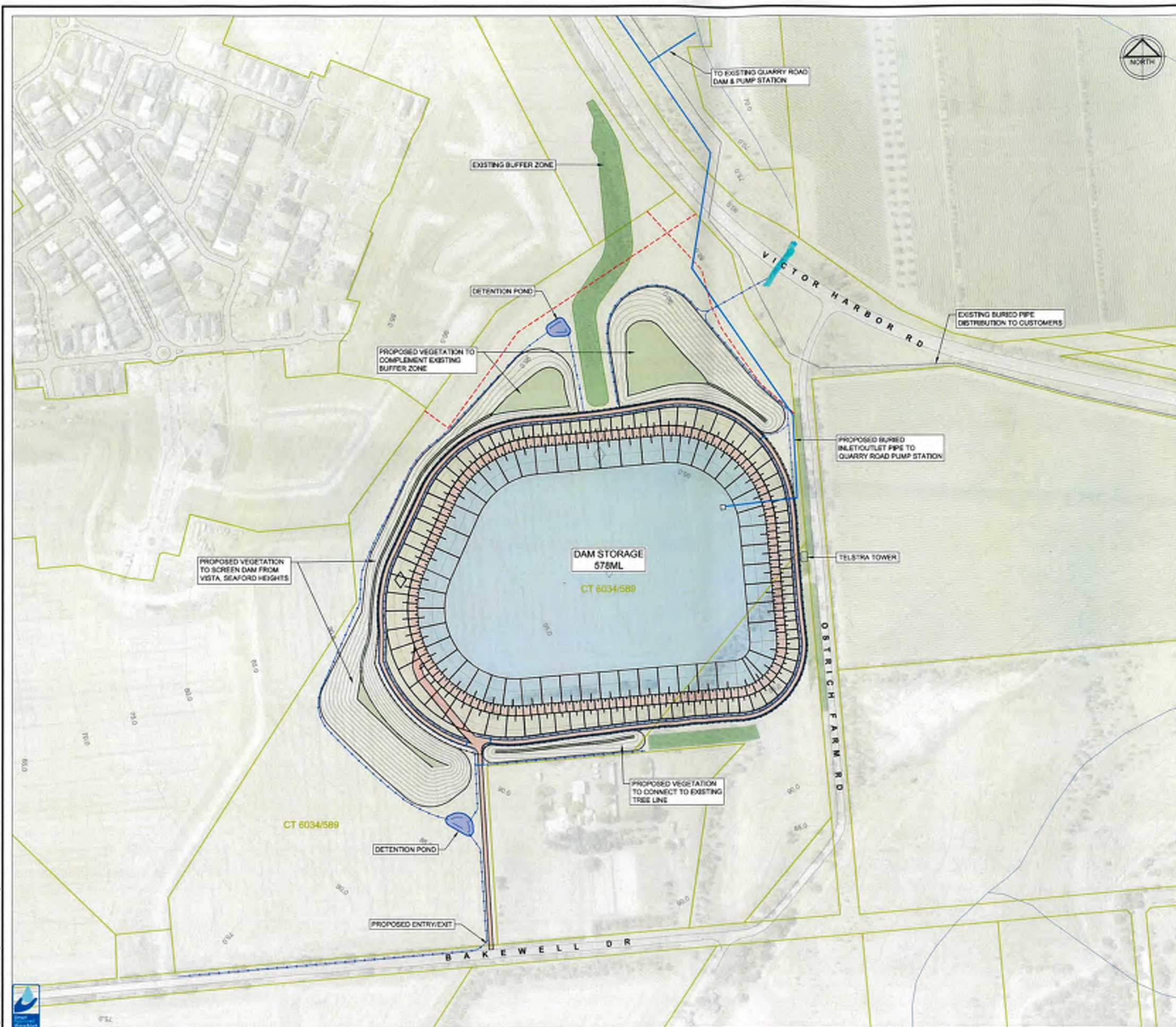
Commonwealth of Australia (Geoscience Australia) 2016, *Australian Rainfall and Runoff: A Guide to Flood Estimation*.

Environmental Protection Agency 2004, *Handbook for Pollution Avoidance on Commercial and Residential Building Sites 2nd ed.*, Government of South Australia.

International Erosion Control Association (IECA) Australasia 2008, *Best Practice Erosion & Sediment Control*, IECA, Australia.

Appendix A

Hydroplan concept design



SITWORKS LEGEND

- PROPERTY LINE
- PROPOSED PIPELINE
- PROPOSED SWALE
- EXISTING PIPELINE
- - - BUFFER LAND BOUNDARY LINE

FINISHED SURFACE LEGEND

- RUBBLE AREA
- STORAGE AREA (PLASTIC LINED)
- OUTSIDE BATTER AREA

VEGETATION LEGEND

EXTENDED VEGETATION AREA: (FOR SCREENING - INDICATIVE ONLY)

EXAMPLE:



NOTE: VEGETATION PLAN TO BE AGREED WITH BIO-DIVERSITY MCLAREN VALE AND DEW. VEGETATION TO SCREEN A 1.8m HIGH SECURITY FENCE ON THE INTERNAL SIDE OF EXTENDED VEGETATION ALIGNMENT.

EXISTING VEGETATION AREA:

EXAMPLES:



0 20 40 60 80 100 120 140 160 180 200m
SCALE 1:2000 ORIGINAL SIZE A1

Drawing No: 2-WBW-44 SRWRA Storage Concept Design Plan with Mounds Date: 20/03/2018 11:13 AM Project Name: SRWRA Storage Concept Design Plan with Mounds

REV	ISSUED	DATE	APPROV	REVISION DESCRIPTION
2	22/03/2018	JT	JGBH	FOR DISCUSSION
1	05/03/2018	JT	JGBH	FOR DISCUSSION
0	20/03/2018	JT	JGBH	FOR DISCUSSION

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The arrangement and general details as shown on this drawing are essentially diagrammatic and must be applied to the circumstances as found on site.

DESIGNER	JT	CURT	WILLINGA BASIN WATER
CHECKED	BH	PROJECT	SRWRA STORAGE
APPROVED	JG	CONCEPT DESIGN PLAN WITH MOUNDS	
DATE	20/03/2018	DRAWING NO	14609-SK017
DRAWN BY	2-WBW-44	SHEET	1 OF 1
		REVISION	2